Oct. 20, 1942. W. M. BEAUMONT 2,299,203

TELEPHONE SYSTEM

Filed July 5, 1940 2 Sheets-Sheet 1

FIG. 2

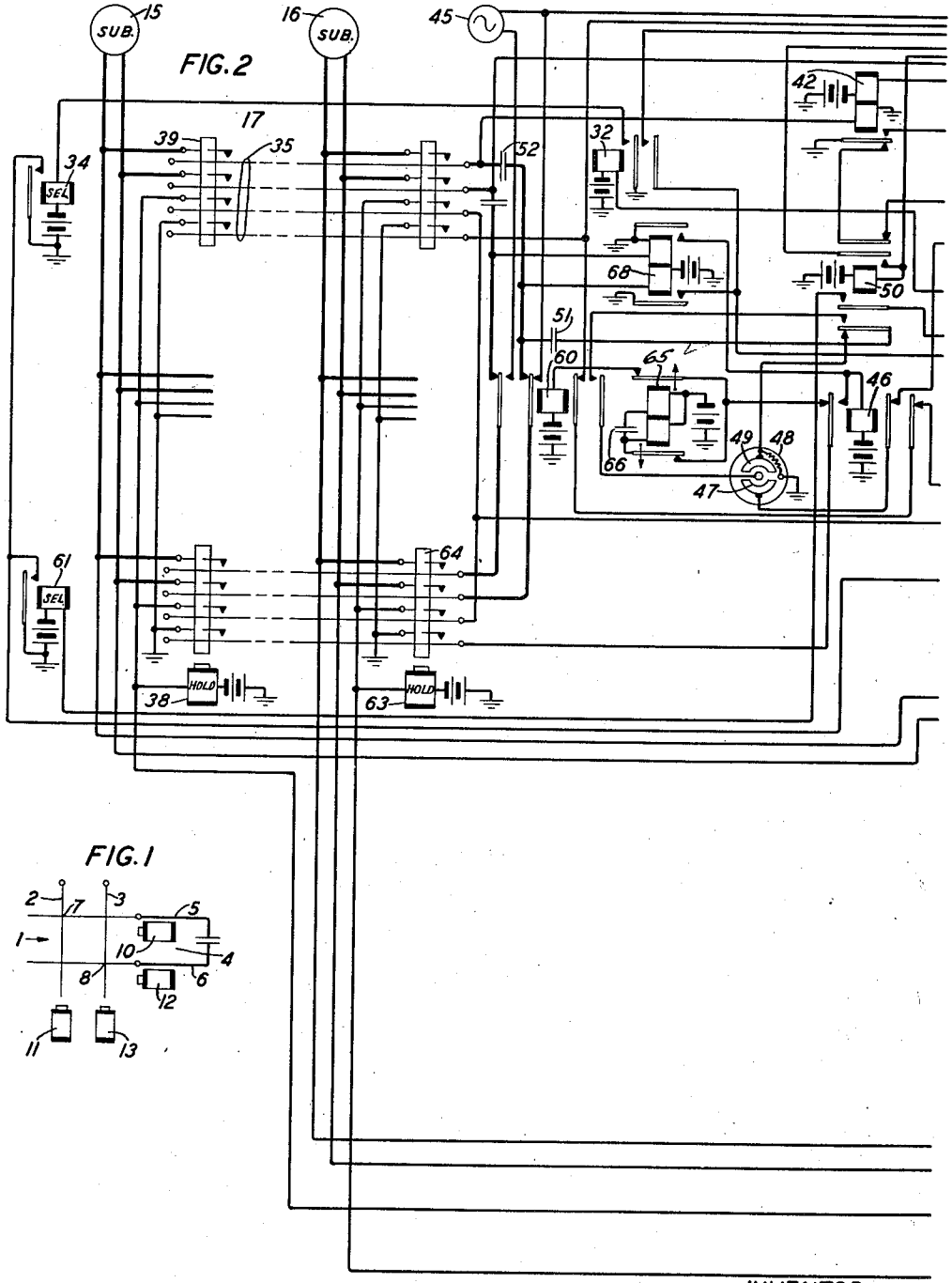


FIG. 1

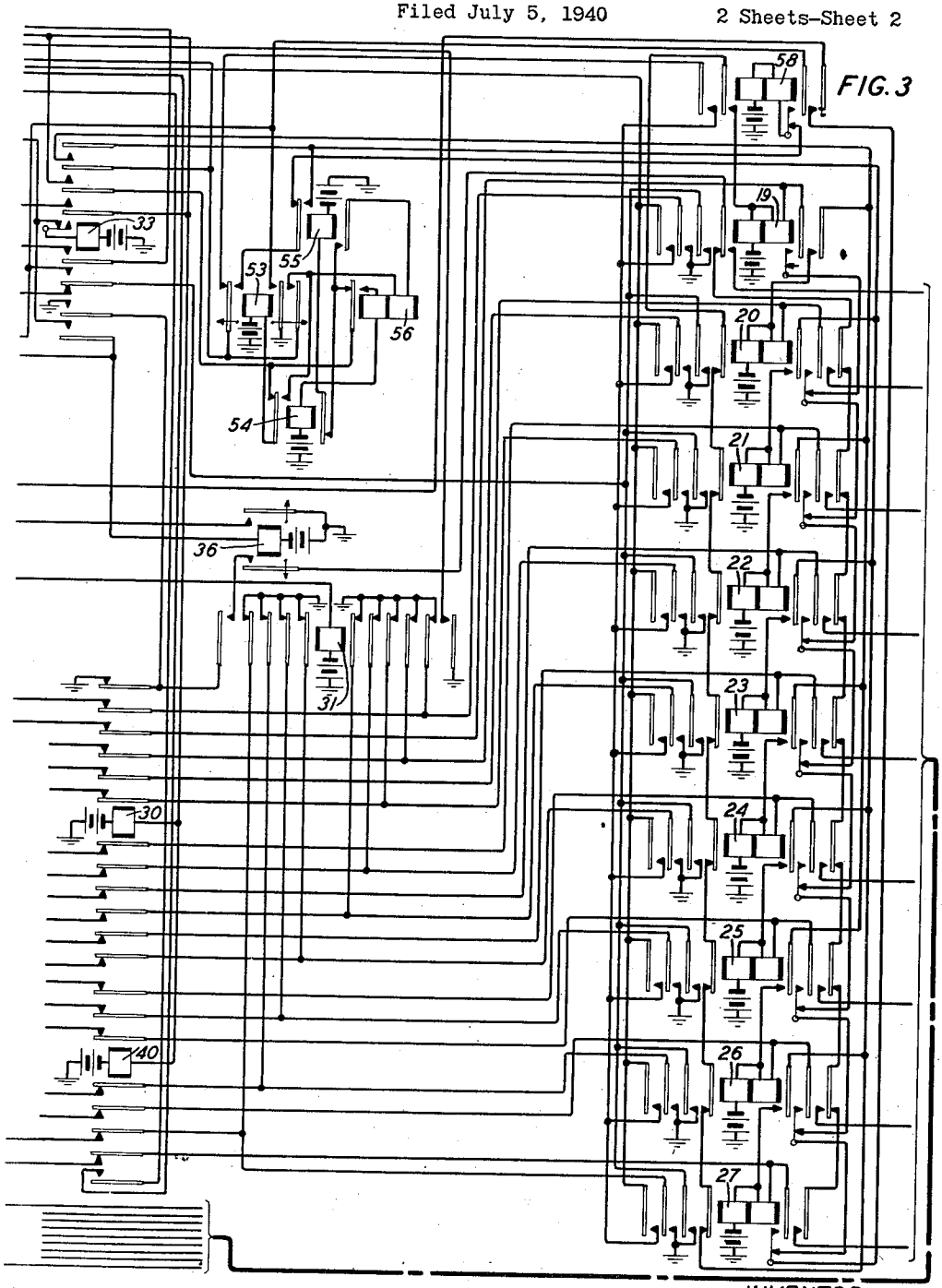
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FIG. 3



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UNITED STATES PATENT OFFICE

2,299,203

TELEPHONE SYSTEM

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Application July 5, 1940, Serial No. 344,025

14 Claims. (Cl. 179—22)

This invention relates to telephone systems and particularly to small capacity automatic telephone systems.

An object of the invention is to provide improved and simplified means for controlling the operation of automatic switches in the establishment of connections between subscribers' lines.

Heretofore systems have been provided in which the connections may be established from any line to any other line in a single cross-bar switch through linking arrangements. A system of this kind has been shown in the patent to L. R. Waller 1,567,309 of December 29, 1925.

The present invention is applicable to systems of this general character in which lines may be connected through a cross-bar switch by means of a single linking arrangement, and a feature thereof is an arrangement whereby line relays individual to lines are operated for establishing connection from a calling line to the link through said switch and operative in response to dial pulses from a calling line for establishing a connection from the link to a called line over the switch.

This invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows in diagrammatic form a cross-bar switching system to which the applicant's device may be applied; and

Figs. 2 and 3 show the detail circuits of this system.

Referring now to Fig. 1, a cross-bar switch 1 has been shown in which two subscribers' lines 2 and 3 appear as verticals and in which link 4 appears with a calling branch 5 and a called branch 6. A connection may be established, for example, from subscriber 2 through the cross-point 7 to the calling branch 5 of the link 4 and over the link to the called branch 6 through cross-point 8 to the called line 3. The switch may be of any well-known type in which select magnet 10 and the hold magnet 11 may be operated to establish the connection at point 7 and the select magnet 12 and the hold magnet 13 may be operated to establish a connection at point 8.

This system may have a capacity of, for example, nine subscribers' lines. In Figs. 2 and 3, the subscribers' lines 15 and 16 have been shown in detail circuits terminating in a switch 17, line 15 being the first and line 16 being the last of the nine subscribers' lines appearing in this switch. Each line is provided with a line relay such as, for example, 19 for line 15, line relays 20 to 26 for the intermediate seven lines and line relay 27 for the line 16.

A description will now be made of the detail operations of this system in a call from line 15 to line 16. If the subscriber of line 15 calls, a connection is established through his telephone sets over the tip and ring conductors through contacts of relay 30; to ground for the tip conductor at contact of relay 31 and to battery for the ring conductor through the two windings in series of the line relay 19. This causes the operation of line relay 19 which now closes a circuit for the relay 32 from battery through the windings of this relay, contacts of relays 33 and 19 to ground. Relay 32 closes an obvious circuit for the select magnet 34 for the calling branch 35 of the link. The select magnet 34 closes an obvious circuit for the operation of relay 31 and this relay closes a circuit for relay 36 from battery through the winding of this relay, contacts of relays 32 and 31 to ground. This causes the operation of the holding magnet 38 for the calling subscriber's line 15. This circuit may be traced from battery through the winding of this holding magnet, contacts of line relay 19, contacts of relays 36, 31 and 30 to ground. This establishes a connection at the cross-point 39, in the cross-bar switch 17 between the calling line 15 and the calling branch 35 of the link. Connections are now established at this cross-point for a holding circuit for the holding magnet 38, from battery through the winding of this magnet, contacts at cross-point 39 to ground at contacts of relay 36. Relays 30 and 40 also operate from battery through the windings of these relays, contacts at cross-point 39 to ground. These relays open the tip and ring connections to all subscribers' lines so as to prevent other subscribers from calling while the present connection is established. The line relay 19, of course, will now release, causing the release of relay 32. The line relay 19 opens the original energizing circuit for the holding magnet 38 while relay 32 opens the circuits for select magnet 34 which now releases and the release of the select magnet causes the release of relay 31.

A connection at the cross-point 39 also connects the calling line to the calling branch 35 of the link and this connection causes the operation of relay 42 from battery through one winding of relay 42, contacts of relay 40, contacts at the cross-point 39, over the ring conductor, through the calling subscriber's loop over the tip conductor, contacts at the cross-point 39, another winding of relay 42 to ground. Relay 42 closes an obvious circuit for the operation of relay 33 which in operating locks over a circuit from battery through the winding of this relay, contacts thereof and at cross-point 39 to ground.

Relay 33 in operating closes a connection from an alternating current supply at 45 through contacts of this relay 33 and contacts of relay 46 to a control electrode 47 of the tube 48 to ground over electrode 49, causing this tube to break down and establish a dial tone from the alternating current source at 45 across these electrodes, contacts of relay 50 and condensers 51 and 52 to the tip conductor of the calling line, back over the subscriber's loop and the ring conductor, contacts of relay 40, upper winding of relay 42, to battery and ground.

The subscriber hearing this dial tone will operate his dial to select a desired subscriber's line. He will dial from two to ten impulses, depending on which subscriber he desired to make connection with. The first impulse causes the release of relay 42 and this in turn closes a circuit for the operation of relay 53 from battery through the winding of this relay, contacts of relays 54, 33, 50 to ground at contacts of relay 42. Relay 55 is also operated at this time over this circuit from battery, through the winding of relay 55, contacts of relays 54, 56, 33, 50 and 42 to ground. Relay 55 in operating closes a circuit for the operation of relay 56 from battery through the winding of relay 55, contacts of relays 54 and 55 and one winding of relay 56, contacts of relays 53 and 33, cross-point 39 to ground when relay 42 operates as it will be noted that as long as relay 42 is released, a short circuit is established for this winding at the contacts of relay 56. Relay 55 also closes a circuit for the operation of relay 58 from battery through the windings of this relay and its make-before-break contacts, contacts of relays 55, 53 and 33 cross-point 39 to ground. Now on the second impulse when relay 42 releases, relay 54 is operated over a circuit from battery through the winding of this relay, the second winding of relay 56 and its armature and front contact, contacts of relays 33 and 50 to ground a relay 42. Relay 54 in operating opens the circuit for relay 55 and this relay releasing, closes a circuit for the first line relay 19 from battery through one winding of this relay, contacts of relay 58, contacts of the succeeding line relays 20 to 27, contacts of relays 55, 53, 33, cross-point 39 to ground. Relay 19 locks from battery, through its windings and contacts, contacts of relays 20 to 27, relays 53, 46, 60 to ground at cross-point 39. Thus the first impulse does not operate any line relay whereas the second impulse operates the first line relay and as this line relay 19 represents the subscriber's own line he must operate his dial to send at least one more pulse to select one of the remaining eight subscriber's lines. On the operation of relay 42 after the second impulse relay 54 is released as well as relay 56 so that on receipt of the third impulse when relay 42 releases, relay 55 will again operate over the circuit as hereinbefore traced. Relay 55 now in operating closes a circuit for the operation of the second line relay 20 from battery through a winding of this relay, contacts of the line relay 19, contacts of relays 33, 55, 53 to ground at the cross-point 39. The relays 54, 55 and 56 now operate and release in the same manner in response to succeeding impulses to alternately operate and release succeeding line relays, relays 21, 23, 25 and 27 operating when the relay 55 is released and relays 22, 24 and 26 operating when relay 55 is operated. As each succeeding line relay operates, the preceding one releases, as the locking circuit described extends through contacts of all line relays. The last relay 27 in operating provides a locking circuit for itself, from battery windings of relay 27, make-before-break contacts of this relay, contacts of relays 58, 46 and 60 through the cross-point 39 to ground. The relay 53 which was maintained operated during pulsing due to its slow-to-release characteristic now releases, causing the operation of relay 50 from battery through the winding of this relay, contacts of relays 27, 58, 53, 33, through the cross-point 39 to ground. Relay 50 in operating provides a locking circuit for itself through its own contacts, contacts of relay 33, to ground through the cross-point 39. Relay 58 locks over another circuit from battery through its winding, contacts of relays 33 and 27 to ground. Relay 50 in operating disables the dial tone circuit and causes the operation of the select magnet 61 for the connection of the link to the called line. This circuit for select magnet 61 may be traced from battery through the winding of this magnet, contacts of relays 50, 33 and 27 to ground. Magnet 61 closes an obvious circuit for reoperation of relay 31 and this relay closes a circuit for the hold magnet 63 from battery, through the winding of this magnet, operated contacts of relay 27, normal contacts of relays 26, 25, 24, 23, 22, 21, 20 and 19, and relays 36, 31 and 30 to ground. The operation of this hold magnet and the select magnet 61 closes the connection at the cross-point 64 for establishing a connection to the called line 16 from the link. Connections at cross-point 64 now close a circuit for the operation of relay 60 from battery through the winding of this relay, contacts of relays 64 and 46, through the cross-point 64 to ground. Relay 60 in operating applies ringing current from the source 45, contacts of this relay over the tip and ring conductors of the called line, through the cross-point 64. It should be noted, however, that this circuit from ground at the cross-point 64 which operated relay 60 will also provide a circuit through contacts of relay 46, contacts of relay 65, through a winding of this relay to battery. This will tend to operate relay 65, but the condenser 66 is charged from battery through the other winding of relay 65 and thus causes a momentary flux through this winding that opposes the flux through the other winding of relay 65, causing a slight delay in the operation of this relay. When relay 65 operates, it opens the circuit for relay 60 to disconnect the ringing source from the called line, and this relay also interrupts its own circuit so that it will then release slowly. On the release of this relay, relay 60 will again be operated and after an interval, relay 65 will also be operated to again release relay 60. Relays 60 and 65 will therefore be operated and released at intervals depending on the slow-operate characteristics of relay 65 to apply ringing current to the called line from source 45 at fixed intervals. On the first operation of relay 60, the locking circuit for the line relay 27 is opened causing this relay to release and this relay in turn causes the release of relay 58 and also the select magnet 61. The select magnet 61 releases relay 31. When the subscriber answers this call, relay 68 will operate from battery and ground, windings of this relay, over the tip and ring conductors connected through contacts of relay 60 when it releases the first time after the called subscriber has removed his receiver to establish a connection over the tip and ring conductors through his set. Relay 68 closes an obvious circuit for the operation of relay 46 and this relay opens the circuit for re-

lays **65** and **69** which thus cease to operate to apply ringing to the called line. The circuits are now in condition for talking between the subscribers of lines **15** and **16** as connected through the link over contacts of relay **60**.

When the subscribers hang up their receivers, relays **68** and **42** release, causing the release of relays **36** and **46**. Relay **36** opens the locking circuit for the hold magnets **38** and **63**, thus releasing the link at the cross-points **64** and **39** and freeing the link and the switch for subsequent calls. The release of the switch causes the release of relays **33**, **30**, **40** and **50**.

What is claimed is:

1. In a telephone system, lines, a link, a switch for connecting a calling line with a called line through said link, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate said switch to connect a calling line with the link, means for operating and releasing said line relays in succession until the line relay of the desired called line is operated and means responsive to the operation of said last-mentioned line relay for actuating said switch to connect the desired called line to the link.

2. In a telephone system, lines, a link, a switch for connecting a calling line with a called line through said link, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate said switch to connect the calling line with the link, means for operating and releasing said line relays in succession until the line relay of the desired called line is operated and means responsive to the operation of said last-mentioned line relay for actuating said switch to connect the desired called line to said link and for transmitting ringing current to said called line.

3. In a telephone system, lines, a link, a switch for connecting a calling line with a called line through said link, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate said switch to connect the calling line with said link, means for operating and releasing said line relays in succession until the line relay of the desired called line is operated, means responsive to the operation of said last-mentioned line relay for actuating said switch to connect the desired called line to said link and for transmitting ringing current to said called line, and means operative when the subscriber of the called line answers the call for disconnecting the ringing.

4. In a telephone system, lines, a link, a switch for connecting a calling line with a called line through said link, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate said switch to connect the calling line with the link, means responsive to impulses received over said calling line for operating and releasing said line relays in succession until the line relay of the desired called line is operated and means responsive to the operation of said last-mentioned line relay for actuating said switch to connect the link to said called line.

5. In a telephone system, lines, a link, a switch for connecting a calling line with a called line through said link, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate said switch to connect the calling line with the link, means responsive to impulses received over said calling line for operating one of said relays for each impulse received and releasing the preceding relay on the operation of a succeeding relay, and means operative in response to the operation of the last relay after the last impulse has been received for connecting the corresponding called line to the link through said switch.

6. In a telephone system, lines, a link, a switch for connecting a calling line with a called line through said link, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate said switch to connect the calling line with the link, means responsive to impulses received over said calling line for operating one of said relays for each impulse received and releasing a preceding relay on the operation of a succeeding relay, means operative in response to the last relay operated after the last impulse has been received for actuating said switch to connect the link to a corresponding called line, and means operative in response to said last-mentioned operation of the switch for transmitting ringing current over a called line.

7. In a telephone system, lines, a link having a calling branch and a called branch, a switch for connecting a calling line to the calling branch and the called line to the called branch of said link, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate said switch to connect the calling line to the calling branch of said link, means responsive to impulses received over said calling line for actuating and releasing the line relays in succession until the line relay of the desired called line is operated, means then responsive to the operation of said last-mentioned line relay for operating said switch to connect the called line to the called branch of said link and for transmitting ringing current over the connected called line, and means responsive to the subscriber on the called line answering the call for discontinuing the transmission of ringing current and connecting the calling and called branches of the link for conversation between the calling subscriber and the called subscriber.

8. In a telephone system, lines, a link, a switch for connecting a calling line with a called line through said link, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate said switch to connect the calling line with the link, means for operating said line relays to actuate said switch to connect a desired called line to the link, a source of alternating current, and means responsive to said last-mentioned actuation of the switch for alternately connecting and disconnecting said source from said called line to transmit ringing current herefrom to said called line.

9. In a telephone system, lines, a link, a switch for connecting a calling line with a called line through said link, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate said switch to connect the calling line with said link, means for operating and releasing said line relays in succession until the line relay of the desired called line is operated, means responsive to the operation of said last-mentioned line relay for actuating said switch to connect said desired called line to said link, means responsive to the establishing of a connection between the called line and the link for transmitting ringing current to said called line at intervals and

to release said last-mentioned line relay, and means operative when the subscriber of the called line answers the call for discontinuing the ringing.

10. In a telephone system, a switch, lines appearing in said switch, a link having a calling branch and a called branch appearing in said switch, operating magnets in said switch for establishing connections between a calling line and the calling branch of the link and for establishing a connection between a called line and the called branch of the link through said switch, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate magnets in said switch to connect the calling line to the calling branch of the link, means responsive to impulses received over the calling line for actuating and releasing the line relays in succession until the line relay of the desired called line is operated, means then controlled by this operated line relay for operating magnets in said switch to connect the called line to the called branch of said link and for transmitting ringing current over the connected called line, and means responsive to the subscriber on the called line answering the call for discontinuing the transmission of ringing current and connecting the calling and called branch of the link for conversation between the calling subscriber and the called subscriber.

11. In a telephone system, a switch, lines appearing in said switch, a link having a calling branch and a called branch appearing in said switch, operating magnets in said switch for establishing connections between a calling line and the calling branch of the link and for establishing a connection between a called line and the called branch of the link through said switch, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay to actuate magnets in said switch to connect the calling line to the calling branch of the link, means responsive to impulses received over the calling line for actuating and releasing the line relays in succession until the line relay of the desired called line is operated, means then controlled by the operated line relay for operating magnets in said switch to connect the called line to the called branch of said link, a source of ringing current, means operative on the connection of the called line to the called branch of the link for alternately disconnecting the calling branch from the called branch and for connecting the calling branch to the called branch of said link and for connecting said ringing source to the called branch of the link when the calling branch is disconnected therefrom to transmit ringing current from said source to the called line at intervals and means responsive to the subscriber on the called line answering the call for disconnecting the ringing source from the called branch of the link to discontinue the transmission of ringing current and for connecting the calling branch to the called branch of the link for conversation between the calling subscriber and the called subscriber.

12. In a telephone system, lines, a link, a crossbar switch in which said lines and said link terminate, and having select magnets for selecting the link and a hold magnet for each line for actuating said switch to establish a connection from a calling line to a called line over said link, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay, means responsive to the operation of said line relay for actuating a select magnet and the hold magnet associated with the calling line to establish a connection between said calling line and the link, means for operating and releasing said line relays to select a called line and means operative on the operation of the line relay of the selected called line for operating a select magnet and the hold magnet of the called line for establishing a connection between the called line and the link.

13. In a telephone system, lines, a link having a calling branch and a called branch, a crossbar switch for connecting a calling line with a called line through said link branches, a select magnet in said switch for the calling branch of the link, a select magnet in said switch for the called branch of the link, a hold magnet in said switch for each line, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay, means responsive to the operation of said line relay for operating the select magnet of the calling branch of said link and the hold magnet of the calling line for actuating said switch to establish a connection between the calling line and the calling branch of said link, and means for operating said line relays to operate the select magnet of the called branch of said link and the hold magnet of the called line to actuate said switch to connect said called branch of the link to said called line.

14. In a telephone system, lines, a link, having a calling branch and a called branch, a crossbar switch for connecting the calling line with a called line through said link branches, a select magnet in said switch for the calling branch of the link, a select magnet in said switch for the called branch of the link, a hold magnet in said switch for each of said lines, a line relay for each line, means responsive to the seizure of a calling line for operating the associated line relay, means responsive to the operation of said line relay for operating the select magnet of the calling branch of said link and the hold magnet of the calling line for actuating said switch to establish a connection between the calling line and the calling branch of said link, means for operating and releasing said line relays in succession until the line relay of the desired called line is operated, means responsive to the operation of said last-mentioned line relay for connecting the selective called line to the called branch of the link by the operation of the select magnet of said called branch and the hold magnet of the selected called line.

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