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TELEPHONE SYSTEM

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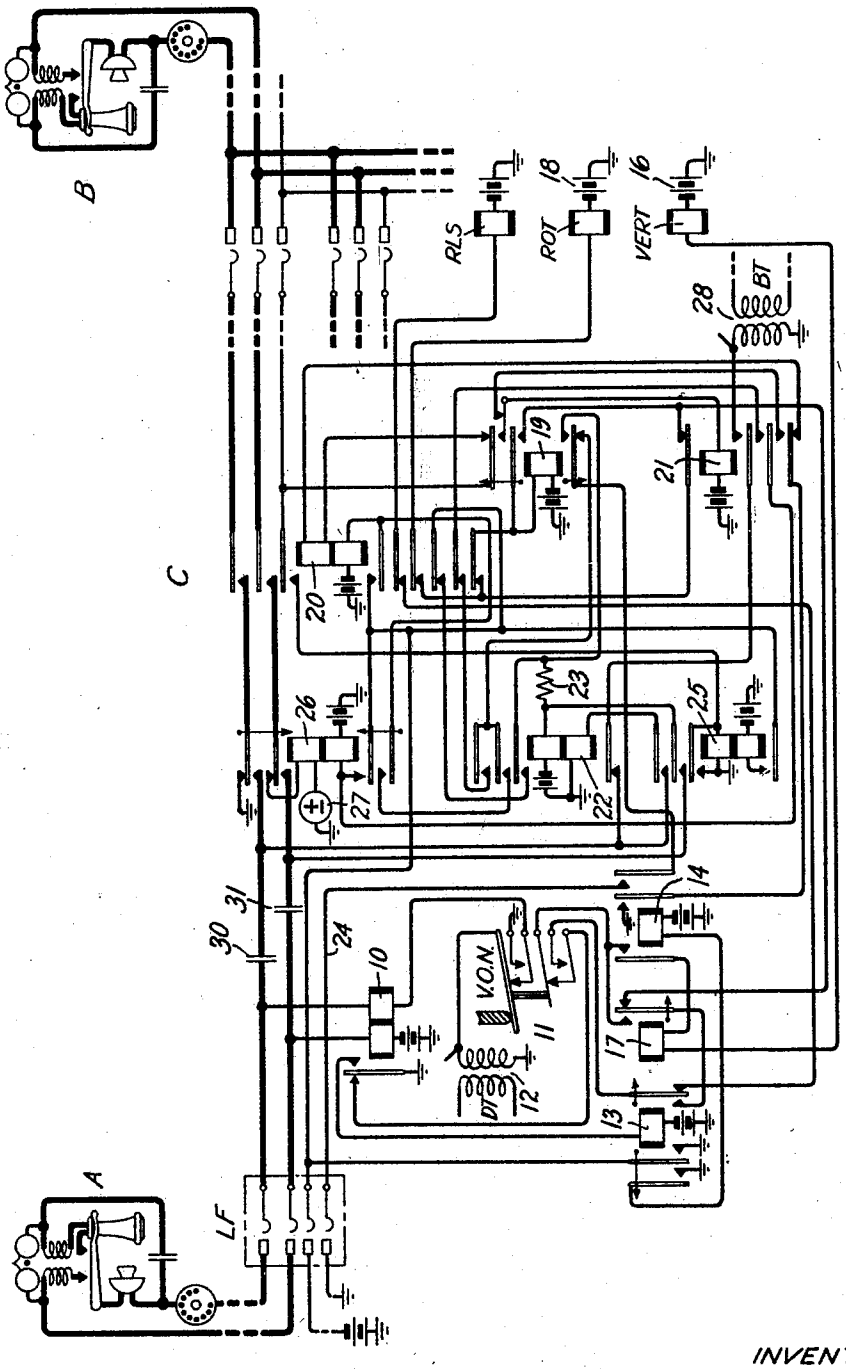

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TELEPHONE SYSTEM

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

The object of this invention is to increase the facilities for intercommunication between the subscribers and to simplify the operation of systems of this type.

Heretofore, systems have been used in which connections to subscribers' lines already engaged may be made by establishing a connection from a calling subscriber to the desired busy line over a connector switch with means for releasing the previous connection and for signaling the subscriber on this line.

A feature of this invention is a system of this type having means associated with a certain subscriber's line and with the connector switches whereby if a call is made from the subscriber of this line to a subscriber already engaged in a previous connection a connector is actuated to establish a permanent talking connection to said busy subscriber without breaking down said previous connection and without transmitting busy tone to the calling subscriber nor causing the busy subscriber to be signaled, whereas if the called subscriber's line is idle said connector is actuated to engage the idle line and signal the subscriber thereon in the usual manner.

Another feature of the invention is a system in which, when the specially equipped subscriber's line makes a call to a busy line, the called subscriber is supplied with talking current from the normal battery supply for this called subscriber's line from the connector in the previous connection regardless of whether said called subscriber's line is that of the previously called or calling subscriber.

The invention has been illustrated in the accompanying drawing in which a connector has been shown arranged in accordance with this invention and associated with the brushes of a line finder. A calling subscriber's line, arranged for the extension of connections to busy lines, has also been shown as well as a called subscriber's line.

Descriptions will now be made of the functions of the connector under the various conditions in which it is used. The first description will relate to the extension of a connection from a calling subscriber at A to a called subscriber at B, when the called subscriber at B is already engaged in a previous connection. The line finder LF for extending the connection from the calling subscriber at A to the connector circuit C may be of any well-known type, except that in this case, it is provided with four brushes and four terminals for each subscriber's line that is arranged for extending connections to busy subscribers' lines. Other subscribers' lines, such as the line of the subscriber at B, will only be represented with tip, ring and sleeve terminals in the line finders. It should be understood that all line finders may be of the same type as it is immaterial whether three or four terminals are actually used by the connected subscribers' lines. The connector C may be of any well-known type except the circuit arrangement which is in accordance with this invention.

When the calling subscriber at A lifts his receiver off the switchhook his line is extended through a line finder such as LF to a connector such as C in the usual manner and when this connection has been established, a circuit is completed through the calling subscriber's loop for the operation of relay 10 as follows: from battery, left hand winding of relay 10, ring brush and terminal of the line finder LF, the calling subscriber's loop, tip terminal and brush of the line finder, right hand winding of relay 10, normal contacts of the vertical off-normal contacts 11, right hand winding of repeating coil 12 to ground. The left hand winding of repeating coil 12 may be connected to a tone source, not shown, so that when this connection is established a tone is transmitted through the repeating coil 12 over the line to the calling subscriber as an indication to him that the connection is ready for dialing. The operation of relay 10 closes an obvious circuit for the operation of relay 13 and this relay in operating closes an obvious circuit for the operation of relay 14 and establishes a connection to ground at its inner left hand armature and front contact for the sleeve connec-

tion through the line finder for purposes well-known in the art, namely, for preventing the release of the line finder until the calling subscriber hangs up his receiver to release the connection. The connections established by the operation of relay 14 will be described hereinafter.

When now the calling subscriber operates his dial in accordance with the digits of the wanted subscribers' line, relay 10, in releasing at the first impulse in response to the dialing, closes a circuit for the operation of the vertical magnet 16 and relay 17 over a circuit from battery, through the winding of vertical magnet 16, winding of relay 17, left hand armature and front contact of relay 14, normally closed vertical off-normal contacts 11, to ground at the armature and back contact of relay 10. The succeeding pulses will operate the vertical magnet to advance the brushes of the connector to the level in which the desired subscriber's line is located. Relay 17 is slow to release so that it will remain operated during succeeding impulses and vertical off-normal contacts 11 are operated after the first vertical step of the connector to close a substitute connection for the pulsing circuit which will now extend through the lower make contacts of the vertical off-normal contacts 11, through the right hand armature and front contact of relay 13, the armature and front contact of relay 17, and from this point to the left hand armature and front contact of relay 14 as hereinbefore described. Due to this change in the pulsing circuit, when the first series of impulses ceases relay 17 will release and is thereafter prevented from operating due to the opening of the normal contacts of the vertical off-normal contacts 11. When the second series of impulses is transmitted, a connection will first be completed for the operation of the rotary magnet 18 and relay 19. The circuit for rotary magnet 18 extends from battery, winding of this magnet, third lower armature and back contact of relay 20, upper armature and back contact of relay 21, armature and back contact of relay 17, right hand armature and front contact of relay 13, lower closed contacts of vertical off-normal contacts 11, to the armature and back contact of relay 10, to ground. The circuit for relay 19 extends from battery, winding of this relay, lower outer armature and back contact of relay 20, and from thereon as hereinbefore described, to the ground at the pulsing relay 10. The rotary magnet is now operated in accordance with the impulses of the second digit to advance the brushes of the connector C to establish a connection with the desired subscriber's line at B. Relay 19 remains operated during the sending of the impulses of the second digit as it is slow to release.

It should be noted that relay 19 in operating closes a locking circuit for itself through its upper inner armature and front contact, to the pulsing circuit independent of the connection through the lower outer armature and back contact of relay 20. When relay 19 operated, a circuit was also closed for the operation of relay 22 from battery, upper winding of this relay, resistance 23, lower armature and front contact of relay 19, outer right hand armature and front contact of relay 14, to the conductor 24 leading to the fourth brush of the line finder LF, through the fourth terminal of the calling subscriber's line to ground. This connection to ground on the fourth terminal is the starting means, for a subscriber of the type that has access to a busy line, for accomplishing this function by the connector. Hence in this case, relay 22 will be operated. Relay 22 in operating closes a locking circuit for itself from battery, its upper winding, resistance 23, upper inner armature and front contact of this relay, fourth lower armature and back contact of relay 20, to ground at relay 13.

As it has been assumed that the called subscriber at B is busy in another connection there will be a ground connection on the sleeve terminal of this line. Hence, when the brushes of connector C come in contact with the terminals of this line, a circuit will be completed for the operation of relay 21 from battery, winding of this relay, upper outer armature and front contact of relay 19 before this relay has time to release after the connection has been established to the line, sleeve brush of connector C, sleeve terminal of the busy line to ground. This ground on the sleeve of a busy line is, in the case of the subscriber at B being the previously called subscriber, the ground at the upper inner armature and front contact of the relay corresponding to relay 25 of this connector in the connector employed in the previous connection. In the case of the subscriber at B being the calling subscriber in said previous connection the ground on the sleeve would be that at the inner left hand armature and front contact of the relay in said previously employed connector corresponding to relay 13 in this connector. When relay 19 releases after the last opening of the pulsing circuit a connection for maintaining relay 21 operated will extend through the upper make-before-break contacts of relay 19, the lower outer armature and front contact of relay 21, to ground at the inner right hand armature and front contact of relay 14. With relays 22 and 21 operated and relay 19 released, a circuit from the ground on lead 24 will now be completed for the operation of relay 26 from battery, lower winding of relay 26, lower middle armature and front contact of relay 21, fifth lower armature and back contact of relay 20, upper outer armature and front contact of relay 22, lower armature and back contact of relay 19, outer right hand armature

and front contact of relay 14 to ground on lead 24. Relay 26 in operating opens the ringing connection through the upper winding of this relay from source 27 and from ground at the upper armatures and back contacts of this relay to the ring and tip conductors to prevent the ringing of the called subscriber's line when relay 20 operates as hereinafter described.

The relay 22 in operating opens at its lower armature and back contact a connection from the busy tone source 28, established at the lower inner armature and front contact of relay 21 when it operated, to the tip conductor leading to the calling subscriber's line so as to prevent busy tone from being transmitted to the calling subscriber. It is, of course, immaterial in this case whether the called subscriber's line is busy or not.

Relay 26 in operating also connects the tip and ring conductors through C to front contacts of relay 20 which also operates. The circuit for relay 20 is as follows: from battery, lower winding of relay 20, lower outer armature and front contact of relay 26, middle upper armature and front contact of relay 22, lower armature and back contact of relay 19, outer right hand armature and front contact of relay 14, to ground on lead 24. Relay 20 connects the tip and ring conductors through from the calling subscriber to the called subscriber at its two upper armatures and front contacts, to establish a talking connection.

It should be noted that the talking battery for the calling subscriber will be supplied through the windings of relay 10, whereas due to the fact that relay 25 is not operated, no talking battery will be supplied to the called subscriber from the connector C. The talking connection through the connector C will extend through the condensers 30 and 31 and the talking battery for the called subscriber will be supplied from the connector employed in the previous connection as follows: If the called subscriber was also the called subscriber in the previous connection, the talking battery will be that connected through the windings of the relay corresponding to relay 23 in the previously used connector. The circuit from this battery supply extends from the windings of this relay, through the upper outer armatures and front contacts of the relay corresponding to relay 25, the tip and ring conductors of the connector, through to the called subscriber's line. In case the called subscriber at B was the calling subscriber in the previous connection, the talking battery will be furnished through the windings of the relay corresponding to relay 10 in the connector used in that connection. In this case it will be extended through a line finder.

If a connection is desired between the subscriber at A and the subscriber at B and the called subscriber is idle, it may be established in the same manner as hereinbefore described for a connection to a busy subscriber, except as follows: Relay 21 will not operate before relay 19 releases, as there is no ground on the sleeve conductor of the desired subscribers' lines. Hence when relay 19 is released, relay 20 will be operated over a circuit as follows: from battery, which is normally supplied through the regular standard cut-off relay, through the sleeve conductor of the desired subscriber's line, upper outer armature and back contact of relay 19, upper winding of relay 20, lower outer armature and back contact of relay 21, to ground at the inner right hand armature and front contact of relay 14. Relay 20 in operating provides a locking circuit for itself through its lower winding and lower inner armature and front contact to ground at the inner left hand armature and front contact of relay 13. As relay 21 is not operated, relay 26 will not operate. Hence ringing current will now be supplied from the source 27, through the upper winding of relay 26, upper inner armature and back contact, through over the ring conductor to the called subscriber's bell and back over the tip conductor to ground at the upper outer armature and back contact of relay 26.

When the called subscriber answers, the ringing relay 26 is operated during the silent period as is well-known in the machine ringing art and completes the connection through its upper armatures and front contacts between the two subscribers. Talking battery will now be supplied to the called subscriber due to the operation of relay 25 over a circuit from battery over the sleeve conductor of the called subscriber's line and the inner upper armature and front contact of relay 20, upper winding of relay 25 to ground. Relay 25 provides a locking circuit for itself from battery, through its lower winding, lower armature and front contact to the ground at relay 13. Relay 25 in operating connects battery and ground through the windings of relay 22 and the two upper outer armatures and front contacts of relay 25 to the tip and ring conductors of the connector C.

In the case of a connection between two subscribers' lines over connector C where the calling subscriber's line is not equipped to establish a connection with a busy line, that is, by having no connection to ground at the fourth terminal in the line finders, the relay 22 will not be operated. Relay 21, however, will be operated in the same manner as hereinbefore if the called line is busy and in this case the busy tone will be supplied from the source 28, through the inner lower armature and front contact of relay 21 and inner lower armature and back contact of relay 22 to the calling subscriber. In this case, relays 20 and 26 will not be operated and when the calling

subscriber releases the connection, relays 10, 13, 14 and 21 will be released.

If the called subscriber is not busy, relay 21 will not be operated and a circuit will function in the same manner as in the case hereinbefore described of a connection to an idle subscriber from the subscriber at A.

It should be understood that while the invention has only been described in connection with one system, it is not confined thereby but is equally applicable to other systems without departing from the spirit thereof, and is limited only by the scope of the appended claims.

What is claimed is:

1. In a telephone system, subscribers' lines, means for establishing a connection between any two of said lines, means for signaling the subscriber on the line to which the connection has been made, and means responsive to a call from a certain subscriber's line for preventing the signaling of the subscriber to which the connection is made if said subscriber is already engaged in a previous connection.

2. In a telephone system, subscribers' lines, means for establishing a connection between any two of said lines, means for transmitting a busy tone to the calling subscriber if the called subscriber is already engaged in a previous connection, and means responsive to a call from a certain subscriber's line for preventing said busy tone from being transmitted if the called subscriber is already engaged in a previous connection.

3. In a telephone system, subscribers' lines, connector switches, a ringing equipment and a busy tone equipment associated with each connector switch, means for actuating any one of said switches for establishing a connection between any two of said subscribers' lines, and means for actuating any one of said connector switches for establishing a connection from a certain subscriber's line with a previously established connection between two subscribers' lines and for disabling the associated ringing and busy-tone equipments.

4. In a telephone system, subscribers' lines, means for establishing a connection between any two of said subscribers' lines, individual talking current supplies for said connected lines, means for establishing a connection from a certain subscriber's line to either of two subscribers' lines between which a connection has been previously established, and means for supplying talking current to said last called subscriber's line from the normal supply of this last called subscriber's line regardless of whether such line was a calling or a called subscriber's line in the previous connection.

5. In a telephone system, subscribers' lines, connector switches, a ringing equipment and a busy tone equipment associated with each connector switch, means for actuating any one of said switches for establishing a connection between any two of said subscribers' lines, and means for actuating any one of said connector switches for establishing a connection from a certain subscriber's line with a previously established connection between two subscribers' lines and for disabling the associated ringing and busy-tone equipments without disturbing said previously established connection.

6. In a telephone system, subscribers' lines, connector switches, a ringing equipment and a busy tone equipment associated with each connector switch, means for actuating any one of said switches for establishing a connection between any two of said subscribers' lines, and means including a relay in a connector switch operating when a connection is established from a certain subscriber's line through said connector switch with a previously established connection between two subscribers' lines for disabling the associated ringing and busy tone equipments without disturbing the previously established connection.

7. In a telephone system, subscribers' lines, means for establishing a connection between any two of said subscribers' lines, means for signaling the subscriber on the line to which the connection has been made, means for transmitting a busy tone to the calling subscriber if the called subscriber is already engaged in a previous connection, individual talking current supplies for said connected lines, means for establishing connections from certain subscribers' lines to either of two subscribers' lines between which a connection has been previously established, means for disabling the ringing means and the busy tone means if a connection is established from such a subscriber's line to an already engaged subscriber's line without disturbing the previous connection to said subscriber's line and for supplying talking current to said last called subscriber's line from the normal supply of this last called subscriber's line regardless of whether it was a calling or a called subscriber's line in the previous connection.

In witness whereof, I hereunto subscribe my name this 1st day of May, 1929.

GERALD V. KING.