

Nov. 28, 1939.

H. A. LEWIS

2,181,191

TELEPHONE SYSTEM

Filed Dec. 16, 1938

2 Sheets-Sheet 1

FIG. 1

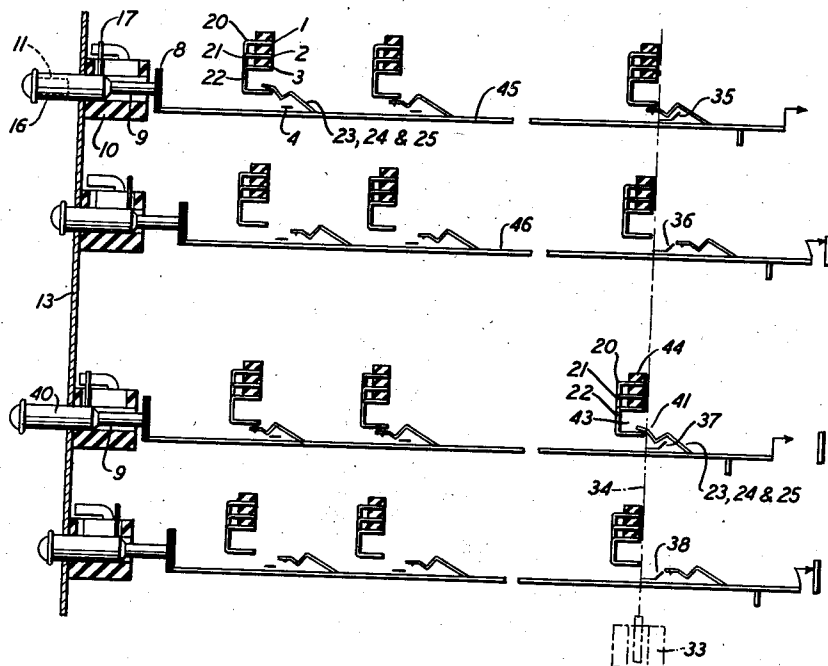
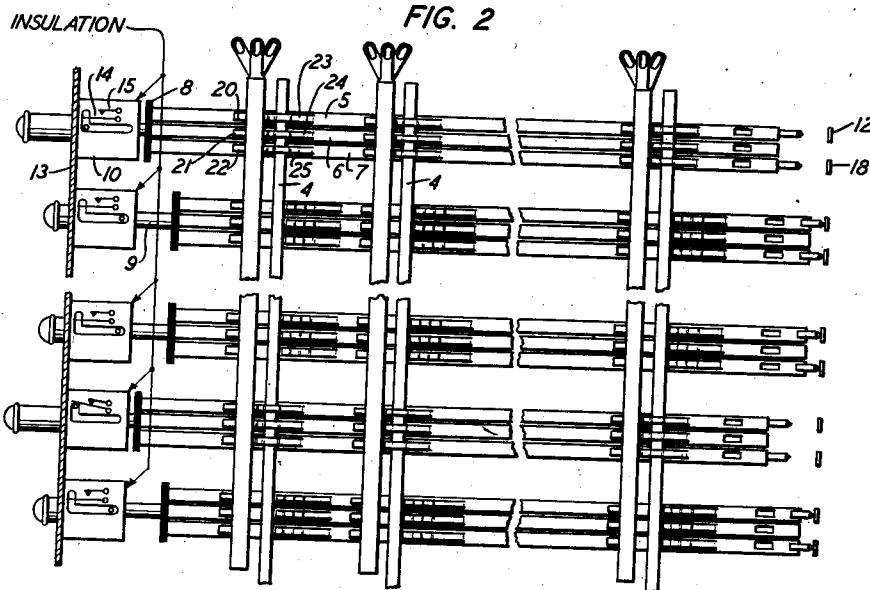


FIG. 2



INVENTOR
H. A. LEWIS

BY
M. J. McKenney
ATTORNEY

Nov. 28, 1939.

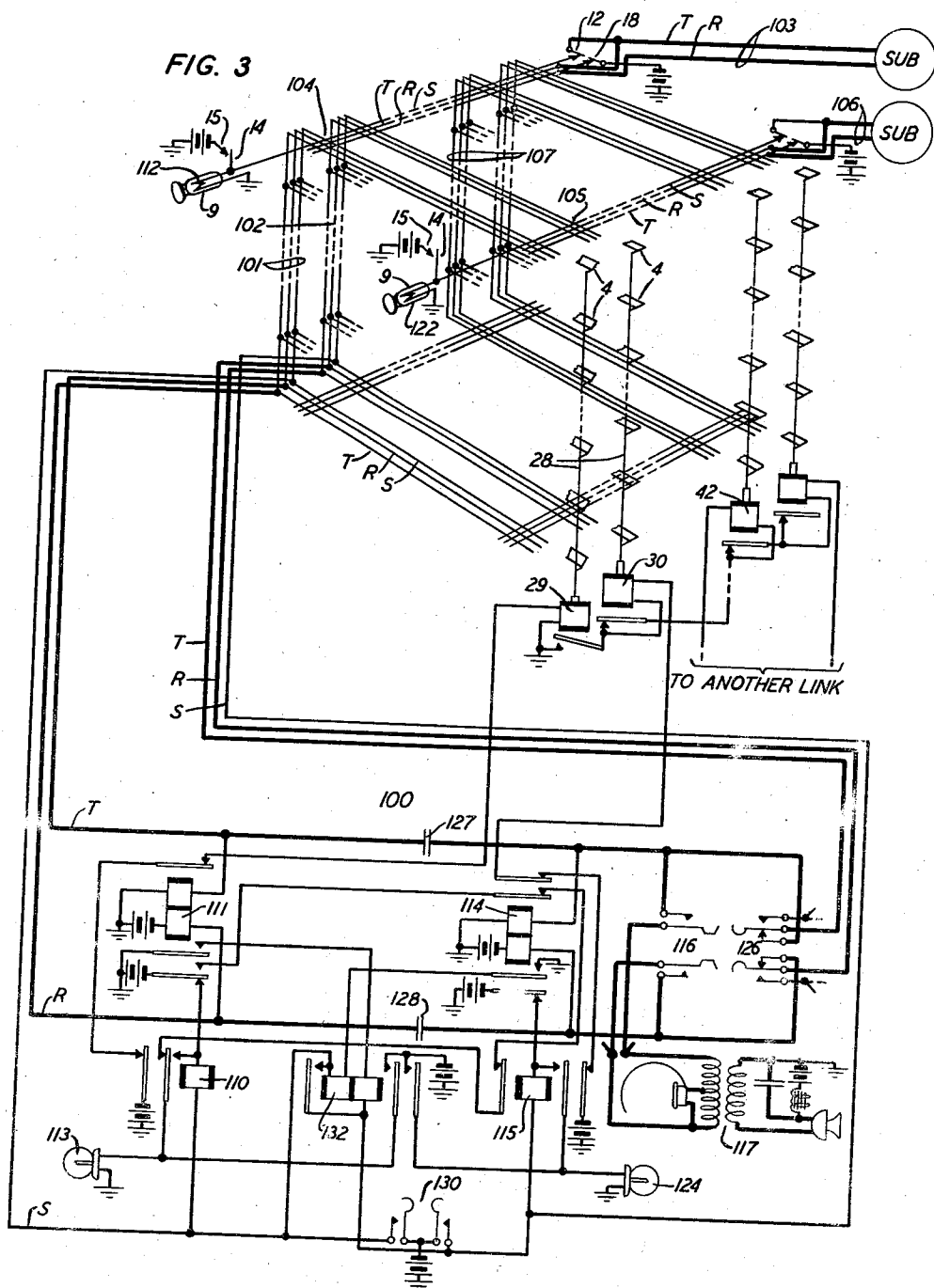
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INVENTOR
H. A. LEWIS

BY

W. T. McNamee

ATTORNEY

UNITED STATES PATENT OFFICE

2,181,191

TELEPHONE SYSTEM

Herbert A. Lewis, Bayside, N. Y., assignor to
Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application December 16, 1938, Serial No. 246,113

7 Claims. (Cl. 179-175.21)

This invention relates to telephone systems and particularly to the 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 mechanism 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 manually by the aid of cross-bar switch structures. Subscribers' lines may be associated with holding bars and connecting links with selecting bars in such structures. Each of said
15 links may have a calling branch and a called branch, each associated with an individual selecting bar. In such systems when a calling subscriber desires a connection with a called subscriber, the operator actuates the calling subscriber's holding bar to connect the calling line to the calling branch of a preselected link and then actuates the called subscriber's holding bar to connect the called line to the called branch of this link.

25 A system of this kind is disclosed in my Patent 2,107,158 of February 1, 1938 which relates to means whereby when the calling subscriber and the called subscriber replace their receivers on the switchhooks, lamps are lighted in the engaged link and whereby the operator can then
30 actuate a key in the engaged link to flash the line lamps to identify the engaged subscriber's lines with the engaged link so that she may release the connection by manually releasing the associated engaged holding bars.

35 The present invention has been disclosed in connection with the system of the above-mentioned patent and a patentable feature thereof is an arrangement in said system whereby when a connection has been established between a calling subscriber and a called subscriber, the operator may identify the engaged link or the connected subscribers with each other by turning a
40 knob or cap associated with either the calling subscriber's or the called subscriber's holding bar which causes a circuit arrangement to be operated to actuate the corresponding signal lamp in the calling or called branch of the engaged link to identify it.

50 The invention has been illustrated in the accompanying drawings in which:

Fig. 1 is a fragmentary side view in cross-section of the cross-bar switch structure as disclosed in the above-mentioned patent in which
55 the applicant's invention has been incorporated;

Fig. 2 is a fragmentary plan view of this switch structure; and

Fig. 3 is a circuit arrangement as disclosed in the above-mentioned patent with the applicant's invention incorporated therein with the cross-bar switches in accordance with Figs. 1 and 2
5 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
15 insulating piece 8 which in turn is connected to a plug 9 in a socket 10 and in which is located a subscriber's line lamp 11. An electrical connection may be made through one of the holding bars, for example, the sleeve 5 to a contact 12
20 at the rear of the switch when the holding bar is in normal position. One terminal of the lamp 11 may be connected to this sleeve strip 5 and the other terminal connected to plug 9 which makes contact with the plate 13 in front of the
25 structure which in turn may be connected to ground. The terminal of the lamp 11 connected to the sleeve strip 5 may also be connected to a spring 14 while a spring 15 may be connected to battery so that when the plug 9 with the lamp 11
30 therein pulled out is through the socket 10 and the lamp 11 and the surrounding sleeve 16 or knob are turned manually, in a counter-clockwise direction, the pin 17 attached to the sleeve 16 will rotate in a slot in socket 10 to engage the
35 spring 14 and move it to make electrical contact with the spring 15. Another connection may also be made between the ring strip 7 and the contact 18 to battery when the selecting bar is in normal position. The purpose of these various connections between contacts 14 and 15 and at 12 and 18 will be apparent as the description proceeds.

The link strips 1, 2 and 3 are provided with downwardly extending hooks 20, 21 and 22 which are bent at their ends in a common horizontal
45 plane. The holding bars 5, 6 and 7 are provided with hook members 23, 24 and 25 for engagement with the hooks 20, 21 and 22, respectively, at the cross-points of the selecting and holding bars in a manner as will hereinafter be described. It
50 should be noted that a plurality of cross-bar switches such as described, have been shown in a drawing with one switch on top of the other and there may be any number of such switches arranged in this manner in an exchange depend-
55

ing 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' line holding bars. The link strips of the various switches may be strapped together in a manner illustrated in Fig. 3, that is two adjacent links in each switch are connected with the two corresponding ones of 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 28 for the first link which is operated by solenoids 29 and 30 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 33 associated with the last line illustrated in dotted lines in Fig. 1 has been operated, the bar 34, also illustrated in dotted lines in this figure, causes the selecting bars 35 to 38 to be turned to the position shown and then plug 9 at 40, for example, is pulled out toward the left by the operator, the projections 23, 24 and 25 at 41 will be raised due to the lower humps on these projections and then lowered to a position where they will contact respectively with the hooks 20, 21 and 22 on the link strips at 43. A connection will therefore be established from a calling subscriber's line connected to the holding bar associated with the plug at 40 to the link strip at 44. 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 these links will be restored to normal and the selecting bars 4 of the companion called link strips will be automatically tilted so that the called line strips will be connected with the called link strips of this link, when the called line plug is pulled out. It should be observed that the selecting bars 35, 36 and 38 will not disturb the projections 23, 24 and 25 on other bars, as for example, in the case of bars at 45 which have already been operated. There is room enough for the selecting bar 35 to move into the tilted position shown due to the upper humps of the projections 23, 24 and 25 of this bar. Similarly in case of the selecting bar 36, the projections on the bars at 46 which have not been operated will not be disturbed due to the normal positions of the projections 23, 24 and 25.

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, and over the called end of the link through, for example, a cross-connection point 105 to a called subscriber's line 106. The link 100 is shown as the first link in

a system. Another link arrangement has been shown at 107. Normally the first link circuit is to be selected by the normal operation of the magnet 29 which has operated to cause the rod 28 to tilt the various selecting rods 4 indicated in this figure merely by lines. These tilted bars therefore make it possible to connect the calling line with the calling end of the link 100. The circuit for magnet 29 may be traced from battery through an armature and back contact of relay 110 and upper armature and back contact of relay 111 through the winding of magnet 29 to ground.

If now the subscriber of line 103 removes his receiver from the switchhook, lamp 112 of this line will be lighted over a circuit from battery, contacts 18 associated with the ring strip over the ring conductor through the loop of the calling subscriber's station, 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 this 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 the 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, lamp 112 is extinguished as the connections through contacts 12 and 18 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 and 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 29 is opened at the upper armature and back contact of this relay, and magnet 29 in releasing closes a circuit for the operation of magnet 30 from battery, contacts of relays 115 and 114, winding of magnet 30, contacts of magnet 29 to ground. This magnet now prepares the selecting bar 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's number may be marked on the front of the plate 13 or on individual plugs for each subscriber's line. Consequently, the operator may now search for the called subscriber's number 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 and 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, sleeve conductors, point 105 and lamp 122 to ground. The lamp 122 does not receive sufficient current at this time to cause it to light 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 30 at its outer right-hand armature and back contact, causing this magnet to release and restore bar 4 to normal. The magnet 30 now 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, in this case the magnet 42 may be operated so that this magnet will operate to prepare the next idle 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 of line 106 answers, the operator restores the ringing key 126 and relay 114 operates from battery and ground through its winding, 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 over 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 of a circuit 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 subscriber's line and called subscriber's line in the switch in order to release these lines at the points 104 and 105 from the link and thus restore the link to common use. To identify the plug of the calling subscriber's line for this purpose, the key 130 is operated repeatedly toward the left. This applies battery directly to the sleeve for lamp 112 and causes it to flash which identifies lamp 112 as that of the calling subscriber whose line is associated with link 100 and the operator may then restore the corresponding plugs 9 to release the connection to this subscriber. This causes the release of relay 110 and the extinguishing of lamp 113. The operator will then operate key 130 toward 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 which opens the connection at point 105 and the relay 115 is thereby restored and the

lamp 124 extinguished. The link 100 may now be used for other calls.

The arrangement in accordance with the invention, whereby when a connection has been established between a calling subscriber and a called subscriber the operator may identify the engaged link or the connected subscriber with each other, operates as follows. When the operator desires to make such an identification, she merely turns the plug 9 of, for example, the calling subscriber's line and this closes a connection between the corresponding contacts 14 and 15 of this line in a manner hereinbefore described in connection with Fig. 1. The closing of this circuit provides the operating circuit for relay 132 from battery through contacts 15 and 14, the connection over the sleeve through points 104, left-hand winding of relay 132 to ground at contacts of relay 114. Relay 132 in operating closes an obvious circuit for the operation of lamps 113 and 124 in the engaged link 100 thus identifying this link as being the one engaged by the subscriber of line 103. Similarly the operator may turn the plug 9 of the subscriber's line 106. This closes a circuit from battery through the contacts 15 and 14 over the sleeve conductor through the point 105, right-hand winding of relay 132 to ground at contacts of relay 111 to cause relay 132 to operate to light lamps 113 and 124.

It should also be noted that regardless of whether the plug of a calling subscriber's line or a called subscriber's line is turned, the lamps of both subscribers' lines are lighted. Thus the two connected subscribers' lines may be identified with each other. If the plug of the calling subscriber's line is turned the circuit for the lamp 112 is obvious and the circuit for lamp 122 may be traced as follows upon the operation of relay 132, from battery through contacts 14 and 15 of the calling subscriber's plug, point 104, the sleeve conductor, the left-hand armature and front contact of relay 132, sleeve conductor of the called subscriber's line, point 105, lamp 122 to ground. A similar circuit is provided for the lighting of lamp 112 in case the called subscriber's plug is rotated. In this case the circuit extends from battery through contacts 14 and 15 of the called subscriber's sleeve, point 105, left-hand armature and front contact of relay 132, the sleeve connection, point 104, lamp 112 to ground. This arrangement of identifying links with the subscribers' lines connected thereto or subscribers' lines with each other is useful in various types of traffic as, for example, in the case where the line of an executive is busy and a trunk call comes in that requires his immediate attention. In this case the operator should be able to tell with whom he is speaking and thus determine whether or not to break in on the conversation.

What is claimed is:

1. In a system comprising cross-bar switches, subscribers' lines, 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 responsive to the automatic selection of two selecting bars and the manual operation of two holding bars, and means responsive to the further manual operation of either of said two manually operated holding bars for identifying the associated link and either of the connected subscribers' lines.

2. In a system comprising cross-bar switches, subscribers' lines, 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 responsive to the automatic selection of two selecting bars and the manual operation of two holding bars, a cap associated with each of said holding bars, and means responsive to the rotation of the caps of either of said two manually operated holding bars for identifying the associated links.

3. In a system comprising cross-bar switches, subscribers' lines, 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 responsive to the automatic selection of two selecting bars and the manual operation of two holding bars, a rotatably mounted extension on each of said holding bars, and means responsive to the rotation of the extension on either of said two manually operated holding bars for identifying one with the other and the associated link.

4. In a system comprising cross-bar switches, subscribers' lines, 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 responsive to the automatic selection of two selecting bars and the manual operation of two holding bars, signaling means associated with said link, and means responsive to the further manual operation of either of said two manually operated holding bars for operating a signaling means of the associated link to identify it.

5. In a system comprising cross-bar switches, subscribers' lines, 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 responsive to the automatic selection of two selecting bars and the manual operation of two holding bars, signaling means associated with each holding bar, signaling means associated with said link, and means responsive to the further manual operation of either of said

two manually operated holding bars for operating the signaling means associated with said holding bars and the signaling means of the associated link to identify one engaged subscriber's line with the other and to identify the associated link.

6. 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 a called 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 subscribers' lines and the called subscribers' lines respectively, a signal associated with each branch of a link, means responsive to the further manual operation of the holding bar individual to the calling subscriber's line for actuating the signal associated with the calling branch of the engaged link to identify it, and means responsive to the further manual operation of the holding bar individual to the called subscriber's line for actuating the signal associated with a called branch of the engaged link to identify it.

7. 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, means responsive to the further manual operation of either of said two manually operated holding bars for identifying the associated link and manually operable means for identifying the two manually operated holding bars for the restoration thereof to normal to release said established connection.

HERBERT A. LEWIS.