

March 30 , 1926.

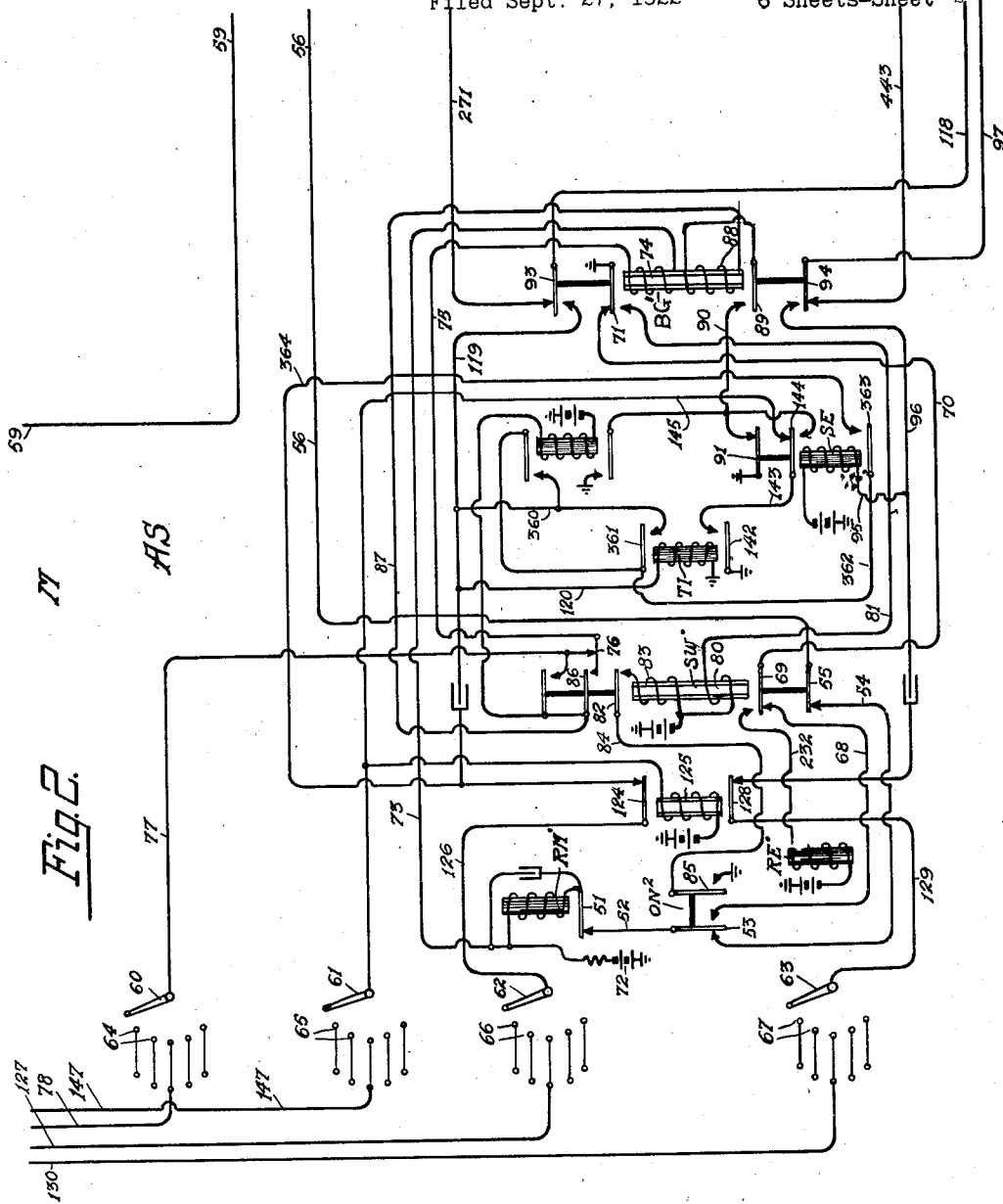
1,578,809

H. D. CURRIER ET AL

TELEPHONE SYSTEM

Filed Sept. 27, 1922

6 Sheets-Sheet 2



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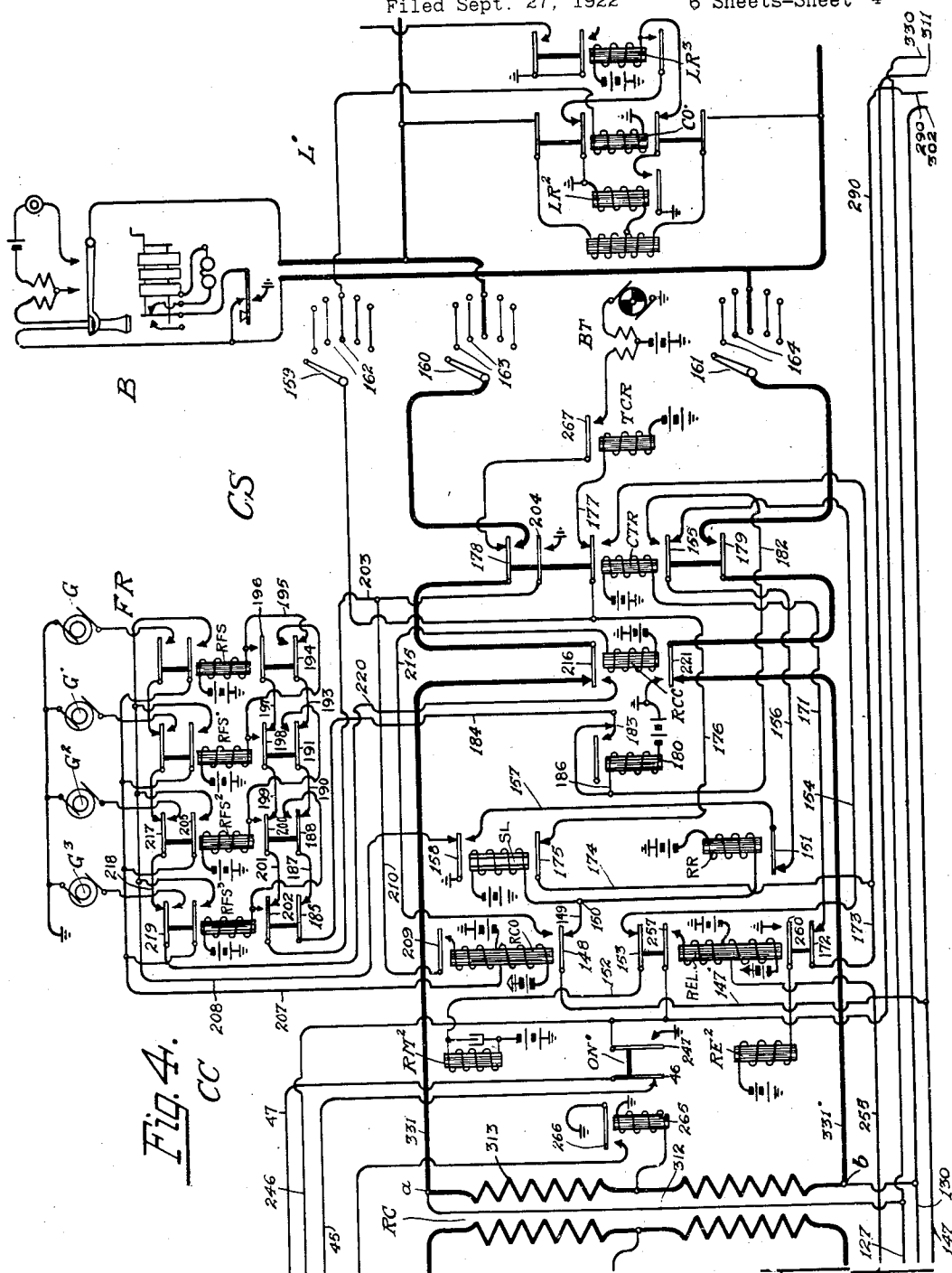
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6 Sheets-Sheet 4



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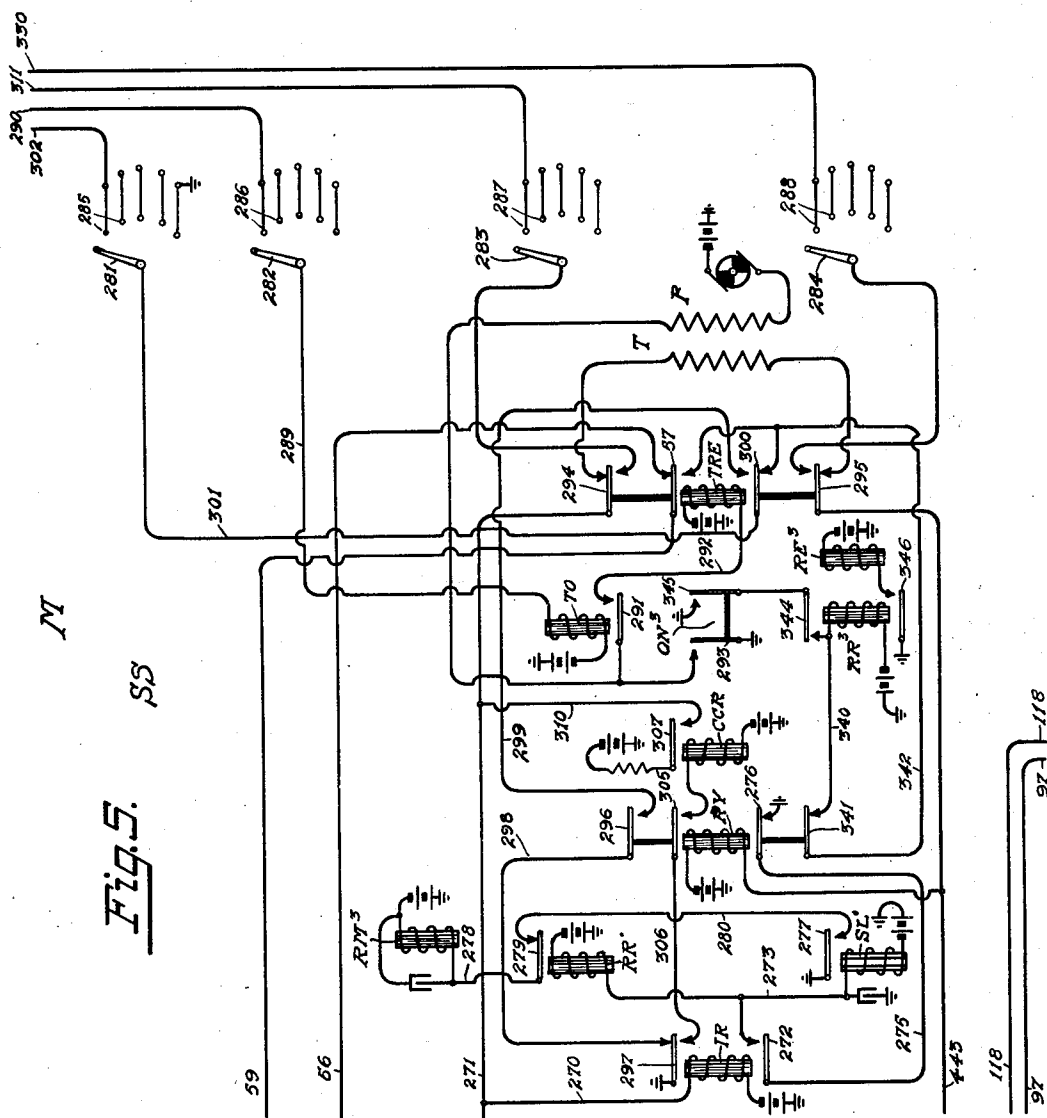
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6 Sheets-Sheet 5



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6 Sheets-Sheet 6

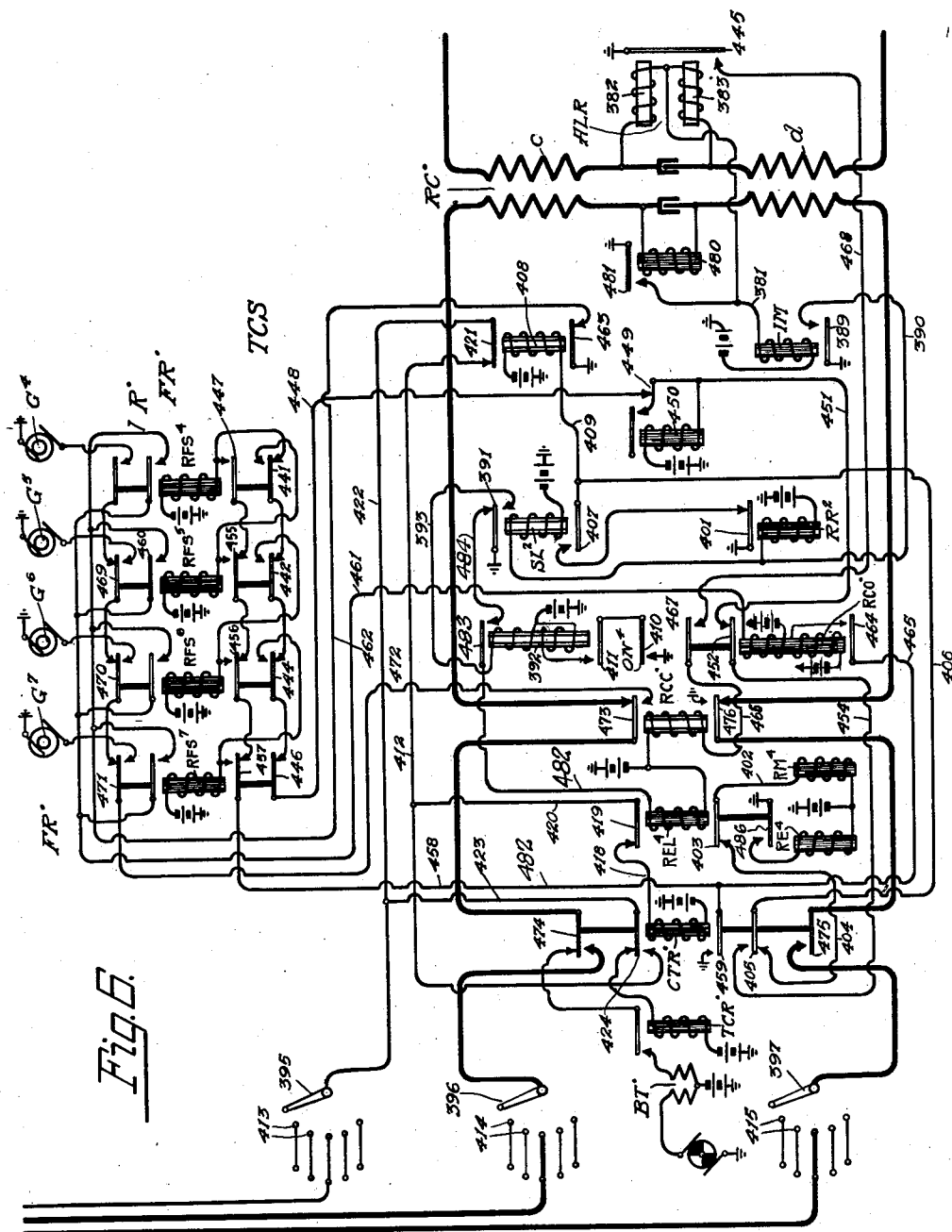


Fig. 6.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed September 27, 1922. Serial No. 590,785.

To all whom it may concern:

Be it known that we, HIRAM D. CURRIER and GEORGE R. EATON, citizens of the United States of America, and residents, respectively, of Chicago and Oak Park, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

Our invention relates to telephone systems, and has to do more particularly with systems known as the magneto type in which the subscribers may be interconnected for conversational purposes, and one of the main objects of our invention is to provide an improved circuit arrangement of the above type.

In the telephone field large operating telephone companies are built up of a number of telephone exchanges, some of them comprising common battery equipment, and some of them comprising magneto equipment. The outlying exchanges in the rural districts are mostly of the magneto type and are small in size. This necessitates the maintaining of an operating force to operate the board, which usually consists of one or two operators. Only a small percentage of the operators' time is required for the proper handling of calls on a board of this size, and an object of our invention is the provision of an improved circuit arrangement in which the operator instead of being placed at the magneto board at a small town may be placed at a centralized control board at one of their main exchanges in a large city where she may handle the regular work in addition to establishing connections between magneto subscribers at the outlying magneto exchange, or an operator may be assigned to handle all the calls from several small exchanges. The equipment used for establishing connections between the different subscribers at the magneto exchange is located at the small town and comprises a plurality of switching instrumentalities for interconnecting the lines under the control of the operator at the centralized control position located in the board at the main exchange.

One of the features of our invention is the termination of the lines of a magneto exchange in the banks of finder switches,

of which one is actuated when a subscriber rings "central" to select the calling line, and the provision of suitable operators' answering equipment in the form of a suitable switch which when actuated selects the connecting circuit predetermined by the starting circuit when the subscriber rings central to connect the calling subscriber with the operator at the centralized control board at the main exchange.

Another feature of our invention is the provision of suitable operators' answering equipment which is automatically connected to the calling line and dialing means in the operator's answering equipment for dialing the number of the called subscriber in the same exchange, and restoring means for restoring the switch which automatically functions to connect the operator's answering equipment with the calling line after the operator has supervised the connection in the usual way so that the same may be immediately available for selecting any other call which may have been placed in the meantime.

Another feature of our invention is the provision of an operator's supervisory equipment associated with the operator at the main exchange, and a supervisory switch associated therewith which may be stepped from one connecting circuit to the next, and those in use she may supervise the same as on a regular magneto cord. Means are also provided in the operator's supervisory equipment for permitting the ringing of a called subscriber should it be necessary.

Another feature of our invention is the provision of a special tone associated with the operator's supervisory equipment which will be heard by the operator supervising connections when a connecting circuit has not been released due to the failure of the parties to ring off so that the same may be released by suitable means associated with the supervisory equipment.

Another feature of our invention is the provision of means whereby the magneto subscribers may ring central to ground to start the switch apparatus to select the calling line through the agency of a grounding key at the subscriber's station, or the subscribers may ring each other on the line metallicly without disturbing the control

operator at the central office, thus eliminating the use of any battery on the magneto line circuit.

Still another feature of our invention is the provision of a harmonic frequency selective circuit which is operated by suitable impulses to select the proper ringing frequency to ring the call bell at the call substation that is located on a party line and is equipped with frequency ringing apparatus.

For a more complete understanding of our invention, reference may be had to the accompanying drawing in which we illustrate apparatus for interconnecting magneto subscribers' lines, and in which Figs. 1, 2, 3, 4, 5 and 6, when joined as shown in Fig. 7, illustrate a complete connection. All of the parts have been shown at normal, and the apparatus illustrated in Figs. 1, 2, 4 and 5 is located at the magneto exchange at a distant point from the main central office. The apparatus in Fig. 3 illustrates the operator's control equipment which is located at the centralized control office at the main exchange. Fig. 6 is a toll line circuit to be used in connection with the other circuits if necessary.

Referring now more in general to our invention, and for the purpose of illustrating and describing the same, we show a system whose ultimate capacity is 46 lines, which lines are single party or party lines equipped with straight line or code ringing, and party lines which are equipped with harmonic ringing. In a system of this type in which the capacity is 46 lines, seven finder switches FS, through which these 46 lines are multipled, and seven connector switches CS, through which said forty-six lines are multipled, are provided, and these switches provide seven connecting circuits CC, each comprising a pair of switches FS and CS which are sufficient to handle the traffic between said subscribers of the exchange. The number of switches just given is used as an arbitrary measure, as the number of switches may be increased or decreased depending upon the traffic.

An answering switch AS common to the seven connecting circuits automatically selects the predetermined connecting circuit as selected by the finder switch FS, and automatically connects the operator's equipment OA and OE located at the centralized control board at the main office with the calling line at the magneto exchange, and through the medium of a suitable impulse transmitting device actuates the connector switch CS to select the contacts of the called line. A ringing frequency selective circuit FR associated with the connector switch CS operated by impulses from the impulse device located at the central control office is adapted to select the proper generator frequency to ring the call bell of a called

subscriber. We also provide a supervising switch SS common to all the connecting circuits which may be actuated by suitable means associated with the operator's supervisory equipment OE to step the wipers of the switch SS from one set of contacts to the next to which the connecting circuits are connected for the purpose of supervising connections as is the case in a magneto exchange.

Referring now more in detail to our invention as illustrated, in Fig. 1, to the left of the drawing, we show a magneto substation A which is one of a plurality located at the magneto exchange M and is provided with a grounding push button GB which when actuated and the hand generator operated causes a finder switch FS to operate to select the contacts of the calling line. The substation A terminates at the exchange M into a line circuit L comprising the usual line relay LR and a secondary line relay LR' and a cut off relay CO. The line circuits L of the lines are multiply connected to the finder switches FS, whereby any one of the switches FS may seize the calling line terminals, as will be more fully hereinafter described. The finder switch FS may be of any desired construction and is provided with a spring restored shaft which carries wipers 11, 12, 13 and 14 and with four sets of fifty contacts 15, 16, 17 and 18, to which contacts the lines of the subscribers of the exchange M are multipled.

A rotary magnet RM is provided for rotating the switch shaft and its wipers 11, 12, 13 and 14 by means of a suitable ratchet and pawl mechanism. A release magnet RE is also provided which when actuated is adapted to bring about the restoration of the switch shaft and its associated wipers 11, 12, 13 and 14. A common starting conductor ST is provided and is common to the subscribers' lines which lead to the group of switches FS. A bridging relay BG is provided which energizes when the calling line is seized by the switch FS to shunt the rotary magnet RM to prevent further advancement of the wipers 11, 12, 13 and 14, and a switching relay SW is provided which energizes upon the actuation of the relay BG to extend the starting conductor ST through to the next finder switch FS of the group (not shown). Off normal contacts ON are provided for the switch FS which assume their alternate position upon the first step of the wipers of the switch FS off normal, and remains so until the switch FS is again restored to normal.

In Fig. 2 we have shown the operator's answering switch AS located at the exchange M which may be of a construction similar to that of finder switch FS, and which is also provided with a rotary magnet RM' for rotating the switch shaft and its

wipers 60, 61, 62 and 63 by means of a ratchet and pawl mechanism over contacts 64, 65, 66 and 67 which lead to the finder switches FS. A release magnet RE' for releasing the switch AS is also provided, and a bridging relay BG' is provided which energizes when the predetermined connecting circuit CC now connected to the calling line is seized by the answering switch AS to shunt the rotary magnet RM' to prevent further advancement of the wipers 60, 61, 62 and 63. Relay BG' upon energization extends the calling line over conductors 97 and 118 to the operator's centralized control equipment OA and OE at the main exchange as illustrated in Fig. 3. The operator's equipment at the main exchange N for interconnecting the subscribers at the exchange M comprises equipment which we will term operator's answering equipment OA, and which comprises a call lamp CL which is lighted when the operator is connected to the calling line to indicate to her that a call is awaiting her attention. A listening key LK' is provided which when actuated connects her operator's set O to the conductors 97 and 118 so as to place her in communication with the calling line. A dialing key DK is also provided which when actuated connects the calling dial CD so that the same may be operated to send the requisite number of impulses to select the called line. A ringing key RK' is also provided for ringing the called for subscriber.

The connector switch CS to which the lines are multiply connected is of a construction similar to that of switches FS and AS and comprises a shaft carrying wipers 159, 160 and 161 which are adapted to be stepped into engagement with the contacts 162, 163 and 164 through the medium of a rotary magnet RM². A release magnet RE² is also provided which when actuated releases the switch wipers 159, 160 and 161 and allows them to restore to normal. The connector switch is of the fifty point rotary type and we leave the tens contacts of the bank contacts blank, that is, the tenth, twentieth, thirtieth and fortieth set of contacts are not connected to the subscribers' lines but are left blank or on open circuit. Assuming that a subscriber is calling a subscriber whose line is connected to the twenty-fifth set of contacts, the operator will operate her calling device CD to send ten impulses which will operate the connector switch CS to cause the wipers to engage the tenth set of contacts in the bank which are blank. The operator will now actuate the calling device to send the second group of ten impulses which will step the wipers of the connector into engagement with the twentieth set of contacts of the bank which are also blank and the final five impulses will step the wipers of the connector switch

into engagement with the twenty-fifth set of contacts which are the contacts of the wanted line. Now, if the tenth and twentieth sets of contacts had a subscriber's line connected thereto, and should the said line connected thereto be in conversational circuit, there would be interference with the connection when the wipers engaged the tenth and twentieth set of contacts, but by leaving the tenth, twentieth, thirtieth and fortieth set of contacts blank, the wipers will always engage blank contacts and prevent interference with existing connections and thus provide for capacity of forty-six lines. A ringing frequency selecting circuit FR is also associated with the switch CS and comprises a group of ring frequency selective relays RFS, RFS', RFS² and RFS³ one of which is associated with each of the frequency generators G, G', G² and G³. The relays RFS, RFS', RFS² and RFS³ are operated by impulses from the calling device CD of the operator's centralized equipment at the main exchange depending upon the frequency selected, and through the agency of the ringing key RK' of the operator's equipment OA the called subscriber may be signaled.

To the right of the drawing we show a called substation B similar to the calling substation A which terminates at the exchange M in a line circuit L' similar to that of L of Fig. 1, and comprises line relays LR² and LR³ and cut off relay CO'.

In Fig. 5 we illustrate a supervisory switch SS common to all the connecting circuits CC of the exchange M and through the medium of the operator's supervisory equipment OE at the main exchange the switch SS may be stepped from one connecting circuit to the next. The switch is similar in construction to that of FS of Fig. 1, and comprises a rotary magnet RM³ which steps the wipers 281, 282, 283 and 284 from one set of contacts 285, 286, 287 and 288 to the next to supervise connections. A release magnet RE³ is also provided for releasing the switch SS to permit the switch wipers to restore. The supervisory equipment OE at the centralized position of the main exchange comprises a listening key LK which when actuated connects the operator's set O to the connecting circuits when she is supervising. A stepping key CSK which when actuated by the operator steps the wipers 281, 282, 283 and 284 from one set of contacts 285, 286, 287 and 288 which are associated with the connecting circuits. A ringing key RK is also provided which may be operated to re-ring a called subscriber who has not as yet answered when the operator is supervising and has found such a condition, all of which will be more fully hereinafter described.

In Fig. 6 we illustrate a toll line circuit

which terminates at the centralized control board at the main exchange N where a truck jack TJ, the disconnect lamp DL, the cut off relay CO² and the relay 387 which controls the lighting of the disconnect lamp DL are all located. A dial connecting key DK' and a calling device CD' are also associated with and located at the main exchange M. The toll line circuit comprises a trunk connector switch TCS comprising a rotary shaft carrying wipers 395, 396 and 397 which are adapted to engage contacts 413, 414 and 415 to which the lines of the exchange M are multiplied. A rotary magnet RM⁴ is provided for stepping the wipers 395, 396 and 397 from one contact set 413, 414 and 415 to the next, and a set of off normal contacts ON⁴ are also provided which assume their alternate position upon the first step of the wipers off normal. A release magnet RE⁴ is also provided which when energized permits the release of the switch wipers. The switch TCS is of a construction similar to that of switch FS of Fig. 1, and is of any suitable non-numerical type. A frequency selecting circuit FR' is also associated with the switch TCS which is similar to the frequency selecting circuit FR associated with the connector switch CS of Fig. 4.

Having described in general the apparatus comprising the circuits of our invention, we will now describe in detail the operation of the same.

Assuming that the subscriber at the substation A located at the exchange M initiates a call, he depresses the grounding key GB and operates the hand generator at the substation. The flow of current from the operated hand generator causes the line relay LR to operate, and the closing of its alternate contact 1 establishes an energizing circuit for the secondary line relay LR' from battery through the winding of relay LR', conductor 3, normal contact 4, of cut off relay CO to ground at alternate contact 1 of relay LR. The closing of alternate contact 5 of relay LR' places ground on the starting conductor ST and establishes an energizing circuit for the rotary magnet RM of the finder switch FS, traced from ground at alternate contact 5 of relay LR', starting conductor ST, normal contact 6 of switching relay SW, conductor 7, normal contact 8 of off-normal contacts ON, conductor 9, normal contact 10 of magnet RM through the winding of magnet RM to battery. The rotary magnet RM is energized and de-energized once over this circuit to step the wipers 11, 12, 13 and 14 of the finder switch into engagement with the first set of contacts 15, 16, 17 and 18. The circuit for rotary magnet RM is opened upon the first step of the wipers 11, 12, 13 and 14 off normal, due to the opening

of normal contact 8 of off-normal contacts ON which assume their alternate position upon the first step of the wipers. A substitute energizing circuit is however established for the rotary magnet RM which may now be traced from battery through the winding of magnet RM, its contact 10, conductor 9, alternate contact 8 of off-normal contacts ON, conductor 19, normal contact 20 of relay SW to ground at normal contact 21 of bridging relay BG. The rotary magnet RM is alternately energized and de-energized over this circuit to step the wipers 11, 12, 13 and 14 from one set of contacts 15, 16, 17 and 18 to the next in search of the contacts of the calling line.

The wipers 11, 12, 13 and 14 when stepped into engagement with the contacts 15, 16, 17 and 18 of the calling line cease further travel, and the instant wiper 12 engages contact 16 of the calling line, an energizing circuit for bridging relay BG is established traced from battery 22 over conductor 23, winding 24 of relay BG, conductor 25, normal contact 26 of relay SW, conductor 27, wiper 12, contact 16, conductor 28, to ground at alternate contact 29 of relay LR'. The instant wiper 12 engages grounded contact 16, the circuit just traced closes a low resistance path through the winding of relay BG to shunt rotary magnet RM, preventing further operations of the same, and relay BG upon energization opens the circuit of magnet RM at its normal contact 21. Relay BG upon energization establishes an energizing circuit for cut off relay CO of the line circuit L and the switching relay SW of the finder switch FS traced from ground through the winding of relay CO, conductor 30, contact 15, wiper 11, conductor 31, alternate contact 32 of relay BG, conductor 33 to battery through the winding 34 of relay SW. The relays CO and SW are energized over this circuit and the closing of alternate contact 35 of relay SW establishes a locking circuit for itself traced from battery through its upper winding 36, its, alternate contact 35, conductor 37 to ground at alternate contact 38 of off normal contact ON. The closing of alternate contact 6 of relay SW now extends the common starting conductor ST through said alternate contact 6 to the starting wire ST' which leads to the next finder switch FS of the group, so that should another subscriber initiate a call, the call will be extended to the next switch of the group. A busy potential is also placed upon the private contact 162' of the connector switch associated with the calling line to busy the same against incoming calls.

The closing of alternate contact 39 of relay SW establishes a locking circuit for relay BG traced from battery 22, conductor 23, winding 24 of relay BG, conductor 25,

alternate contact 39 of relay SW, conductor 40, winding 41 of relay BG, conductor 42, to ground at normal contact 43 of the release control relay REC. The relay BG upon energizing closes its alternate contact 21, establishing an energizing circuit for the answering switch starting control relay AN traced from battery through the winding of relay AN, conductor 45, normal contact 46 of the off-normal contacts ON' of the connector switch CS, conductor 47, normal contact 48 of relay REC, conductor 49 to ground at alternate contact 21 of relay BG. The closing of alternate contact 50 of relay AN establishes an energizing circuit of the rotary magnet RM' of the answering switch AS, traced from battery through the winding of magnet RM', its normal contact 51, conductor 52, normal contact 53 of off-normal contacts ON² of answering switch AS, conductor 54, normal contact 55 of switching relay SW', conductor 56, normal contact 57 of tone connecting relay TRE of the supervisory switch SS, conductor 59, to ground at alternate contact 50 of relay AN. The magnet RM' of the answering switch AS is energized and de-energized once over this circuit to step the wipers 60, 61, 62 and 63 into engagement with the first set of contacts 64, 65, 66 and 67. The movement of the wipers 60, 61, 62 and 63 one step permits the off-normal contacts ON² to assume their alternate position and the opening of normal contact 53 of off-normal contacts ON² opens the initial energizing circuit of the magnet RM', but a substitute energizing circuit for the magnet RM' is established which may be traced from battery through the winding of magnet RM', its normal contact 51, conductor 52, alternate contact 53 of off-normal contacts ON², conductor 68, normal contact 69 of relay SW', conductor 70, to ground at normal contact 71 of bridging relay BG'. The magnet RM' is alternately energized and de-energized over this circuit due to the interruption of its normal contact 51 to step the wipers 60, 61, 62 and 63 from one contact set 64, 65, 66 and 67 to the next in search of the finder switch FS that selected the calling line. When the wiper 60 of the answering switch AS engages the contact 64 which leads to the line finder FS, an energizing circuit is established for the relay BG', traced from battery 72, over conductor 73, through the winding 74 of relay BG', conductor 75, normal contact 76 of relay SW', conductor 77, wiper 60, contact 64, conductor 78 to ground at alternate contact 79 of relay AN. The circuit just described closes a low resistance path through the winding 74 of relay BG' and shunts the magnet RM' to prevent further actuations of the same, and the wipers 60, 61, 62 and 63 remain in engagement with the selected contacts 64, 65, 66 and 67 which lead to the connecting circuit CC associated with the finder switch FS that selected the calling line. The relay BG' upon energization closes its alternate contact 71, establishing an energizing circuit for switching relay SW', traced from battery through winding 80 of relay SW', conductor 81, to ground at alternate contact 71 of relay BG'. The relay SW' energizing, its alternate contact 82 is closed to establish a locking circuit for itself, traced from battery through its winding 83, its alternate contact 82, conductor 84 to ground at alternate contact 85 of off-normal contacts ON². The closure of alternate contact 86 of relay SW' establishes a circuit through the lower winding 88 of relay BG', which may be traced from battery 72, conductor 73, winding 74 of relay BG', conductor 75, alternate contact 86 of relay SW', conductor 87, lower winding 88 of relay BG', its alternate contact 89, conductor 90 to ground at normal contact 91 of sleeve relay SE. The closing of alternate contacts 93 and 94 of relay BG' establishes an energizing circuit for the call lamp control relay CLC of the operator's answering equipment OA located at a centralized position at the main exchange N, traced from battery, through the winding of relay SE, conductors 95 and 96, alternate contact 94 of relay BG', conductor 97, contact 98 of the connector release key CRK of the operator's supervisory equipment OE, contact 99 of the ringing key RK of the operator's supervisory equipment OE, normal contact 100 of the operator's supervisory switch stepping key CSK, normal contact 101, of the listening key LK, conductor 102, normal contact 103 of the calling switch release key CSW, normal contact 104 of relay 105, conductor 106, normal contact 107 of the listening key LK' of the operator's answering equipment OA, conductor 108, through the winding of relay CLC, conductor 109, normal contact 110 of listening key LK', conductor 111, normal contact 112 of key CSW, conductor 113, normal contact 114 of the listening key LK, normal contact 115 of stepping key CSK, normal contact 116 of key RK, normal contact 117 of key CRK, conductor 118, alternate contact 93 of relay BG', conductor 119 and 120 to ground through the winding of tip relay TI. Relay CLC is energized over this circuit, but due to their high resistance relays SE and TI do not energize, and the relay CLC, upon energization, closes its alternate contact 122, establishing a circuit for the operator's call lamp CL, traced from battery through the call lamp CL, conductor 123 to ground at alternate contact 122 of relay CLC. The lamp CL at the operator's centralized position at the main exchange N is lighted and signals the operator, notifying her that a call is awaiting her attention from a subscriber at the magneto exchange M.

The operator now actuates her listening key LK' to connect her operator's set O to the calling line, which may be traced from the alternate contact 110 of the listening key LK', conductor 111, normal contact 112 of key CSW, conductor 113, normal contacts 114, 115, 116 and 117 of keys LK, CSK and RK and CRK, conductor 118, alternate contact 93 of relay BG', conductor 119, normal contact 124 of relay 125, conductor 126, wiper 62, contact 66, conductor 127 to the terminal *a* of the repeating coil RC. The other lead from the operator's set O extends from alternate contact 107 of the listening key LK' over conductor 106, contact 104 of relay 105, normal contact 103 of key CSW, conductor 102, normal contacts 101, 100, 99 and 98 of keys LK, CSK and RK and CRK, conductor 97, alternate contact 94 of relay BG', conductor 96, normal contact 128 of relay 125, conductor 129, wiper 63, contact 67, conductor 130, to the terminal *b* of the repeating coil RC. The listening key LK', when actuated, closes its alternate contact 132, establishing an energizing circuit for the relay 133, traced from battery, through the winding of relay 133, conductor 141, to ground at alternate contact 132 of the key LK'. The listening key LK' when actuated also interrupts the circuit of relay CLC, due to the opening of its normal contacts 107 and 110, and relay CLC de-energizes, opening its alternate contact 122, effacing the lamp CL.

The operator having been connected to the calling line at exchange M now inquires the wants of the calling subscriber, and assuming that the called subscriber's number is 25, the operator actuates her dialing key DK and actuates her calling device CD to send twenty-five impulses, and as before described, every tenth set of contacts of the connector switch CS is on open circuit, and to extend the calling line to the called line, the operator will send two series of ten impulses each, and then send five impulses which will bring the wipers of connector switch CS into engagement with contacts of the wanted line. The operator now advances the calling device CD to send the first set of ten impulses, and upon the movement of the calling device off-normal, an energizing circuit is established for relay TI, traced from battery 210, conductor 134, closed impulse spring contacts 135 and 136, closed shunt spring 137, alternate contacts 138 and 139 of the dial key DK, conductors 140 and 111, normal contact 112 of key CSW, conductor 113, contacts 114, 115, 116 and 117, conductor 118, alternate contact 93 of relay BG', conductors 119 and 120, to ground through the winding of relay TI. Relay TI upon energization closes its alternate contact 142 establishing an energizing circuit for the slow-acting relay SL and rotary relay RR of the connector switch CS, which circuit may be traced from ground at alternate contact 142 of relay TI, conductor 143, normal contact 144 of relay SE, conductor 145, wiper 61, contact 65, conductors 147 and 147', normal contact 148 of ringing control relay RCO, conductor 149 to the junction 150 and the circuit dividing and passing through the relay RR to battery and through the relay SL to battery.

The closing of alternate contact 142 of relay TI also establishes an energizing circuit for the relay 125 of the answering switch AS traced from battery through the winding of relay 125, conductor 145, normal contact 144 of relay SE, to ground at alternate contact 142 of relay TI. Relay 125 is energized, and due to its slow to release construction it remains energized during the rapid interruptions of contact 142 of relay TI. The opening of normal contacts 124 and 128 of relay 125 disconnects the finder switch FS conductors to prevent the calling subscriber from hearing the line interruptions caused by the impulses transmitted to actuate the connector switch CS. When the operator releases the calling device CD, the impulse springs 135 and 136 are opened and closed ten times, interrupting the circuit of relay TI ten times and each de-energization of relay TI brings about the interruption of the circuit of the rotary relay RR of the connector switch CS, and consequently rotary relay RR is energized and de-energized ten times, but relay SL of the connector CS however remains energized during the rapid interruptions of contact 142 due to its slow to release construction. Relay RR is thus energized and de-energized ten times, and upon each closure of normal contact 151 of relay RR an energizing circuit is established for the rotary magnet RM², traced from battery, through the magnet RM², conductor 152, normal contact 153 of release relay REL, conductor 154, normal contact 155 of connector test relay CTR, conductor 156, normal contact 151 of relay RR, conductor 157, to ground at alternate contact 158 of relay SL. Rotary magnet RM² is thus energized and de-energized ten times to step the wipers 159, 160 and 161 into engagement with the tenth set of contacts 162, 163 and 164, which are blank. The off normal contacts ON' of the connector switch CS assume their alternate position upon the first step of the switch wipers off normal, and the opening of normal contact 46 of said off normal contacts ON' opens the energizing circuit of relay AN of the finder switch FS. The operator again actuates the calling device CD to send the second set of ten impulses to operate relays TI, RR and SL and magnet RM² as just described, and again actuates the calling device CD to send the final five impulses which operate the same

relays and magnets of the answering and connector switches AS and CS in a similar manner as just described to place the wipers 159, 160 and 161 of the connector CS into engagement with the twenty-fifth set of contacts 162, 163 and 164, which are the contacts of the wanted line of the called subscriber B.

After the last impulse is sent relay TI restores and permits relays RR and SL of the connector CS to restore, and if the called line is busy either as a called or calling line, the operator as well as the calling subscriber will receive a special tone notifying them of the busy condition of the called line, as will be more fully hereinafter described.

Assuming that the called line is idle, the private contact 162 which is engaged by the private wiper 159 is at a ground potential and an energizing circuit is, therefore, established for the relay CTR, traced from battery through the winding of said relay CTR, conductor 171, normal contact 172 of relay REL, conductors 173 and 174, normal contact 175 of relay SL, conductor 176, wiper 159, to ground at contact 162. The tone connecting relay TCR is also energized when the wiper 159 engages the private contact 162 from battery through the winding of relay TCR, normal contact 177 of relay CTR, conductor 176, wiper 159 to grounded contact 162. The relay TCR is momentarily operated but this operation is only incidental as relay CTR is energized and the opening of its normal contact 177 opens the circuit of relay TCR. Relay CTR energizes over this circuit and the closure of its alternate contacts 178 and 179 extends the talking conductors to the called line.

Assuming that the called subscriber B is on a party line and said line is equipped for harmonic ringing, the next function that the operator performs is the actuation of the calling device CD to select the proper ringing generator frequency to ring the call bell at the called subscriber's substation B. Assuming that it is the generator G² which is of the proper frequency to ring the bell at the called substation B, the operator now actuates her calling device CD to send three impulses of current, which three impulses will energize and de-energize the relay TI of the answering switch AS three times, and the relay TI will in turn again affect relays RR and SL of the connector CS as before described. The relay SL upon energization will open the initial energizing circuit of relay CTR, but the closure of alternate contact 177 of relay CTR establishes a locking circuit for said relay CTR, traced from battery through the winding of relay CTR, conductor 171, normal contact 172 of relay REL, conductor 173, alternate contact 177 to the grounded contact 162. The first de-energization of relay RR will establish an

energizing circuit for ringing frequency selective relay RFS of the frequency ringing selection circuit FR associated with the connector CS, traced from ground at alternate contact 158 of relay SL, conductor 157, normal contact 151 of relay RR, conductor 156, alternate contact 155, of relay CTR, conductor 182, normal contact 183 of relay 180, conductor 184, normal contact 185 of relay RFS³, conductor 187, normal contact 188 of relay RFS², conductor 190, normal contact 191 of relay RFS', conductor 193, normal contact 194 of relay RFS, conductor 195, to battery through the winding of relay RFS. Relay RFS upon energization opens its normal contact 194, opening its initial energizing circuit, but due to the closing of its alternate contact 196 a locking circuit is established for itself, traced from battery, through its winding, its alternate contact 196, conductor 197, normal contact 198 of relay RFS', conductor 199, normal contact 200, of relay RFS², conductor 201, normal contact 202 of relay RFS³, conductor 203, to ground at alternate contact 204 of relay CTR. Relay 180 is also energized to battery, over conductors 182 and 186, to open its normal contact 183 for purposes as will presently be described. The second impulse will traverse the same path just described up to contact 194 of relay RFS, but now passes through alternate contact 194 to battery, through the winding of relay RFS'. Relay RFS' upon energization closes its alternate contact 198, establishing a locking circuit for itself, traced from battery through its winding, its alternate contact 198, to ground at alternate contact 204 of relay CTR over the previously described path. The opening of normal contact 198 of relay RFS' opens the locking circuit of relay RFS, which now restores. The third ringing selection impulse now passes over the previously described path and passes through alternate contact 191 to battery through relay RFS², and the closing of its alternate contact 200 establishes a locking circuit for itself to ground at alternate contact 204 of relay CTR. Relay RFS² upon energization opens its normal contact 200, opening the locking circuit of relay RFS', which relay now restores. Relay 180 is also energized as described, and upon the first impulse of current from the calling device CD relay 180 and relay RFS of the ringing frequency selection circuit FR are energized simultaneously. Relay 180 upon energization opens its normal contact 183 so as to regulate the length of the impulse so that the instant relays 180 and RFS are energized and contact 194 of relay RFS is closed, the contact 183 of relay 180 is changed thus preventing the impulse of current that operated relay RFS from operating a second relay RFS. Relay RFS² remains energized

as it is associated with the selected frequency, and the closing of its alternate contact 205 establishes an energizing circuit for relay RCO, as will now be described. After the last ringing impulse has been sent, relay TI of the answering switch AS and relays SL and RR of the connector switch CS restore, and the closure of normal contact 158 of relay SL establishes an energizing circuit for relay RCO traced from battery, through its lower winding, conductor 207, alternate contact 205 of relay RFS², conductor 208, to ground at normal contact 158 of relay SL, and the relay RCO upon energization closes its alternate contact 209 to establish a locking circuit for itself, traced from battery, through its upper winding, alternate contact 209, conductor 210 to ground at alternate contact 204 of relay CTR. The operator having finished dialing, now restores her dialing key DK and actuates her ringing key RK' of her answering equipment OA, again connecting battery over conductor 134 through alternate contacts 212 and 213 of the ringing key RK', and over conductor 113 to ground through the winding of relay TI. Relay TI energizing, its alternate contact 142 is closed, establishing an energizing circuit for ringing current connecting relay RCC traced from battery through the winding of relay RCC, conductor 215, alternate contact 148 of relay RCO to ground at alternate contact 142 of relay TI. Relay RCC upon energization closes its alternate contact 216 to connect ringing current to the called line, traced from the ungrounded pole of the selected ringing frequency generator G², alternate contact 217 of relay RFS², conductor 218, normal contact 219 of relay RFS², conductor 220, alternate contact 216 of relay RCC, alternate contact 178 of relay CTR, wiper 160, contact 163, through the call bell and condenser at the called substation B, back through contact 164, wiper 161, alternate contact 179 of relay CTR, to ground at alternate contact 221 of relay RCC. Each time the operator wishes to actuate the call bell at the called substation B, the ringing key RK' is actuated to operate the relay RCC to connect ringing current from generator G² to the called line. The subscriber at the called substation, in response to his call signal, removes his receiver and converses with the calling subscriber over the heavily marked conductors and through the repeating coil RC.

The operator having her listening key LK' closed to connect her operator's set O knows when the calling subscriber at the substation A and the called subscriber at the substation B are in conversational circuit, and when they are she restores her listening key LK'. The opening of alternate contact 132 of the listening key LK' opens the energizing circuit for relay 133, but due to its slow to

release construction, its alternate contact 230 is held momentarily closed, thus establishing an energizing circuit for the relay 105 of the answering operator's equipment OA and relay SE of the answering switch AS, traced from battery through the winding of relay SE, conductors 95 and 96, alternate contact 94 of relay BG', conductor 97, contacts 98, 99, 100 and 101 of keys CRK, RK, CSK and LK, conductor 102, normal contact 103, normal contact 104 of relay 105, conductor 106, normal contact 107 of key LK', conductor 108, alternate contact 230 of relay 133, conductor 231 to ground through the winding of relay 105. Relay SE upon energization opens its normal contact 91 to open the energizing circuit of relay BG' which restores and the closing of normal contact 71 of relay BG' establishes an energizing circuit for the release magnet RE', traced from battery through the winding of magnet RE', conductor 232, alternate contact 69 of relay SW', conductor 70 to ground at normal contact 71 of relay BG'. The release magnet RE' upon energization withdraws the retaining pawl and the wipers 60, 61, 62 and 63 now restore, and when reaching their normal position, off-normal contacts ON² are moved back to their normal position, and the opening of alternate contact 85 opens the circuit of relay SW', which relay restores and opens the energizing circuit of magnet RE', which now restores. The answering switch AS and its associated apparatus is now in its normal position, and may again be used for establishing another connection with a calling line. Should another call have been initiated during the time that the operator was setting up the connection just described another finder switch of the group would have selected the calling line, and the operation of the relay AN of the finder switch would place a ground upon the common conductor 59 and the answering switch AS upon restoration would again be started to select the finder switch and calling line so as to extend the line to the operator in a manner just described.

After the subscribers have finished conversation, they replace their receivers upon their respective switchhooks, and assuming the subscriber at the substation A is the first to disconnect, he depresses his grounding button GB and actuates the hand generator and current therefrom actuates the disconnect relay 240, and the said relay upon energization closes its alternate contact 241, establishing an energizing circuit for relay REC, traced from battery through the lower winding of relay REC, conductor 243, alternate contact 241 of relay 240, conductor 244 to ground at normal contact 50 of relay AN. Relay REC is energized over this circuit due to the closure of alternate contact 241

of relay 240 during the time that current from generator at substation A is passing through its winding. Relay REC upon energization opens its normal contact 43, opening the energizing circuit of relay BG, but during the time that relay 240 is held energized relay BG remains energized from ground at normal contact 50 of relay AN, conductor 244, alternate contact 241 of relay 240, conductor 243, alternate contact 43 of relay REC, conductor 42 and over the previously described path to battery 22. During the time relay 240 is energized, relay REC is locked up from battery through its upper winding, its alternate contact 48, conductor 49, to ground at alternate contact 21 of relay BG. When relay 240 restores relay BG is de-energized due to the opening of alternate contact 241 of relay 240 and opening of normal contact 43 of relay REC, and the opening of alternate contact 21 of the restored relay BG opens one of the locking circuits of relay REC, but a second locking circuit is closed for relay REC through its alternate contact 245 over conductor 246 to ground at alternate contact 247 of off-normal contacts ON' of the connector switch CS. The closing of normal contact 21 of relay BG establishes an energizing circuit for the release magnet RE of the finder switch FS traced from battery through the winding of magnet RE, conductor 250, alternate contact 20 of relay SW, conductor 251 to ground at normal contact 21 of relay BG. The release magnet RE withdraws the retaining pawls, allowing the wipers 11, 12, 13 and 14 to restore and when the wipers reach their normal position, off-normal contacts ON assume their normal position, and the opening of normal contact 38 opens the locking circuit of relay SW, which restores, and the opening of its alternate contact 20 opens the circuit of release magnet RE. Relay BG restoring, its alternate contact 32 is opened, allowing relay CO of the line circuit of the calling substation to restore. The circuit just traced through the lower winding 41 of the relay BG to hold the said relay BG energized so that in the event that the subscriber at the substation A actuates the hand generator thereat to send a prolonged disconnect signal, the relay 240 remains energized during this time and holds the relay REC energized, and the ground from normal contact 50 extends through the alternate contact 43, through the lower winding of relay BG to hold the same energized during this time. If this contact 43 was not provided so as to hold the relay BG energized, the instant relay REC energized ground would be removed from the lower winding of relay BG at normal contact 43 and permit relay BG to de-energize, and close an energizing circuit for the release magnet RE and the switch would restore and permit the cut off relay CO of the line circuit to restore. The release of the switch FS and the energization of the release magnet RE is about simultaneous, and if this disconnect current were to continue after the finder switch has restored, the closing of normal contact of the cut off relay CO would permit the relay LR to energize and close a circuit to be completed for relay LR', to place ground on the common starting conductor and bring about a false start of the finder switch FS. The relay BG in restoring closes its normal contact 252 and as relay REC is locked up to ground over a circuit as before described, an energizing circuit for relay REL of the connector switch CS is established, traced from battery through the lower winding of relay REL, conductor 255, alternate contact 253 of relay REC, conductor 256 to ground at normal contact 252 of relay BG. The relay REL upon energization closes its alternate contact 257, closing a locking circuit for itself, traced from battery, through its upper winding, its alternate contact 257, to ground at alternate contact 247 of off-normal contacts ON' of the connector switch CS. The closure of alternate contact 260 of relay REL establishes an energizing circuit for the release magnet RE² of the connector switch CS from battery through the winding of magnet RE² to ground at alternate contact 260 of relay REL. The opening of normal contact 172 of relay REL opens the energizing circuit of relay CTR, and the relay CTR upon de-energization opens its alternate contact 204, opening the locking circuit of relay RFS² of the relay frequency ringing equipment FR, and the relay RFS² de-energizing the ringing selection equipment FR is restored to normal. The opening of alternate contact 204 also opens the locking circuit of relay RCO which relay restores. Release magnet RE² energizing withdraws the retaining pawl and permits the wipers 159-160 and 161 to restore, and when reaching normal the off-normal contacts ON' assume their normal position and the opening of alternate contact 247 of off-normal contacts ON' opens the circuit of relay REC of the line finder switch FS and relay RCO of the connector switch CS. The apparatus which was used in establishing a connection between the calling subscriber at the substation A and the called subscriber at the called substation B is now available for use in establishing other connections.

Assuming now that the called subscriber at the substation B was the first to replace his receiver upon the switchhook and operate the hand generator at the substation for disconnect, the current therefrom will operate the connector switch release relay 265 and the relay, upon energization, will close its alternate contact 266, which closes a circuit for the relay REC of the finder switch

FS and the disconnection of the apparatus of finder switch FS and connector switch CS from this point on is the same as just described, and a further description is not thought necessary.

Assuming now that the line of the called-for subscriber is busy, the operation of the apparatus for establishing the connection from the calling line A to the called line B is the same up to and including the engagement of the wipers 159, 160 and 161 with the contacts 162, 163 and 164 of the called line, and before the operator has dialed for the proper ringing frequency. The line being busy, there will be a busy potential on the bank contact 162 of the called line, said battery also extending to ground through the cut-off relay CO'. When the test wiper 159 engages private busy contact 162, test relay CTR will not energize due to its high resistance and due to the potential on contact 162, which does not permit sufficient flow of current to operate said relay CTR, and relay CTR failing to energize, relay TCR being of low resistance, will energize to connect the busy tone BT in circuit with the calling subscriber at substation A to notify the subscriber thereof of the busy condition of the line. The busy tone is also transmitted to the operator to also indicate to her the busy condition of the called line. The circuit for relay TCR extends from battery through the winding of relay TCR, normal contact 177 of relay CTR, conductor 176, wiper 159, contact 162 to ground through the cut-off relay CO' of the line circuit L' of the called line. The closing of alternate contact 267 of relay TCR connects the busy tone BT to the tip conductor back to the calling subscriber A and to the operator. The calling subscriber receiving the busy signal now replaces his receiver and operates the hand generator to operate relay 240 and said relay energizing closes its alternate contact 241 to close the release circuit of the finder switch FS and connector switch CS to release the switches as previously described. The operator receiving the busy signal now restores her listening key LK' to close the release circuit of the answering switch AS and the switch restores in a manner already described.

The system of our invention is also provided with means whereby the operator may supervise the connections after they have been established by connecting her operator's set thereto to permit her to listen in and see to it that all connections have been properly established and that the switches used in establishing connections have been released, and if the subscribers have failed to release the switches after the termination of conversation she may actuate means to release the switches, all of which will now be fully described in detail.

Should the operator at the centralized con-

trol board at the main exchange wish to supervise the connecting circuits CC as to their condition, she will actuate the listening key LK of her operator's supervisory equipment OE, and the closing of alternate contacts 101 and 114 of the listening key LK will connect the operator's set O over conductors 97 and 118 to normal contacts 93 and 94 of the bridging relay BG' of the answering switch AS, and through the medium of the supervisory switch she may now connect her operator's set to any of the connecting circuits CC so that she may listen in and supervise. The answering switch AS has been restored to normal after the operator has extended the call to the called substation allowing relay BG' to restore to close its normal contacts 93 and 94, as before described.

Having actuated the listening key LK the operator now actuates the key CSK of her supervisory equipment OE, and upon the actuation of the said key its alternate contact 115 is grounded establishing an energizing circuit for the interrupter relay IR of the supervisory switch SS, traced from battery through the winding of relay IR, conductors 270 and 271, normal contact 93 of the relay BG', conductor 118, normal contact 117 of the circuit controlling release key CRK, normal contact 116 of the ringing key RK to ground at alternate contact 115 of the key CSK. The relay IR upon energization closes its alternate contact 272 establishing an energizing circuit for the slow-acting relay SL', and the rotary relay RR' of the supervisory switch SS, the circuit of relay SL' being traced from battery through the winding of relay SL', conductor 273, alternate contact 272 of the relay IR, conductor 275 to ground at normal contact 276 of the release control relay RY, and the circuit of rotary relay RR' being traced from battery through the winding of the relay RR', conductor 273 to ground at normal contact 276 of the relay RY. The operator having actuated her key CSK to close alternate contact 115 immediately restores it to its normal position, and upon the first restoration of the key CSK its alternate contact 115 is returned to normal to interrupt the energizing circuit of the relay IR of the switch SS and the opening of its alternate contact 272 of relay IR opens the energizing circuit of rotary relay RR' and the slow-acting relay SL'. Relay RR' de-energizes, but relay SL', due to its slow to release construction, holds its alternate contact 277 momentarily closed to establish an energizing circuit for the rotary magnet RM^s of the supervising switch SS, traced from battery through the winding of the magnet RM^s, conductor 278, normal contact 279, of the relay RR' to ground at the momentarily closed alternate contact

277 of the relay SL'. Rotary magnet RM³ upon energization steps the wipers 281, 282, 283 and 284 of the supervising switch SS into engagement with the first set of contacts 285, 286, 287 and 288, which lead to the first connecting circuit CC which comprises finder switch FS and connector switch CS, which were used in establishing the connection between the calling subscriber at the substation A and the called subscriber at the substation B, as before described.

Assuming that the called subscriber at the substation B to which the calling subscriber at the substation A has been connected by the operator through the medium of switches FS and CS and the operator's answering equipment as before described in detail, has not as yet answered, the instant the wipers 281, 282, 283 and 284 engage the contacts 285, 286, 287 and 288, which lead to the connecting circuit just described, an energizing circuit is established for the tone control relay TO associated with the supervising switch SS, traced from battery through the winding of the relay TO, conductor 289, wiper 282, contact 286, conductor 290 to ground at alternate contact 247 of the off-normal contacts ON' of the conductor switch CS whose wipers 159, 160 and 161 are in engagement with the contacts 162, 163 and 164 that lead to the called subscriber's substation B who has not as yet answered.

Relay TO upon energization closes its alternate contact 291 closing an energizing circuit for the tone connecting relay TRE traced from battery through the winding of the relay TRE, conductor 292, alternate contact 291 of the relay TO to ground at alternate contact 293 of the off-normal contacts ON³ which contacts have assumed their alternate position upon the first step of the switch wipers of the supervising switch SS off normal. The relay TRE upon energization opens its normal contacts 294 and 295 to disconnect the special tone T. The operator's set O is connected to conductors 271 and 443 through alternate contacts 294 and 295 of relay TRE through wipers 283 and 284, contacts 287 and 288 and over conductors 311 and 330 to conductors 331' and 331 of the connector switch CS which now places the operator in direct connection with the calling and called lines. The operator not receiving any tone indicates to her that the finder switch FS and the connector switch CS are in use, and due to the fact that the operator's set O is connected to the connecting cord conductors, she may now challenge the connection, and assuming that the calling subscriber at the substation A has not as yet received a response from the called subscriber at the substation B, the subscriber at the substation A in response to the challenge of the oper-

ator, tells the operator that the called party has not as yet answered. This being the case, the operator now actuates the ringing key RK of her supervising control circuit OE, and the closing of alternate contact 99 of the actuated ringing key RK connects ground from alternate contact 99 of the key RK through normal contact 98 of the key CRK, conductor 97, normal contact 94 of the relay BG' of the answering switch AS, conductor 443, through the winding of the relay RY of supervising switch SS, to battery. The relay RY upon energization closes its alternate contact 296, establishing an energization circuit from ground at normal contact 297, of the relay IR, conductor 298, alternate contact 296 of the relay RY, conductor 299, through alternate contact 300, of relay TRE, conductor 301, wiper 281, contact 285, conductors 302 and 147, alternate contact 148 of the relay RCO, of the connector switch CS, conductor 215 to battery through the winding of relay RCC of the conductor switch CS, and as the ringing frequency selection circuit FR has been set up as before described, the relay RCC in energizing over this circuit again connects ringing generator G² through alternate contact 217 of the relay RFS², conductor 218, normal contact 219 of relay RFS³, conductor 220, through alternate contact 216 of the relay RCC, over the previously described ringing path which passes through the called bell at the called substation B and back to ground at alternate contact 221 of the relay RCC. Each time the operator actuates the ringing key RK of her supervising equipment OE, relay RY of the supervising switch SS is energized to bring about the actuation of the relay RCC of the connector switch CS to bring about the application of ringing current to the called subscriber's line. After the called subscriber at the substation B has answered, and the operator listening in is aware of the fact that the subscribers are now in conversational circuit, the operator now restores the ringing key RK which returns contact 99 to normal to open the energizing circuit of the relay RY. The operator having supervised the first connecting circuit now actuates her stepping key CSK again to close alternate contact 115 to again establish an energizing circuit for the relay IR to again bring about the energization of the relay RR', and the slow-acting relay SL', and the key upon restoration again opens the energizing circuits of the relays IR and RR' to again operate the rotary magnet RM³ of the supervisory switch which magnet steps the wipers 281, 282, 283 and 284 into engagement with the second set of contacts 285, 286, 287 and 288 which lead to the second connecting circuit.

Assuming that the calling subscriber at

the substation A and the called subscriber at the substation B have carried on a conversation and have replaced their receivers upon their respective switchhooks, but have not actuated their hand generators to transmit disconnect current to the relays 240 and 265, the two relays remain at normal, due to the fact that they have not received disconnect current, and therefore no release circuit is established for either the finder switch FS or the connector switch CS, and the switches will thus remain in their advanced position.

Assuming that the finder switch FS and the connector switch CS are in this condition, and that the operator has actuated her key CSK to step the wipers 281, 282, 283 and 284 of the supervising switch SS into engagement with the first set of contacts 285, 286, 287 and 288 which lead to the connecting circuit CC, comprising the switches FS and CS that were used in establishing the connection between the calling subscriber at the substation A and the called subscriber at the substation B, the operator not receiving a tone as previously described, challenges the connection, and receiving no response is aware of the fact that conversation between the calling subscriber at the substation A and the called subscriber at the substation B has terminated, but that they have failed to release the switches FS and CS. This being the case, the operator now actuates the connecting circuit release key CRK of the supervising equipment OE, and the closing of alternate contact 117 of the relay CRK connects ground from said alternate contact 117, over conductor 118, through normal contact 93 of the relay BG' of the answering switch AS, over conductors 271 and 270 to battery through the winding of the relay IR. The closing of alternate contact 98 of the key CRK connects ground over conductor 97, through normal contact 94 of the relay BG', conductor 443 to battery through the winding of the relay RY, and the relays IR and RY are energized; the closing of alternate contact 297 of relay IR and alternate contact 305 of relay RY establishes an energizing circuit for the connecting circuit release relay CCR, traced from battery through the winding of the relay CCR, alternate contact 305 of relay RY, the conductor 306 to ground at alternate contact 297 of the relay IR. The relay CCR upon energization closes its alternate contact 307, establishing an energizing circuit for the connector switch release relay 265, traced from battery to alternate contact 307 of the relay CCR, conductor 310, conductor 271, alternate contact 294 of relay TRE, wiper 283, contact 287, conductor 311, conductor 312, through the winding 313 of the repeating coil RC to ground through the winding of the con-

connector switch release relay 265. The relay 265 upon energization closes its alternate contact 266, and the closing of alternate contact 266 closes the release circuit of the finder switch FS and the connector switch CS, and the switches are released in a manner as previously described.

Assuming that the calling and called subscriber at substations A and B have finished conversation and have replaced their receivers upon their respective switchhooks, and have actuated the hand generators to transmit disconnect current to restore the finder switch FS and connector switch CS, and, assuming further that the operator actuates her stepping key CSK to step the wipers 281, etc., into engagement with the first set of contacts 285, etc., which lead to the connecting circuit that was used by the calling and called subscribers, and having assumed that the switches have been restored, now when the wiper 282 engages contact 286 the said contact will be free from ground due to the fact that the connector switch CS has restored, and therefore, alternate contact 247 of the off-normal contacts ON' of the connector switch CS are open as the off-normal contacts ON' have assumed their normal position when the said switch CS restores, and therefore, no energizing circuit is established for the relay TO of the supervising switch SS. Relay TO remaining normal, its alternate contact 291 remains open, and therefore, relay TRE remains at normal. The tone T is therefore connected through normal contacts 294 and 295 to conductors 271 and 443 to transmit a tone to the operator, notifying her that the connecting circuit is free, and she immediately steps the switch SS into engagement with the next set of contacts.

If the supervisory switch wipers 281, etc., are left in engagement with the contacts 285, etc., which lead to the connecting circuit that comprises the switches FS and CS, and the subscriber at the calling substation A initiates a call, the finder switch FS will select the calling line. The instant the selecting operation of the switch FS has been completed, the answering switch AS will start its selecting operation, as previously described, to select the finder switch FS. When the switch AS has performed its selecting operation the operator answers the call, and the instant the operator starts to dial, the relay TI will energize as before described, and the closing of its alternate contact 142 will establish an energizing circuit for the release relay RR³ of the supervising switch SS, traced from battery, through the winding of relay RR³, conductor 340, normal contact 341 of relay RY, conductor 342, normal contact 300 of relay TRE, conductor 301, wiper 281, contact 285,

conductor 302, conductor 147, contact 65 and wiper 61 of the answering switch AS, conductor 145, normal contact 144 of relay SE, conductor 143 to ground at alternate contact 142 of relay TI. Relay RR³ energizing closes its alternate contact 344, establishing a locking circuit for itself to ground at alternate contact 345 of off-normal contacts ON³, and the closing of alternate contact 346 closes a circuit for release magnet RE³ from ground through alternate contact 346 to battery, through the winding of magnet RE³; magnet RE³ energizing causes the withdrawal of the retaining pawl of the switch SS and permits the wipers 281, etc., to restore, and the restoration of off-normal contacts ON³ and the opening of alternate contact 345 of off-normal contacts ON³ opens the circuit of relay RR³, which relay in turn opens the circuit of magnet RE³.

Should the wipers 281, etc., of the supervising switch SS be in engagement with a set of contacts 285, etc., which lead to a connecting circuit that is in use, or has been in use, and is not as yet released, the relays TRE and TO will be energized as before described, and should the subscriber at substation A initiate a call, the finder switch FS will select the calling line, as before described, and bring about the operation of the relay AN of the finder switch FS. The closure of alternate contact 50 of relay AN will establish an energizing circuit for the release relay RR³ of the supervising switch SS, traced from battery through relay RR³, conductor 340, normal contact 341, conductor 342, alternate contact 57 of relay TRE, conductor 59 to ground at alternate contact 50 of relay AN of the finder switch FS. Relay RR³ of switch SS will energize to close a circuit for release magnet RE³ to release the switch SS, as previously described. Relays TO and TRE will de-energize, and the closing of normal contact 57 of relay TRE will connect ground from alternate contact 50 of relay AN of the finder switch FS over conductor 56 to battery through the rotary magnet RM' of the answering switch AS to start the operation of the switch AS to select the finder switch FS and connect the operator to the calling line.

From the foregoing description it may be seen that the supervising switch SS will always be restored when in an off-normal position and a call is initiated, so that in case the switch SS is engaging a busy connection, the instant a call is initiated on one of the lines of the group with which the supervising switch is associated, the switch is immediately restored to open the circuit of relay TRE to permit the normal contact 57 to close, so as to close the initial energizing circuit for the rotary magnet RM' of the answering switch AS, so as to permit the switch AS to instantly connect the oper-

ator's set to the calling line. If this were not the case, should the operator be supervising connections when a call is initiated, the same would be delayed until such time as the operator would restore the supervising switch SS to normal to allow the relay TRE of the switch SS to restore so that the answering switch AS could operate to connect the operator to the calling line.

The operator in supervising the connecting circuit steps the wipers 281, etc., of the switch SS from one set of contacts 285, etc., to the next, and having assumed that there are seven connecting circuits when the operator steps the wipers into engagement with the last connecting circuit, an eighth step of the switch wipers will place the switch wiper 281 into engagement with the last contact which is ground, and this ground will establish an energizing circuit of the release relay RR³ of the switch SS, and the release relay RR³ in turn operates the release magnet RE³ to release the switch SS, as before described.

Assuming now that the calling subscriber at the substation A initiates a call, the finder switch FS will be actuated to step its wipers into engagement with the contacts of the calling line followed immediately by the operation of the answering switch AS to step its wipers into engagement with the contacts leading to the actuated finder switch FS and to signal the operator that a call is awaiting her attention, all of which has already been described. The operator having connected her set O to the connecting circuit now inquires the wants of the calling subscriber at substation A. Assuming that the subscriber at substation A wishes to converse with a party on his own line, the operator requests the calling subscriber to replace his receiver. The operator now actuates the calling switch release key CSW of her operator's answering equipment OA, and the closing of alternate contact 112 of the key CSW establishes an energizing circuit for the relay TI of the answering switch AS, traced from battery 210 at alternate contact 112 of key CSW, conductor 113, normal contacts 114, 115, 116 and 117 of the keys LK, CSK, RK and CRK of the operator's supervisory equipment OE, conductor 118, alternate contact 93 of relay BG' of the answering switch AS, conductors 119 and 120 to round through the winding of relay TI. The closing of alternate contact 103 of the key CSW establishes an energizing circuit for relay SE of the answering switch AS traced from ground at alternate contact 103, conductor 102, normal contacts 101, 100, 99 and 98 of key LK, CSK, RK and CRK, conductor 97, alternate contact 94 of relay BG', conductors 96 and 95 to battery through the winding of relay SE. Relays TI and SE of the

answering switch AS now operate and establish an energizing circuit for the connector switch release relay 265 of the connecting circuit CC, traced from battery 210 at alternate contact 112 of the key CSW, conductor 113, normal contacts 114, 115, 116 and 117, conductor 118, alternate contact 93 of relay BG' of answering switch AS, conductor 119, conductor 360, alternate contact 361 of relay TI, conductor 362, alternate contact 363 of relay SE, conductor 364, normal contact 124 of relay 125, conductor 126, wiper 62, contact 66, conductor 127, conductor 312, through the winding 313 of the repeating coil RC to ground through the winding of relay 265. Relay 265 upon energization closes its alternate contact 266, establishing an energizing circuit for the relay REC of the finder switch FS, traced from battery through its lower winding, conductor 243 to ground at alternate contact 266 of relay 265. Relay REC upon energization opens its normal contact 43 to open the energizing circuit of relay BG, and the relay BG restoring, its normal contact 21 is closed to establish an energizing circuit for the release magnet RE; which magnet upon energization withdraws the retaining pawl and permits the finder switch wipers 11, 12, 13 and 14 to restore to normal; off-normal contacts ON are also restored to open the circuit of relay SW. When the operator restores key CSW relay 265 will restore, as will relays TI and SE of the answering switch AS, and the restoration of relay 265 will permit the de-energization of relay REC and the finder switch thus restored. The operator now actuates her dialing key DK and operates her calling device CD to send the required number of impulses to actuate the connector switch CS to step its wipers 159, 160 and 161 into engagement with the contacts 162, 163 and 164 of the wanted line. The operator also dials for the proper ring generator frequency and rings the called-for subscriber by actuating her ringing key RK', and the operation of the switch CS and frequency selector circuit FR is the same as previously described, as is also the release of the answering switch AS when the operator has finished dialing and the release of the connector switch is the same after conversation has terminated and the subscribers have transmitted a disconnect signal is also the same as previously described.

The circuits thus far have been described in connection with party line harmonic ringing, but with a single line where the subscriber is equipped with straight line ringing and is the called party he may be connected to in the way as described in detail, and to signal the party on the line, the operator will actuate her calling device CD to dial the first frequency and then actuate her ring-

ing key to signal the subscriber in the way already described in detail.

The subscriber at the substation A may initiate a call as before described, and the operation of the apparatus is the same as previously described so as to connect the operator's set O at the centralized control board at the main exchange with the calling line. Now should the calling subscriber just desire information only, the operator gives this information and then operates the calling switch release key CSW to bring about the restoration of the finder switch FS, and the restoration of the listening key LK' brings about the restoration of the answering switch AS, all of which was described in detail, and a further description is not thought necessary.

Assuming now that a subscriber at the substation A wishes to make a toll call, he proceeds to initiate the call in the regular way, as before described, to signal the operator at the centralized control board at the main exchange, and gives the operator the number of the party wanted. The operator at the main exchange requests the subscriber to replace his receiver and establishes the connection with the called subscriber in the usual way, and then inserts a calling plug into the trunk jack TJ. This insertion of the plug into the trunk jack TJ establishes an energizing circuit for the cut-off relay CO². The cut-off relay CO² upon energization closes its alternate contact 380 establishing an energizing circuit for the impulse relay IM of the trunk selector switch TCS, traced from battery through the winding of the relay IM, conductor 381, through windings 382 and 383 of the alternate current relay ALR, through the windings *c* and *d* of repeating coil RC', windings *e* and *f* of repeating coil RC², conductor 384, alternate contact 380 of the relay CO², conductor 385 to the normal contact 386 of the dialing key DK', through the winding of the relay 387 to ground. The opening of normal contact 388 of relay 387 prevents the premature lighting of the disconnect lamp DL. The relay IM upon energization closes its alternate contact 389 establishing an energizing circuit for the relay SL² and the relay RR², traced from ground at alternate contact 389, conductor 390 to battery through the windings of the relays SL² and relay RR². The relay SL² upon energization closes its alternate contact 391, establishing an energizing circuit for the relay 392 traced from battery through the upper winding of the relay 392, conductor 393 to ground at alternate contact 391 of relay SL². The operator at the centralized control board at the main exchange now actuates the dialing key DK', and assuming that the call number of the calling subscriber A at the exchange M who initiated the toll call is 15, the operator ac-

tuates the calling device CD' to send a series of ten impulses, and five impulses to step the wipers 395, 396 and 397 of the toll connector switch TCS into engagement with the contacts of the calling line A. The initial energizing circuit of the relay IM is opened at normal contact 386 when the dialing key DK' is actuated, but the closing of alternate contact 398 of the dialing key DK' establishes a substitute circuit for the relay IM traced from ground through the impulse spring contacts 399 and 400 of the calling device CD', alternate contact 398, conductor 385, alternate contact 380 of relay CO² to battery through the winding of the relay IM over the previously described path. The operator actuates the calling device CD' to now send the ten impulses to cause ten interruptions of the impulse spring contacts 399 and 400 of the calling device CD', and upon the first interruption of the springs 399 and 400, the energizing circuit of the relay IM is opened, and the relay IM restores, and the opening of its alternate contact 389 opens the energizing circuit of the relays SL² and the relay RR². Due to the following interruptions of the impulse springs of the calling device CD', the relay IM is thus de-energized and energized ten times to cause the contact 389 of the relay IM to be opened and closed ten times which interrupts the circuit of the relay SL² and relay RR² ten times. The relay RR² energizing and de-energizing ten times, its normal contact 401 is opened and closed ten times, but due to the slow release construction of the relay SL², the relay SL² remains energized during the rapid interruptions of the alternate contact 389 of the relay IM. Upon the first de-energization of the relay RR², an energizing circuit is established for the rotary magnet RM⁴, traced from battery through the winding of the relay RM⁴, conductor 402, normal contact 403 of the release relay REL⁴, conductor 404, normal contact 405, of the connector test relay CTR', conductor 406, alternate contact 407 of the relay SL² to ground at normal contact 401 of the relay RR². An energizing circuit is also established for the relay 408, from said ground at normal contact 401 of relay RR² through alternate contact 407 of relay SL², conductor 409, to battery, through the winding of relay 408. The rotary magnet RM⁴ is thus energized and de-energized ten times to step the wipers 395, 396 and 397 into engagement with the tenth set of contacts which are blank. Upon the first step of the wipers 395, 396 and 397 off normal, the off-normal contacts ON⁴ assume their alternate position, and the closing of alternate contact 410 of off-normal contacts ON⁴ establishes a locking circuit for the relay 392 traced from battery through the lower winding of the relay 392, alternate contact 411

of the relay 392, to ground at alternate contact 410 of the off-normal contacts ON⁴. The operator now sends five impulses to bring about the energization and de-energization of the rotary magnet RM⁴, as above described, to step the wipers 395, 396 and 397 into engagement with the fifteenth set of contacts 413, 414 and 415, which contacts lead to the calling line A.

Assuming that the called line is idle, an energizing circuit is established for the relay CTR' traced from battery through the winding of the relay CTR', conductor 418, normal contact 419, of the relay REL⁴, conductors 420 and 412, normal contact 421, of the relay 408, conductor 422, wipers 395, contact 413, to ground through the winding of the cut-off relay CO of the line circuit L of the calling line A. The tone connecting relay TCR' is also energized from battery through the winding of the relay TCR', normal contact 424 of relay CTR', conductors 423 and 422, wiper 395 to the grounded contact 413. The energization of the relay TCR' at this time is only incidental. The closing of alternate contact 424 of the relay CTR' establishes a locking circuit for the relay CTR' traced from battery through the winding of relay CTR', conductor 418, normal contact 419, of the release relay REL⁴, conductor 420, alternate contact 424 of the relay CTR', conductors 423 and 422, wiper 395 to the grounded contact 413.

The operator having stepped the toll connector switch TCS into engagement with the contacts of the calling line, and assuming that the line A is a party line and equipped with harmonic ringing, the operator now actuates the calling device CD' to operate the ringing frequency selection circuit FR' associated with the switch TCS to select the proper ringing generator frequency to ring the call bell at the substation A. Assuming that it is the generator G² that is to be selected, the operator actuates the calling device CD' to send two impulses of current. Upon the first interruption of the impulse springs 399 and 400, relay IM restores to normal, and the opening of its alternate contact 389 opens the energizing circuit of relays SL² and RR². Normal contact 401 is closed upon the deenergization of relay RR², but due to the slow to release construction of relay SL², its alternate contact 407 remains closed thus establishing an energizing circuit for ringing frequency selection relay RFS⁴ traced from battery through the winding of relay RFS⁴, its normal contact 441, normal contact 442 of relay RFS⁵, normal contact 444 of relay RFS⁶, normal contact 446 of relay RFS⁷, conductor 448, normal contact 449 of relay 450, conductor 451, normal contact 452 of relay RCO', conductor 454, alternate contact 405 of relay CTR', conductor 406, alternate contact 407 to ground at normal

contact 401 of relay RR². Relay 450 is also energized by this impulse to open its normal contact 449 for purposes as previously described in connection with relay 180 of the connector switch CS. Relay RFS⁴ upon energization closes its alternate contact 447 establishing a locking circuit for itself traced from battery through its winding, its alternate contact 447, normal contacts 455, 456 and 457 of relays RFS⁵, RFS⁶ and RFS⁷, conductor 458 to ground at alternate contact 459 of relay CTR'. The second de-energization of relay RR² establishes an energizing circuit for relay RFS⁵ from battery through the winding of relay RFS⁵ to ground at normal contact 401 of relay RR² over the previously described path. Relay RFS⁵ upon energization closes its alternate contact 455, establishing a locking circuit for itself traced from battery through its winding, its alternate contact 455, to ground at alternate contact 459 of relay CTR'. The opening of normal contact 455 of relay RFS⁵ opens the locking circuit of relay RFS⁴, and said relay restores. After the last impulse is sent, relay 408 restores and the closing of alternate contact 460 of relay RFS⁵ establishes an energizing circuit for relay RCO' traced from battery through the upper winding of relay RCO' conductor 461, alternate contact 460 of relay RFS⁵, conductor 462 to ground at normal contact 463 of relay 408. Relay RCO' upon energization closes its alternate contact 464 closing a locking circuit for itself traced from battery through its lower winding, its alternate contact 464, conductor 465 to ground at alternate contact 459 of relay CTR'. The operator at the main exchange now actuates the ringing key of the cord connected to the jack TJ to transmit generator current through the alternating current relay ALR, and the relay ALR upon energization closes its alternate contact 445 to establish an energizing circuit for the relay RCC' traced from battery through the winding of relay RCC', conductor 466, alternate contact 467 of relay RCO', conductor 468 to ground at alternate contact 445 of relay ALR. Ringing current from the generator G⁵ is now connected and may be traced from the ungrounded pole of the generator G⁵, alternate contact 469 of relay RFS⁵, normal contacts 470 and 471 of relays RFS⁵ and RFS⁷, conductor 472, alternate contact 473 of relay RCC, alternate contact 474 of relay CTR', wiper 396, contact 414, through the call bell and condenser at the substation A, back through contact 415, wiper 397, alternate contact 475 of relay CTR', to ground at alternate contact 476 of relay RCC'. Each time the operator at the main exchange wishes to signal the subscriber at A, she actuates her key to energize relay ALR which in turn energizes relay RCC' to connect ringing current to the called line.

The calling subscriber at the substation A of the exchange M in response to the call signal removes his receiver from the switchhook, thus placing the subscriber A in conversational circuit with the called subscriber at the main exchange, the talking circuit being traced over the heavily marked conductors. The subscriber at the called substation at the main exchange and the calling subscriber at the exchange M having finished conversation, replace their receivers upon the respective switchhooks. The replacing of the receiver at the called substation at the distant exchange lights suitable supervisory signals to indicate to the main exchange operator that conversation has terminated. The subscriber at the exchange M having replaced his receiver actuates his hand generator transmitting current therefrom through alternate contacts 474 and 473 of relays CTR' and RCC' through the winding of the relay 480, back to alternate contacts 476 and 475 of the relays RCC' and CTR', back to the hand generator. Relay 480 upon energization closes its alternate contact 481 connecting ground to the winding of the relay IM to maintain relay IM energized. The ground at alternate contact 481 also passes through windings 383 and 384 of relay ALR to the winding of relay 387 which is also connected to ground. This ground to ground connection shunts relay 387 and causes the said relay to restore, and the closing of its normal contact 388 lights the disconnect lamp DL over a circuit traced from battery through the lamp DL, normal contact 388, conductor 487 to ground at alternate contact 488 of relay CO². The lamp DL which is located at the centralized control board at the main exchange is now lighted and indicates to the operator that the calling subscriber at exchange M has replaced his receiver, and she now withdraws the plug from the trunk jack TJ permitting the relay CO² to restore. The relay IM also restores and the opening of its alternate contact 389 opens the energizing circuits of relays SL² and RR². The closing of normal contact 391 of relay SL² upon de-energization, establishes an energizing circuit for the release relay REL⁴, traced from battery through the winding of the relay REL⁴, conductor 482, alternate contact 483 of relay 392, conductor 484 to ground at normal contact 391 of the relay SL². Relay REL⁴ upon energization closes its alternate contact 485 establishing an energizing circuit for the release magnet RE⁴ from battery through the winding of the relay RE⁴ to ground at alternate contact 485 of relay REL⁴. The release magnet RE⁴ upon energization withdraws the retaining pawl to permit the wipers 395, 396 and 397 to

restore to normal. The release relay REL⁴ upon energization opens its alternate contact 419 which opens the energizing circuit of the relay CTR' and the cut-off relay CO of the calling line circuit L, said relays restoring to normal. The relay CTR' upon restoring to normal opens its alternate contact 459 which breaks the locking circuit of relay RCO', and the relay RFS² of the ringing frequency selection circuit FR', the said relays restoring.

When the wipers assume their normal position, off-normal contacts ON⁴ will also restore to their normal position, and the opening of alternate contact 410 of the said off-normal contacts opens the locking circuit of the relay 392 which restores to normal. The apparatus that was used in establishing the connection is now at normal and available for use in establishing other toll connections.

Assuming now that the line of the calling subscriber is busy, when the operator attempts to extend the connection thereto, the operation of the circuit is the same up to and including the engagement of the wipers 395, 396 and 397 with the contacts 413, 414 and 415 of the calling line. The line being busy, there will be a busy potential on the bank contact 413 of the calling line, said battery also extending to ground through the cut-off relay CO. Now, when the test wiper 395 engages the private busy contact 413, relay CTR' will not energize, due to its high resistance, and due to the potential on contact 413 which does not permit sufficient current to flow through the relay CTR' to permit its energization. Relay TCR' being of low resistance will energize to connect the busy tone BT' in circuit with the operator at the main exchange, and this busy signal will notify the operator of the busy condition of the line. The circuit of relay TCR' extends from battery through the winding of relay TCR', normal contact 424 of relay CTR' conductor 423, wiper 395, contact 413, to ground through the cut-off relay CO of the line circuit L of the calling line. The operator receiving the busy signal withdraws the plug from the trunk jack TJ, which withdrawal opens the circuit of the cut off relay CO², and the relay CO² upon de-energization opens its alternate contact 380 opening the energizing circuit of the relay IM and the relay IM upon deenergization opens its alternate contact 389 to open the energizing circuits of the relays SL² and RR², and the closing of normal contact 391 establishes an energizing circuit for the relay REL⁴, and the restoration of the switch wipers and its associated apparatus is the same as previously described.

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 to limit ourselves to

the precise structures shown and described, but what we do claim is:

1. In a telephone system including telephone lines terminating at an auxiliary exchange, a group of non-numerical rotary finder switches multiply associated with said lines, any one of them adapted to seize said lines as calling lines, a main exchange supervisory means under the control of the operator at the main exchange for supervising connections between calling and called lines at said auxiliary exchange and operator's answering equipment located at a centralized operator's position at said main exchange, an answering switch common to said finder switches for seizing a finder switch of the group that selected one of said lines as a calling line to connect said line with said answering equipment at said main exchange and connector switches at said first exchange paired with said finder switches to form connecting circuits between calling and called lines.

2. In a telephone system including telephone lines terminating at an auxiliary exchange, a group of non-numerical finder switches multiply connected with said lines, an answering switch common to said finder switches, a main exchange, an operator's answering equipment located at said main exchange, supervisory means at said auxiliary exchange controlled by the operator at said main exchange for supervising connections, means controlled by said telephone lines to initiate travel of one of said finder switches to select a line that is calling, means operative upon the seizure of said calling line by said finder switch to initiate travel of said answering switch to connect said operator's answering equipment at said main exchange with said calling line and connector switches at said first exchange paired with said finder switches to form connecting circuits between calling and called lines at said first exchange.

3. In a telephone system comprising telephone lines terminating at an auxiliary exchange, finder switches multiply associated with said lines as calling lines, connector switches associated with said lines as called lines, an answering switch common to said finder switches, a main exchange, an operator's answering equipment at a centralized operator's position at said main exchange, supervisory means at said auxiliary exchange controlled by the operator at said main exchange for supervising connections, means controlled by said lines as calling lines to cause the travel of one of said finder switches when one of said lines initiates a call, starting means controlled by said finder switch for initiating the travel of said answering switch to connect said operator's answering equipment at said main exchange with said calling line, and means controlled

by said operator to actuate said one of said connector switches to select one of said lines as a called line, said connector switches paired with said finder switches to form
5 connecting circuits between calling and called lines at said first exchange.

4. In a telephone system including subscribers' lines terminating at an auxiliary exchange, finder switches at said exchange
10 for seizing said lines as calling lines, a main exchange, an operator's answering equipment terminating at said main exchange, supervisory means at said auxiliary exchange under the control of the operator at
15 the said main exchange for supervising connections, an answering switch at said first exchange common to said finder switches, starting means controlled by said finder switches for starting said answering switch
20 after one of said finder switches has seized a line as a calling line to connect said operator's answering equipment with said calling line, and connector switches located at said first exchange and under the control of the
25 operator at said main exchange for extending the connection from said calling line at said first exchange to a called line in the same exchange, said connector switches paired with said finder switches to form
30 connecting circuits between calling and called lines at said first exchange.

5. In a telephone system including telephones terminating at an exchange, finder switches at said exchange to which said lines
35 are multiply connected and which are adapted to select said lines as calling lines, an answering switch common to said finder switches, operator's answering equipment located at a central exchange, connecting
40 means including said answering switch and a finder switch for extending said operator's answering equipment at said central exchange to one of said lines as a calling line, connectors at said first exchange, means under
45 the control of said operator at said central exchange to extend a connection to one of said lines as a called line through the medium of one of said connector switches at said first exchange, and supervisory means
50 under the control of the operator at the main exchange for supervising connections between calling and called lines at said first exchange.

6. In a telephone system including telephone lines terminating at an exchange, a
55 group of finder switches at said exchange common to said lines as calling lines, a group of connector switches at said exchange common to said lines as called lines, connecting
60 circuits for conductively uniting said lines as calling and called lines including a finder switch and a connector switch, an answering switch at said exchange common to said finder switches, a central exchange, operator's answering equipment located at said

central exchange, means under the control of said lines as calling lines for connecting said operator's answering equipment with said calling lines through the medium of said answering switch and one of said
70 finder switches, operator-controlled means at said central exchange for extending a connection to one of said lines at said first exchange including a connector switch paired with said finder switch connected to said
75 calling lines to form one of said connecting circuits for conversational purposes and supervisory means under the control of the operator at the main exchange for supervising connections between calling and called
80 lines at said first exchange.

7. In a telephone system, including telephone lines terminating at an exchange, finder switches and connector switches for interconnecting said lines terminating at said
85 exchange, an answering switch at said exchange common to said finder switches, a central exchange, operator's answering equipment at said central exchange connected to said lines as calling lines through the
90 medium of said answering switch, and one of said finder switches, operator-controlled means at said main exchange for extending a call from one of said lines in said first exchange to another one of said lines in
95 said first exchange including a connector of said first exchange, said finder switch and connector switch forming a connecting circuit between said calling and called lines, means in said operator's equipment for releasing
100 said answering switch in said first exchange from said connecting circuit and supervisory means under the control of the operator at the main exchange for supervising connections between calling and called
105 lines at said first exchange.

8. In a telephone system including telephone lines terminating at an exchange, finder switches and connector switches connected in
110 pairs to form connecting circuit for interconnecting said lines as calling and called lines, an answering switch at said exchange common to said finder switches, a central exchange, operator's answering equipment at
115 said central office, means including one of said finder switches and said answering switch for extending said operator's equipment at said central exchange to a calling line at said first exchange, means under the control of
120 said operator for operating a connector switch paired with said finder switch connected to said calling line for extending the connection to a line as a called line in said first exchange, release means under the control
125 of said operator for releasing said answering switch from said connecting circuit and a supervisory switch at said first exchange under the control of said operator for engaging said connecting circuits for supervisory purposes.
130

9. In a telephone system including telephone lines terminating at an auxiliary exchange, finder switches at said exchange for seizing said lines as calling lines, an answering switch at said exchange common to said finder switches associated with said lines, starting means controlled by said finder switch that seized a line as a calling line for starting said answering switch, operator's answering equipment terminating at a main exchange, said answering switch extending said answering equipment to said calling line at said auxiliary exchange, a group of connector switches at said auxiliary exchange associated with said finder switches to form connecting circuits between calling and called lines at said auxiliary exchange, said connector switches being under the control of said operator's answering equipment to extend calls to lines in said auxiliary exchange, and supervisory means under the control of the operator at the main exchange for supervising connections between calling and called lines at said auxiliary exchange.

10. In a telephone system including telephone lines terminating at an auxiliary exchange, finder switches at said exchange for seizing said lines as calling lines, an answering switch at said auxiliary exchange common to said finder switches associated with said lines, operator's answering equipment at a main exchange, starting means closed by the finder switch that seized a calling line to start said auxiliary switch to extend said operator's answering equipment at said main exchange to said calling line at said auxiliary exchange, connector switches at said first exchange associated with said finder switches to form connecting circuits between calling and called lines at said auxiliary exchange, control means at said operator's equipment at said main exchange for operating said conductor switches to extend a connection to a called line in said auxiliary exchange, and supervisory means at said auxiliary exchange controlled by the operator at said main exchange for supervising connections.

11. In a telephone system including telephone lines terminating at an auxiliary exchange, finder switches at said auxiliary exchange for seizing said lines as calling lines, an answering switch at said auxiliary exchange common to said finder switches associated with said lines, operator's answering equipment at a main exchange, starting means closed by one of said finder switches that seized a line at said auxiliary exchange upon the initiation of a call to start said answering switch to extend said operator's answering equipment at said main exchange to said calling line, connector switches at said auxiliary exchange associated with said finder switches to form connecting circuits between calling and called lines at said

auxiliary exchange, control means at said operator's equipment at said main exchange for operating said connector switches for extending a connection to a called line at said auxiliary exchange and supervisory means at said auxiliary exchange controlled by the operator at said main exchange for supervisory connections.

12. In a telephone system comprising telephone lines terminating at an auxiliary exchange, finder switches at said exchange for seizing said lines as calling lines, an answering switch at said exchange common to said finder switches to which said lines are multiply connected, operator's answering equipment at a main exchange, means controlled by said finder switches for starting said answering switch when any of said switches seizes a line at said auxiliary exchange to extend said line to said main exchange in connection with said operator's answering equipment, and switching means at said auxiliary exchange controlled by the operator at said main exchange to extend a call from said main exchange to a line in said auxiliary exchange and supervisory means at said auxiliary exchange controlled by the operator at said main exchange for supervisory connections.

13. In a telephone system comprising telephone lines terminating at an auxiliary exchange, a plurality of finder switches, any one of which is adapted to seize said lines as calling lines, an operator's answering equipment at a main exchange, an answering switch for said auxiliary exchange common to said finder switches for extending said operator's equipment to a calling line at said auxiliary exchange, connector switches at said auxiliary exchange associated with said line finders to form connecting circuits between calling and called lines at said auxiliary exchange, means at said operator's equipment for operating said connector switches to extend connections to called lines in said auxiliary exchange, means under the control of the operator at said main exchange for causing the release of said answering switch at said auxiliary exchange after a call has been extended to a called line and supervisory means at said auxiliary exchange controlled by the operator at said main exchange for supervising connections.

14. In a telephone system comprising telephone lines terminating at an auxiliary exchange, a plurality of finder switches, any one of which is adapted to seize said lines as calling lines, an operator's answering equipment at a main exchange, an answering switch at said auxiliary exchange common to said finder switches for extending said operator's equipment to a calling line at said auxiliary exchange, connector switches at said auxiliary exchange associ-

ated with said line finders to form connecting circuits between calling and called lines at said auxiliary exchange, means at said operator's equipment for operating said connector switches to extend connections to called lines in said auxiliary exchange, means under the control of the operator at said main exchange for causing the releasing of said answering switch at said auxiliary exchange after extending a call to a called line, and supervisory means at said auxiliary exchange controlled by the operator at said main exchange for supervising connections.

15. In a telephone system including telephone lines terminating at an auxiliary exchange, finder switches and connector switches connected in pairs to form connecting circuits for interconnecting said lines as calling and called lines, an answering switch at said auxiliary exchange common to said finder switches, a central exchange, operator's answering equipment at said central office, means including one of said finder switches and said answering switch for ex-

tending said operator's equipment to a calling line at said auxiliary exchange, control means at said operator's equipment for causing a connector switch paired with a line finder switch connected to said calling line to extend said connection to a line as a called line in said auxiliary exchange, release means under the control of said operator for releasing said answering switch from said connecting circuit, supervisory means at said auxiliary exchange under the control of said operator for engaging said connecting circuits for supervisory purposes, and means for releasing said supervisory means upon the initiation of a call should said supervisory means engage a connecting circuit that is being used for extending a connection from a calling to a called line in said auxiliary exchange.

Signed by us in the city of Chicago, county of Cook and State of Illinois, this 14th day of September, 1922.

HIRAM D. CURRIER.
GEORGE R. EATON.