

Feb. 1, 1938.

H. A. LEWIS

2,107,158

TELEPHONE SYSTEM

Filed Feb. 26, 1937

2 Sheets-Sheet 1

FIG. 1

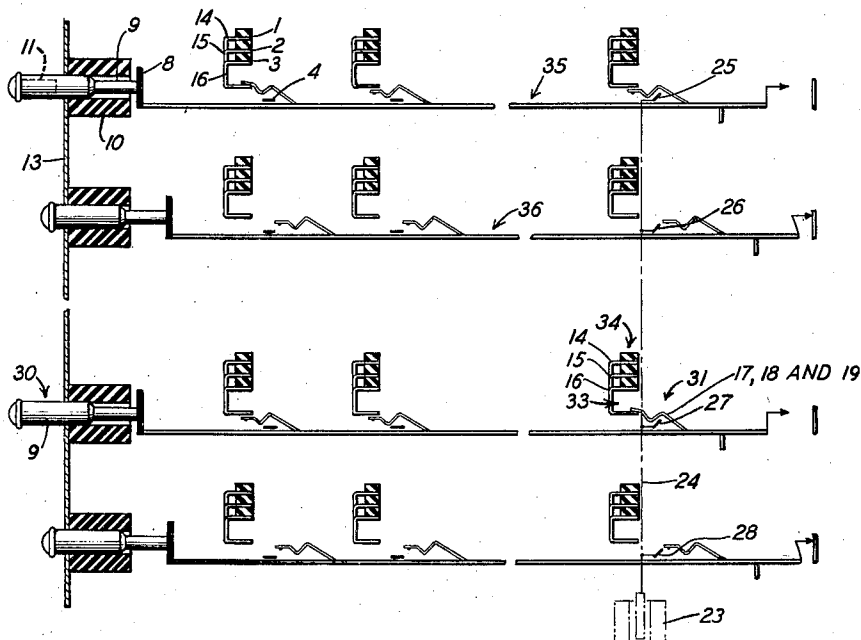
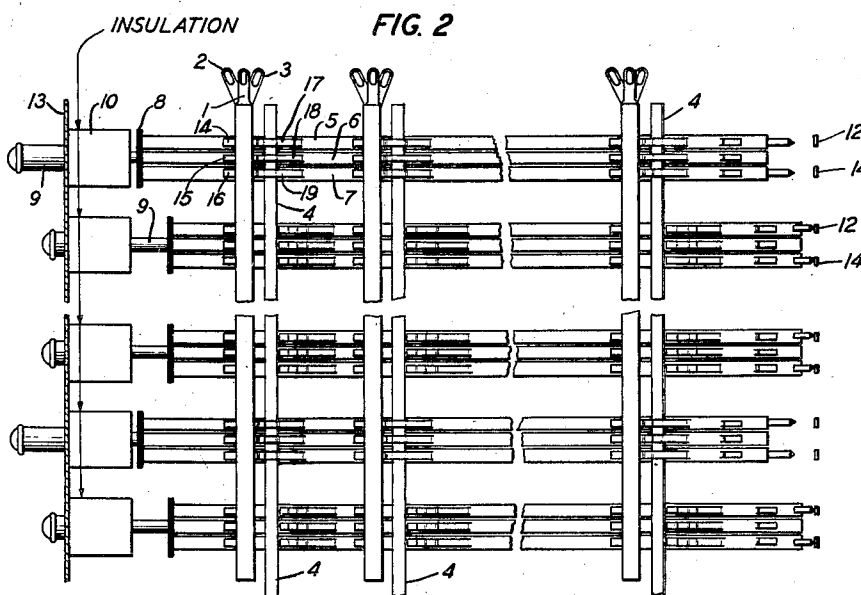


FIG. 2



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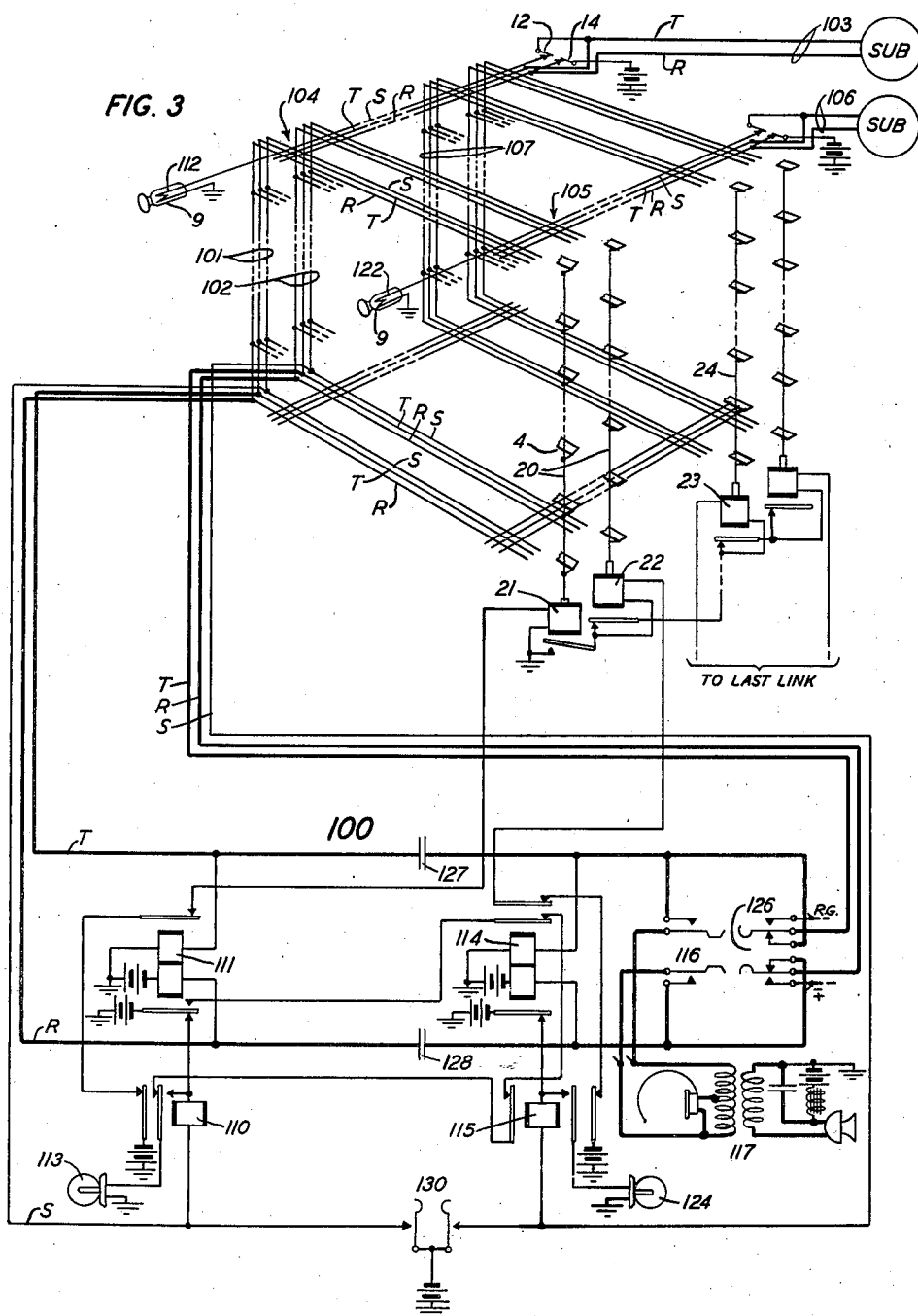
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TELEPHONE SYSTEM

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Application February 26, 1937, Serial No. 127,908

8 Claims. (Cl. 179—27)

This invention relates to telephone systems and particularly to improvements in the mechanism for establishing connections between subscribers' lines at an exchange.

5 An object of the invention is to simplify and improve the mechanisms and circuits employed by the operators at an exchange for establishing telephone connections.

10 Heretofore systems have been provided for establishing connections between subscribers' lines automatically or manually by the aid of cross-bar switch structures. Cross-bar switches are well known in the art in which connections between two lines are established by the operation of a selecting bar followed by the operation of a holding bar, the connection being established at the cross-point of said bars. Systems have also been provided in which the subscribers' lines are associated with the holding bars and links are associated with the selecting bars. A connection between a calling subscriber's line and a called subscriber's line in this case is established by operating a holding bar to connect the calling line to one end of a preselected link and by operating another holding bar to connect the called subscriber's line to the other end of this link.

20 The applicant's invention has been disclosed in connection with a mechanism of the last mentioned type, in which each subscriber's line and line lamp are associated with a holding bar and in which when a subscriber calls his line lamp is lighted at his associated holding bar whereupon the operator manually manipulates this holding bar to establish a connection between the calling subscriber's line and one end of the preselected link. The operator whose telephone set may be associated with the link then inquires from the calling subscriber the number of the desired subscriber's line. Upon the receipt of this number she operates the holding bar of the desired subscriber's line and thereby connects the called subscriber's line to the other end of the preselected link.

45 A feature of the applicant's invention is an arrangement in a system of this type whereby when the subscribers replace the receivers on the switchhooks after a conversation, lamps are lighted in the engaged link and whereby the actuation of a key by the operator in the link flashes the line lamps of these subscribers' lines to identify them with the engaged link. The connection may then be released by the manual restoring of the holding bars. The subscriber's line lamp may be located in a knob or plug that

may be used for the manual operation of the associated holding bar.

The applicant's invention has been illustrated in the accompanying drawings in which

Fig. 1 is a fragmentary side view in cross-section of a cross-bar switch structure suitable for use in connection with the applicant's invention; and

Fig. 2 is a fragmentary plane view of this switch structure.

Fig. 3 is a circuit arrangement embodying the applicant's invention with the cross-bar switch in accordance with Figs. 1 and 2 shown in diagrammatic form.

Referring now to the drawings, and particularly to Figs. 1 and 2, each end of a link is represented by three strips 1, 2 and 3 insulated from each other and the selecting bars associated therewith are shown in the form of flat bars 4, while each subscriber's line is represented by a holding bar comprising three adjacent strips 5, 6 and 7 connected together at one end by an insulating piece 8 which in turn is connected to a plug 9 in a socket 10 and in which is located the subscriber's line lamp 11. An electrical connection may be made from this line lamp 11 through one of the holding bar strips, for example the sleeve strip 5 to a contact 12 at the rear of the switch when the holding bar is in normal position. One terminal of the lamp 11 may be connected to the sleeve strip 5 and the other connected to plug 9 which makes contact with the plate 13 in front of the structure which in turn may be connected to ground. Another connection may also be made for the ring strip 7 at contact 14 to battery when the selecting bar is in normal position. The purpose of these connections at contacts 12 and 14 will become apparent as the description proceeds. The link strips 1, 2 and 3 are provided with downwardly extending hooks 14, 15 and 16 which are bent at their ends in a common horizontal plane. The holding bars or subscriber's line strips 5, 6 and 7 are provided with hooked members 17, 18 and 19 for engagement with the hooks 14, 15, 16, respectively at the cross-points of the selecting and holding bars in a manner as will hereinafter be described. It should be noted that a plurality of cross-bar switches such as described have been shown in the drawings with one switch on top of the other. There may be any number of such switches arranged in this manner in an exchange depending only on the number of lines terminating therein. There may, for example, be ten switches horizontally arranged one on top of the

other and each switch may have ten subscribers' lines or holding bars. The link strips of the various switches may be strapped together in the manner illustrated in Fig. 3, that is two adjacent links in each switch are connected with the two corresponding ones in all the other switches arranged above or below them. The selecting bars 4 associated with the link strips are similarly connected together by vertical bars shown in diagrammatic form in Fig. 3, and indicated by the numeral 20 for the first link which are operated by solenoids 21 and 22 to rotate the connected selecting bars 4 or tilt them for the purpose of selecting as will hereinafter be described.

This mechanism operates as follows: If, for example, the magnet 23 associated with the last link and illustrated in dotted lines in Fig. 1 has been operated, the bar 24, also illustrated in dotted lines in this figure, causes the selecting bars 25 to 28 to be turned to the position shown and then plug 9 at 30 is pulled towards the left by the operator, the projections 17, 18 and 19 at 31 will be raised due to the humps on these projections and then lowered to a position where they will contact respectively with the hooks 14, 15 and 16 on the link strips at 33. A connection will therefore be established from a calling subscriber's line connected to the holding bar associated with the plug at 30 to the link strips at 34. These link strips may be named "calling link strips". In a similar manner, a called subscriber's line may be connected through a holding bar to the companion link strips that may be named "called link strips". It should be understood that as soon as the calling link strips have been connected the bars 4 of this link will be restored to normal and the selecting bar 4 of the companion called link strips will be automatically tilted so that the called line strips will be connected, when the called line plug is pulled out, with the called link strips of this link. It should be observed that the selecting bars 25, 26 and 28 will not disturb the projections 17, 18 and 19 on other holding bars, as for example, in the case of the bars at 35 which have already been operated, there is room enough for the selecting bar 25 to move into the tilted position shown due to the bent portion of the projections 17, 18 and 19 of this bar. Similarly in case of the selecting bar 26, the projections on the bar at 36, which has not been operated, will not be disturbed due to similar bent portions on the projections 17, 18 and 19.

Referring now to the operation of the circuit as shown in Fig. 3, it will be noted that the link circuit shown at 100 terminates in a calling end in the tip, ring and sleeve conductors at 101 multiplied to the corresponding calling link tip, ring and sleeve strips of the different layers of switches, the upper and lower of which have been shown in diagrammatic form. This link circuit also terminates in the called end in tip, ring and sleeve conductors at 102 multiplied to the corresponding called link tip, ring and sleeve strips of the different layers of switches. A connection from a calling subscriber's line such as 103 may therefore be extended through contacts at the cross connecting point 104 through the calling end of the link circuit at 100 over the called end of the link through, for example, a cross connecting point 105 to a called subscriber's line 106. The link 100 is shown as the first link in the system. A second link arrangement has been shown at 107. Normally, the first link circuit is preselected by the normal operation

of the magnet 21 which has operated to cause the rod 20 to tilt the various selecting rods 4 indicated in this figure merely by lines. These tilted bars 4, therefore, make it possible to connect a calling line with the calling end of the link 100. The circuit for magnet 21 may be traced from battery through an armature and back contact of relay 110, an upper armature and back contact of relay 111, through the winding of magnet 21 to ground.

If now the subscriber of line 103 removes his receiver from the switchhook the lamp 112 of this line will be lighted over a circuit from battery, contacts 14 associated with the ring strip over the ring conductor through the loop at the calling subscriber's station over his line 103, back over the tip conductor, through contacts 12 over the sleeve strip through the lamp 112 to ground. This indicates to the operator in attendance that this subscriber desires to make a call. She consequently pulls out the plug 9 of the calling subscriber's line bar and thereby establishes a connection between the tip, ring and sleeve strips of this line and the corresponding tip, ring and sleeve strips of the calling end of link 100 at cross connecting point 104. This connection at 104 is established in the manner described in connection with Figs. 1 and 2. In pulling out this plug the lamp 112 is extinguished as the connections through contacts 12 and 14 are opened. Relay 111 is now operated from battery and ground through its windings, tip and ring conductors of the calling end of the link through the connection at 104, the tip and ring conductors and the calling subscriber's loop. Relay 111 in operating closes a circuit for the lighting of lamp 113 from battery through the lower armature and front contact of relay 111, contacts of relays 114, 115 and 110, lamp 113 to ground. The lighting of this lamp indicates to the operator which link the calling subscriber's line is connected to. She consequently operates the talking key 116, and thereby connects her telephone set 117 to the link 100, answers the calling subscriber and receives the desired subscriber's number. When relay 111 operated the circuit hereinbefore traced for magnet 21 is opened at the upper armature and back contact of this relay and magnet 21 in releasing closes a circuit for the operation of the magnet 22 from battery, contacts of relays 115 and 114, winding of magnet 22, contacts of magnet 21 to ground. This magnet now prepares the selecting bars 4 of the called end of the link 100 for a connection to a called subscriber's line. It should of course be understood that the proper subscriber number may be marked on the front of the plate 13 or on the individual plugs for each subscriber's line. Consequently, the operator may now search for the called subscriber's number on this plate and when found pull out the corresponding plug 9; in this case the one leading to the subscriber of line 106 may be chosen. This causes a connection to be established at the cross connecting point 105 between the called end of the link over the tip, ring and sleeve conductors and the called subscriber's line 106. The connection for the sleeve conductors causes the operation of relay 115 from battery, contacts of relay 114, winding of relay 115, the sleeve conductor, point 105 and lamp 122 to ground. This lamp 122 does not receive sufficient current to light it at this time due to the resistance of the winding of relay 115. Relay 115 in operating closes a connection for lamp 124 which now lights over a circuit from

battery, contacts of relays 114 and 115, lamp 124 to ground. Relay 115 in operating also opens the circuit for magnet 22 at its outer right-hand armature and back contact causing this magnet to release and restore bars 4 to normal. This magnet closes at its armature and back contact a circuit to ground for the preselection of the magnet for the calling end of the next link, that is, in this case magnet 23 as noted in Fig. 3, so that this magnet will operate to prepare the next link for a call. The operator in observing the lighted lamp 124 knows that the called subscriber's line has been connected to the link and will therefore ring the called subscriber by operating the ringing key 126 in the usual manner.

When the called subscriber at 106 answers this call and the operator restores the ringing key 126, relay 114 operates from battery and ground through its windings, contacts of the ringing key 126, the connection through the tip and ring conductors over the called end of the link through the point 105 and the loop of the called subscriber's line 106. Relay 114 in operating opens the circuit for relay 115 which releases and extinguishes lamp 124. A connection is now established from the calling subscriber's line 103 to the called subscriber's line 106 through link 100, and talking batteries for these subscribers are supplied through windings of relays 111 and 114 and a talking connection through condensers 127 and 128.

After conversation is finished and, for example, the calling subscriber replaces his receiver on the switchhook the relay 111 is released. This relay closes a circuit for the operation of relay 110. This circuit may be traced from battery through contacts of relay 111, winding of relay 110, the calling end of the link, point 104, lamp 112 to ground. Lamp 112 does not receive sufficient current to light due to the resistance of the winding of relay 110. Relay 110 in operating closes an obvious circuit for the lighting of lamp 113. This indicates to the operator that the calling subscriber has hung up his receiver.

When the called subscriber hangs up his receiver relay 114 is released. This causes the operation of relay 115, and the lighting of lamp 124 over circuits hereinbefore traced. As both lamps 113 and 124 are now lighted, the operator will know that the connection through this link has been relinquished by both subscribers. It is now only necessary to restore the plugs 9 of the calling and called subscribers' lines in the switch in order to release these lines at the points 104 and 105 from the link and restore the link to common use. To identify the plug of the calling subscriber's line plug for this purpose the key 130 is operated repeatedly. This applies battery to the sleeve for lamp 112 and causes this lamp to flash which identifies lamp 112 as that of the calling subscriber associated with link 100 and the operator may then restore the corresponding plug 9 to release the connection to this subscriber. This causes the release of relay 110 and the extinguishing of lamps 113. The operator will then operate key 130 towards the right to similarly flash the lamp 122 of the plug 9 of the called subscriber's line. When this identification is made she restores the corresponding plug 9 to normal and opens the connection at 105, thereby restoring the relay 115 and extinguishing the lamp 124. The link 100 may then be used for other calls.

What is claimed is:

1. In a system comprising cross-bar switches, subscribers' lines, holding bars, selecting bars,

links, means for establishing a connection between a calling subscriber's line and a called subscriber's line over a link through a switch responsive to the automatic selection of two selecting bars and the manual operation of two holding bars, and manually operative means for identifying the two manually operated holding bars for the restoration thereof to normal to release said established connection.

2. In a system comprising cross-bar switches, subscribers' lines, holding bars, selecting bars, links, means for establishing a connection between a calling subscriber's line and a called subscriber's line over a link through a switch responsive to the automatic selection of two selecting bars and the manual operation of two holding bars, an operator's position, means responsive to the calling subscriber and called subscriber replacing their receivers on the switchhooks for identifying the engaged link, and manually operated means for identifying the two manually operated holding bars with said engaged link for the manual restoring of said bars to normal to release said established connection.

3. In a cross-bar switching system, subscribers' lines, selecting bars, holding bars, links, means for establishing a connection between a calling subscriber's line and a called subscriber's line over a link through a cross-bar switch in said system responsive to the automatic operation of two selecting bars and the manual operation of two holding bars, a signal associated with each subscriber's line, a key associated with each link, means responsive to the operation of the key of an engaged link for actuating the signals of the connected subscribers' lines to identify said lines with said engaged link, and means responsive to the manual restoring of said holding bars for releasing the established connection between the calling and the called subscribers' lines.

4. In a cross-bar switching system, subscribers' lines, selecting bars, holding bars, links, means for establishing a connection between a calling subscriber's line and a called subscriber's line over a link through a switch in said system responsive to the automatic operation of two selecting bars and the manual operation of two holding bars, a signal associated with each line, signals associated with each link, a key associated with each link, means for actuating the signals associated with the engaged link in response to the calling and called subscribers replacing their receivers on the switchhooks, means responsive to the actuation of the key associated with the engaged link for actuating the signals of said subscribers' lines for the identification of said subscribers' lines with said engaged link and means responsive to the restoring of the actuated holding bars for releasing the established connection.

5. In a cross-bar switching system, subscribers' lines, selecting bars, holding bars, links, each link having a calling branch and a called branch, means for establishing connections between a calling subscriber's line and the calling branch of a link and between a called line and the called branch of said link in response to the automatic operation of two selecting bars individual to said link and the manual operation of two holding bars individual to the calling subscriber's line and the called subscriber's line respectively, a signal associated with each subscriber's line, a signal associated with each branch of a link, means for actuating the signals of the engaged link in response to said subscribers replacing their receivers on the switchhooks, means for actuating said

subscribers' line signals to identify them with the engaged link, and means responsive to the manual restoring of the operated holding bars for releasing said connection and disabling the actuated signals.

- 5 6. In a telephone system, a cross-bar switch comprising manually operable holding bars and automatically operable selecting bars, links each controlled by a pair of automatically operated selecting bars, circuit means for preselecting a pair of selecting bars of a link, means responsive to the manual operation of two holding bars for establishing a connection between a calling subscriber's line and a called subscriber's line over said preselected link through said switch, and manually operative means for identifying the pair of manually operated holding bars with the engaged link for the manual restoring of said bars to release the connection.
- 10 7. In a telephone system, a cross-bar switch comprising manually operable holding bars and automatically operable selecting bars, links each controlled by a pair of automatically operated selecting bars, circuit means for preselecting a

pair of selecting bars of a link, means responsive to the operation of the two holding bars for establishing a connection between a calling subscriber's line and a called subscriber's line over said preselected link through said switch, manually operative means for identifying the pair of manually operated holding bars with the engaged link, and means responsive to the manual restoring of said operated holding bars for releasing the connection.

- 10 8. In a system comprising cross-bar switches, subscribers' lines, holding bars, selecting bars, links, means for establishing a connection between a calling subscriber's line and a called subscriber's line over a link to a switch responsive to the automatic selection of two selecting bars and the manual operation of two holding bars, a signal associated with each holding bar, and means for flashing the signals associated with the two manually operated bars for identifying said bars for restoring them to normal to release said established connection.

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