June 10, 1930. C. D. KOECHLING ET AL 1,763,161

TELEPHONE SYSTEM

Filed Nov. 1, 1928

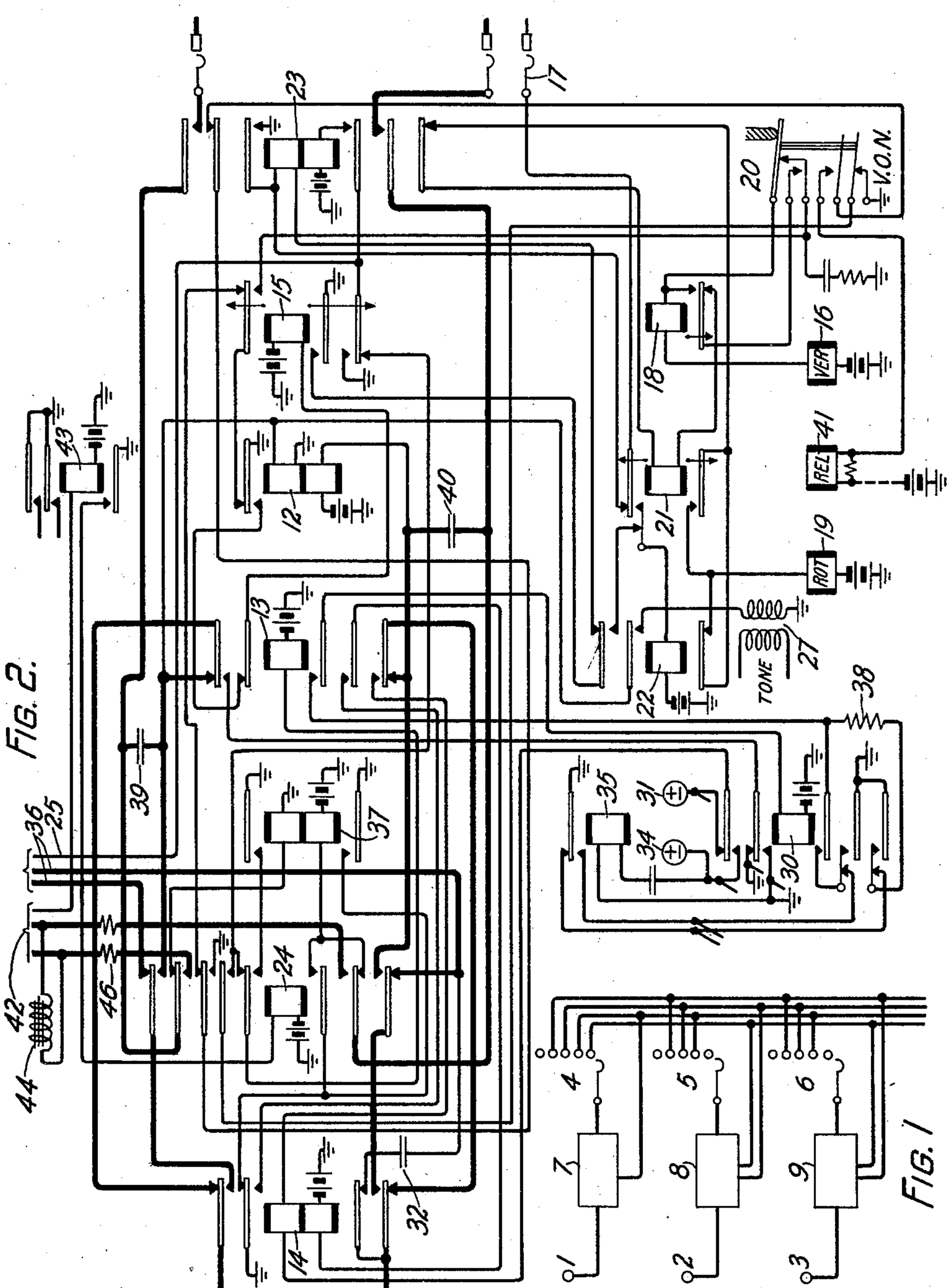

FIG. 2.

FIG. 1

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Patented June 10, 1930 1,763,161

UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Application filed November 1, 1928. Serial No. 316,433.

This invention relates to telephone systems, and particularly to automatic private branch exchange systems.

The object of this invention is to economically arrange a system of this type for conference call connections.

Heretofore systems have been used in which conference call connections were established by having the subscriber dial a certain number, thereby causing his line to be automatically connected through line finders and selective switches with all of the other subscribers' lines arranged for conference connection. A system of this general type is disclosed in the Patent 1,264,158 of April 30, 1918, to H. P. Clausen. In that system ringing current and talking current are supplied by means individual to the line circuits of the called lines.

According to a feature of this invention, each subscriber's line terminates in an automatic selective switch. These switches are so arranged that when a conference connection is desired the calling subscriber by dialing a certain number causes his individual switch to connect his line with all of the other subscribers' lines arranged for conference connection. The ringing current and talking current are supplied to the called subscribers' lines from the circuit arrangement of the automatic switches individually associated with these called subscribers' lines and not from means individual to line circuits of the called subscribers' lines as in the prior art.

Another feature of the invention is the provision of means whereby, when a conference connection is made, any previous line-to-line connections to any of the called subscribers' lines included in the conference connection are disabled.

Another feature of the invention is the provision of means whereby, if a line-to-line connection is established, ringing current is applied to the called subscriber's line from the automatic switch associated with said called subscriber's line, while talking current is supplied to the connection from the switch individual to the calling subscriber's line.

Another feature of the invention is the provision of means whereby, if a line-to-line connection is established, the calling subscriber receives an audible signal when the called subscriber's bell is rung, while, if a conference connection is made, the calling subscriber does not receive any such signal.

This invention has been illustrated in the accompanying drawings in which Fig. 1 shows in diagrammatic form interconnections between three subscribers' lines to illustrate the system in a general manner, and Fig. 2 shows a connector switch and associated circuits of a single subscriber's line.

Referring now to Fig. 1, 1, 2 and 3 indicate subscribers' lines, 4, 5 and 6 indicate connector switches individual to said lines and the boxes 7, 8 and 9 indicate the circuits associated with said connectors, respectively. The connectors are shown having access to terminal banks in which the first set of terminals in the bank of switch 4 is multipled and associated with the circuits 8 and 9 of switches 5 and 6 for a conference call connection, while the other sets of terminals of the banks of all three switches are multipled together, each set leading to a separate subscriber's line through the circuits associated with said subscribers' individual connector. An ordinary line-to-line call from subscriber of line 1, to, for example, the subscriber of line 3, will be established by having the subscriber of line 1 dial the number of line 3 and thereby actuate the associated connector 4 and its circuit 7 to cause a connection to be extended through the fourth set of terminals and circuit 9 to line 3. Similarly, calls from other subscribers in line-to-line calls will be extended in a similar manner. In this circuit only the line of subscriber 1 has been arranged for conference calls with subscribers 2 and 3. In case a conference connection is desired, the subscriber of line 1 will dial a special code to actuate switch 4 and circuit 7 to establish a connection with the first set of terminals which, as noted, is connected in multiple to circuits 8 and 9 and these circuits are actu-

ated to establish connections to the corresponding subscribers of lines 2 and 3.

Detail descriptions will now be made of a line-to-line call followed by a conference call in connection with the circuit shown in Fig. 2. It should be understood that this circuit is identical for the connectors of all the lines except as described in connection with Fig. 1. If the connector is that of any other line but the line 1, the first set of terminals of the banks of these connectors will be made artificially busy, that is, a ground connection will be made on the sleeve of these sets of terminals, while the first set of terminals of switch 4 which are the conference call terminals will not be connected in multiple to the connector circuit of line 1. The connector switches are of the standard Strowger step-by-step type well known in the art.

Referring now to Fig. 2 when a calling subscriber removes his receiver from the hook, a circuit is closed for the operation of relay 12 from battery, through the lower winding of this relay, lower outer armatures and back contacts of relays 13 and 14, through the subscriber's loop, upper outer armatures and back contacts of relays 14 and 13, through the upper winding of relay 12, to ground. Relay 12 in operating causes the operation of relay 15 over a circuit from battery, through the winding of this relay, upper inner armature and back contact of relay 13, upper armature and front contact of relay 12, to ground. Relay 15 in operating prepares a pulsing circuit for the vertical magnet 16 at its upper armature and front contact, establishes a ground connection through its lower inner armature and front contact for the sleeve brush 17, the purpose of which will be apparent hereinafter, and connects a busy ground to the sleeve conductor 25 to make this line busy to other subscribers.

The circuits are now in condition for the reception of dialing impulses from the calling subscriber. Relay 12 is now released and operated in accordance with the impulses and operates the vertical magnet accordingly over a circuit as follows: Battery, vertical magnet 16, winding of relay 18, through vertical off normal contacts 20, upper armature and front contact of relay 15, and upper armature and back contact of relay 12, to ground. The vertical magnet steps the brushes of this connector to the level in which the terminals of the desired line are located. Relay 18 is operated in this circuit on the first closure thereof and as this relay as well as relay 15 have slow releasing characteristics they are held up during the dialing period. On the first operation of the connector the vertical off normal contacts 20 are operated and the pulsing circuit is thereby transferred through the armature and front contact of relay 18 and operated contacts of the vertical off normal contacts 20. When the first digit impulses from the calling subscriber cease, relay 18 is released and transfers the pulsing circuit through its armature and back contact to the rotary magnet 19. On the next digit impulses from the calling subscriber, relay 12 in releasing for the first time causes the operation of the rotary magnet 19 and the relay 21 over a circuit from battery, through the winding of the rotary magnet 19, lower armature and back contact of relay 22, lower outer armature and back contact of relay 23, winding of relay 21, armature and back contact of relay 18, operated contacts of the vertical off normal contacts 20, upper armature and front contact of relay 15, and upper armature and back contact of relay 12 to ground. Relay 21 is also slow in releasing so that it will be held up during dialing. The rotary magnet 19 in following the succeeding impulses causes the brushes of the connector to be rotated in the selected level until they are connected with the terminals of the desired line. Relay 21 in operating prepares a busy test circuit for the line by the operation of its upper armature. This busy test circuit extends through the winding of relay 22 to battery. Relay 21 also extends through its lower armature and front contact, the pulsing circuit hereinbefore traced through the lower armature and back contact of relay 22. This transfer of the pulsing circuit is for the purpose of preventing it from being opened in case relay 22 should operate while the sleeve brush 17 passes over the terminals of busy lines while it is being advanced to the wanted subscriber's line.

On the completion of the dialing of the second digit, the relay 21 remains operated for a short interval after the brushes have made contact with the terminals of the desired line. During this time a busy test is made by relay 22. If the line is idle, relay 22 is not operated and on the release of relay 21 relay 23 will energize over a circuit from battery, through the winding of the relay corresponding to relay 13 of the connector of the selected line, upper inner armature and back contact of the relay corresponding to relay 24, lower armature and back contact of the relay corresponding to relay 15, to the sleeve terminal of the selective line over the lead corresponding to lead 25, brush 17, upper armature and back contact of relay 21, upper winding of relay 23, upper outer armature and back contact of relay 22, inner lower armature and front contact of relay 15, to ground. Relay 23 operates sufficiently to close a connection from battery through its lower winding and lower inner armature and front contact to ground at the lower outer armature and front contact of relay 15. Relay 23 is thereby fully actuated to

operate the remaining armatures and thereby closes a connection for the tip and ring conductors of the line and opens the circuit for the rotary magnet. The upper winding of relay 23 is now short-circuited and a direct ground connection established for sleeve brush 17 through the upper inner armature and front contact of relay 23 for the purpose of operating the relay corresponding to relay 13 in the connector of the selected line over the circuit hereinbefore traced. This ground connection also serves as a busy indication on the sleeve terminal of the selected line.

If the selected line should be busy the ground on the sleeve terminal would cause the operation of relay 22 from battery, through the winding of this relay, upper armature and front contact of relay 21, before relay is released and immediately after the last rotary impulse has been received, as hereinbefore described, through brush 17, to ground. When relay 21 releases, relay 22 is locked through the make-before-break contact of relay 21, the upper outer armature and front contact of relay 22, to ground at the inner lower armature and front contact of relay 15. Relay 22 in operating transmits a busy tone from the tone source 27 through its upper inner armature and front contact of relay 22, the upper outer armatures and back contacts of relays 13 and 14, over the tip conductor of the calling subscriber's line, to notify him that the desired line is busy.

As hereinbefore stated if the desired line is idle the relay corresponding to relay 13 of the connector of this line is operated on the operation of relay 23. This relay in operating causes the relay corresponding to relay 12 to be disconnected from the line at the upper and lower outer armatures and back contacts of this relay, prepares a circuit for the relay corresponding to relay 30, and connects ringing current from a common continuous ringing current source 31, for calling the desired subscriber. The circuit for the ringing current may be traced as follows; from source 31 through the upper outer armature and back contact of the relay corresponding to relay 30, upper winding of the relay corresponding to relay 14, outer lower armature and front contact of the relay corresponding to relay 13, lower outer armature and back contact of the relay corresponding to relay 14, to the ring conductor of the desired line, back through the tip conductor and upper outer armature and back contact of the relay corresponding to relay 14, upper outer armature and front contact of the relay corresponding to relay 13, through the inner upper armature and back contact of the relay corresponding to relay 30, to ground. A condenser corresponding to condenser 32 and circuits associated therewith are provided to permit the ringing of the desired subscriber to be heard by the calling subscriber, the circuit connection being extended from the inner lower armature of the relay corresponding to relay 14 to the ring conductor of the pair 36, the associated ring terminal and brushes and ring conductor of the calling subscriber's switch. A common machine ringing source 34 is provided which supplies intermittent ringing current to the called subscriber's line at the next silent period of ringing from this source in place of the continuous ringing from source 31. The common relay 35 is released during this period and completes a circuit for the operation of the relay corresponding to relay 30, over a circuit as follows: From battery, through the winding of this relay, inner lower armature and front contact of the relay corresponding to relay 13, resistance corresponding to resistance 38, lower make-before-break contacts of the relay corresponding to relay 30, armature and back contact of relay 35, to ground. The relay corresponding to relay 30 is thereby operated partially to close the connection through its lower inner armature and front contact so that when relay 35 is again operated, a circuit is completed for this relay from ground through the top armature and front contact of relay 35, through the inner lower make-before break contacts and lower inner armature and front contact of the relay corresponding to relay 30, to short circuit the resistance corresponding to the resistance 38 and thus cause the relay corresponding to relay 30 to complete its operation. The connection is thereby transferred from the ringing source 31 to the machine ringing source 34, through the upper armatures and front contacts of this relay and a locking circuit is provided for itself through the middle lower armature and front contact, to ground, under control of the relay corresponding to relay 13.

When the called subscriber answers, the relay corresponding to relay 14 is operated through its upper winding sufficiently to close a circuit from battery, through its lower winding, lower middle armature and front contact of the relay corresponding to relay 13, its upper inner armature and front contact to ground to fully operate it. This relay in operating breaks the ringing current connection, disconnects the condenser corresponding to condenser 32, and closes the talking circuit from the leads corresponding to leads 36, through the upper and lower outer armatures and back contacts of the relay corresponding to relay 24, and the upper and lower outer armatures and front contacts of the relay corresponding to relay 14, to the called subscriber's line. The connection is now completed to the called subscriber and talking battery is supplied to the called subscriber's line through the windings of relay 37, whereas the talking battery for the calling subscriber is supplied through the windings of

relay 12 over a circuit as hereinbefore described. The circuit for the talking battery for the called subscriber may be traced as follows: From battery, through the lower winding of relay 37, lower middle armature and back contact of relay 24, ring brush of the connector of the calling line, through the ring conductor of the pair of conductors corresponding to pair 36, lower outer armature and back contact of the relay corresponding to relay 24 of the called subscriber's connector, and the lower armature and front contact of relay 14 of this connector, through the called subscriber's loop, the upper outer armature and front contact of the relay corresponding to relay 14, the upper outer armature and back contact of the relay corresponding to relay 24, tip conductor of the pair corresponding to pair 36, tip brush of the connector of the calling subscriber, upper outer armature and front contact of relay 23, fourth upper armature and back contact of relay 24, upper winding of relay 37, to ground. Relay 37 operates in this circuit but performs no useful function at this time. The calling subscriber's line is connected through the condensers 39 and 40 to the called subscriber's line for talking purposes.

When the calling subscriber replaces the receiver on the hook at the end of the conversation, relay 12 is released, causing the release of relay 15. This relay in turn causes the release of relay 23 thereby closing the circuit for the release magnet 41 from battery, through the winding of this magnet, operated contacts of the vertical off normal contacts 20, upper middle armature and back contact of relay 23, third upper armature and back contact of relay 24, upper armatures and back contacts of relays 15 and 12, to ground. The connector is now returned to normal and on the release of the vertical off normal contacts 20 the circuit for the release magnet is opened. On the release of relay 23 the release of the relays in the connector circuit of the called subscriber's line corresponding to relays 13, 14 and 30 is effected and thus this circuit is also restored to normal condition.

When a conference connection is desired a certain code number is dialed by the calling subscriber which causes his connector to select the conference number in the same manner as any other line is selected as hereinbefore described. The conference line is multipled to all the subscriber's lines that are included in the conference connections and terminates in the connectors of said lines at the point 42. When these lines are called all relays 43 are operated over the sleeve circuit instead of the relay 13 as in an ordinary call.

Reference will now be made to the connection through one of the connectors, bearing in mind that the functions are the same for all of the connections included in the conference connection. The circuit for relay 43 through the call originating connector originates at the front contact and inner upper armature of relay 23. Relay 43 closes an obvious circuit for the operation of relay 24. Relay 24 closes a circuit for the operation of relay 37 as follows: Battery, lower winding of this relay, inner lower armature and front contact of relay 24, upper inner armature and back contact of relay 14 to ground. Relay 37 provides a locking circuit for itself from battery, lower winding of this relay, lower inner armature and front contact of relay 24, lower armature and front contact of relay 37 to maintain it operated after relay 14 is later operated as will hereinafter be described. The operation of relays 24 and 37 causes the operation of relay 13 from battery to the winding of this relay, upper inner armature and front contact of relay 24 and upper armature and front contact of relay 37, to ground. From this point on the operations of the connector is the same as for station to station calls, except that the conference line is connected to the stations from point 42 through operated contacts of the relay 24 and that the ringing of the individual subscriber in the conference connection is not heard by the calling subscriber. It should be noted that the condenser 32 is not included in the conference connection but only to the ring conductor for ordinary calls to subscribers.

The talking battery for the called lines is furnished by the relays 12 associated with the individual connectors of these lines. The circuit from the talking battery for a called line may be traced from battery, through the lower winding of relay 12, lower outer armatures and front contacts of relays 24 and 14, through the subscriber's loop, upper outer armatures and front contacts of relays 14 and 24, upper winding of relay 12 to ground. It should be noted that in this case the talking battery for the calling line is furnished as in station to station calls through the relay 12 of the connector associated with this line. It should also be observed that a retardation coil 44 is bridged across the tip and ring conductors of conference line 42. This is for the purpose of providing a path for the battery and ground connection through the windings of relay 37 and the brushes of the connector of the calling line, in order to insure a good electrical contact between these brushes and the conference line terminals. This battery and ground are not serving as a talking battery in this connection.

If a line in the conference connection group is busy in a connection in which it is a calling line, when a conference call is originated, the operation of relay 24 of the connector of this line will connect the conference line to the station and will release relay 37 and then reoperate it by a circuit closed from battery

through its lower winding to ground at the upper inner armature and back contact of relay 14. Relay 37 in operating causes the operation of relay 13 as hereinbefore described. The connector will then restore to normal as described in connection with a line to line call except that a circuit is closed for the release magnet to ground at the third upper armature and front contact of relay 24. The normal release circuit is not closed at this time as relay 12 will be operated due to the called subscriber being engaged. The connection of the conference line with this station will then function in the manner hereinbefore described in connection with an idle line, except that relay 14 will operate immediately without transmitting ringing current to the called subscriber if the receiver of this subscriber is off the hook. The operation of relay 14 takes place in the manner hereinbefore described in connection with a line to line call when the called subscriber removed his receiver from the hook. If the receiver of this subscriber is on the hook his line is called in the usual manner for line to line calls.

If a line in the conference group is busy in a connection in which it is a called line, when a conference call is originated, the operation of relay 24 of the connector of this line will release relay 13 of this connector and connect the conference line to the station. The release of relay 13 will in turn cause the release of relays 30 and 14 of this connector. The release of relay 14 causes the operation of relay 37 and this relay in turn causes the reoperation of relay 13. If the receiver of the called subscriber's station is off the hook relay 14 will immediately reoperate. If the receiver of the called subscriber is on the hook ringing current will be connected to this station in the usual manner. Resistances 46 in tip and ring conductors of the conference line 42 are provided so that in case the line of any subscriber in the conference group should be crossed or grounded the conference group arrangement will still be operative in connection with the other stations in the group.

Although this invention has only been shown in connection with one circuit arrangement it should be understood that it could readily be applied to a number of other systems without departing from the spirit of the invention and that it should only be limited by the scope of the appended claims.

What is claimed is:

1. In a telephone system, lines, an automatic selecting switch for each line, means responsive to the actuation of the switch of any one of said lines for associating said line with all of the other lines, and means associated with the switch of each of said called lines for individually applying ringing current and talking current to the corresponding called lines.

2. In a telephone system, lines, an automatic switch associated with each line, means responsive to the actuation of the switch of any one line for connecting said line to all of the other lines, means responsive to the establishing of such a connection and associated with the switches of said connected lines respectively for applying ringing current to said lines individually, and means effective on the establishment of a connection to said lines respectively and associated with the switch of these lines respectively for removing the ringing current and supplying talking current to said lines individually.

3. In a telephone system, lines, an automatic switch associated with each line, a trunk, means for selecting said trunk in response to the actuation of the automatic switch of any one line, means individual to the other lines responsive to the selection of said trunk for applying ringing current to said lines respectively, means rendered effective by the seizure of said other lines for removing said ringing current from said lines individually and for applying talking current to said lines individually and for connecting the trunk to said lines.

4. In a telephone system, lines, a connector switch for each line, means responsive to the actuation of the connector of any one of said lines for establishing a line-to-line connection, and means responsive to the actuation of the connector of any one of said lines for connecting said line to all of the other lines and for disabling any previous line-to-line connection to any of said other lines.

5. In a telephone system, lines, a connector switch for each line, means responsive to the actuation of the connector of any one of said lines for establishing a line-to-line connection, means responsive to the actuation of the connector of any one of said lines for connecting said line to all of the other lines, and means for disabling any previous line-to-line connections, the means for disabling a line in this respect, whether a calling or a called subscriber's line, being individual to the connection of the line thus disabled.

6. In a telephone system, lines, a connector switch for each line, means responsive to the actuation of the connector of any one of said lines for establishing a line-to-line connection and for establishing a conference connection between all of said lines, and means responsive to the establishing of a conference connection for disabling any previous line-to-line connections.

7. In a telephone system, lines, an automatic selecting switch for each line, means responsive to the actuation of the switch of any one of said lines for connecting said line with any other desired line, and means responsive to such a connection for applying ringing current to the called line from the switch individual to said line and for sup-

plying talking current to the connection from the switch individual to the calling line.

8. In a telephone system, lines, a connector switch for each line, means responsive to the actuation of the connector of any one of said lines for establishing a line-to-line connection and for establishing a conference connection between all of said lines, means associated with each connector operative in case of a line-to-line connection to apply talking current for the connection from the means associated with the connector of the calling subscriber's line and to apply ringing current from the means associated with the connector of the called subscriber's line and operative in case of a conference connection to apply both talking and ringing current to the called subscribers individually from the means associated with the connectors of the called subscribers' lines, respectively.

9. In a telephone system, lines, a connector switch for each line, means responsive to the actuation of the connector of any one of said lines for establishing a line-to-line connection and for establishing a conference connection between all of said lines, means associated with each connector operative in case of a line-to-line connection to apply talking current for the connection from the means associated with the connector of the calling subscriber's line and to apply ringing current from the means associated with the connector of the called subscriber's line and operative in case of a conference connection to apply both talking and ringing current to the called subscribers individually from the means associated with the connectors of the called subscribers' lines, respectively, and to apply talking current to the calling subscriber's line from the means associated with the connector individual to said calling line.

10. In a telephone system, lines, an automatic selecting switch for each line, means responsive to the actuation of the switch of any one of said lines for establishing a line-to-line connection, means responsive to the actuation of the switch of any one of said lines for establishing a conference connection to all of the other lines, and means responsive to the establishing of a line-to-line connection for transmitting an audible signal to the calling line and means responsive to the establishing of a conference connection for omitting such signal to the calling line.

11. In a telephone system, groups of lines, a connector switch for each line, means responsive to the actuation of the connectors of any of said lines for establishing line-to-line connections and means responsive to the actuation of any one of the connectors of certain of said lines for connecting the associated line with all of the lines simultaneously in any one of said groups.

12. In a telephone system, lines, a connector switch for each line, means responsive to the actuation of the connector of any one of said lines for establishing line-to-line connections, and means responsive to the actuation of the connectors of certain of said lines for establishing conference connections between certain of said lines and for disabling any previous line-to-line connections between any of said certain lines.

13. In a telephone system, lines, a connector switch for each line, means responsive to the actuation of the connector of any of said lines for establishing line-to-line connections, means responsive to the actuation of the connector of one of said lines for establishing a conference connection to certain of said lines, means responsive to the actuation of the connector of another line for establishing a conference connection to certain of said lines, and means responsive to the establishing of a conference connection for disabling any previous line-to-line connection to any of the lines involved in said conference connection.

14. In a telephone system, lines, a connector switch for each line, means responsive to the actuation of the connector of any one of said lines for establishing a line to line connection and for establishing a conference connection between all of said lines, and means responsive to the establishing of a conference connection for disabling any previous line to line connection in which the calling subscriber has abandoned the connection by replacing his receiver on the switchhook.

In witness whereof, we hereunto subscribe our names this 31st day of October 1928.

CHARLES D. KOECHLING.
GERALD V. KING.