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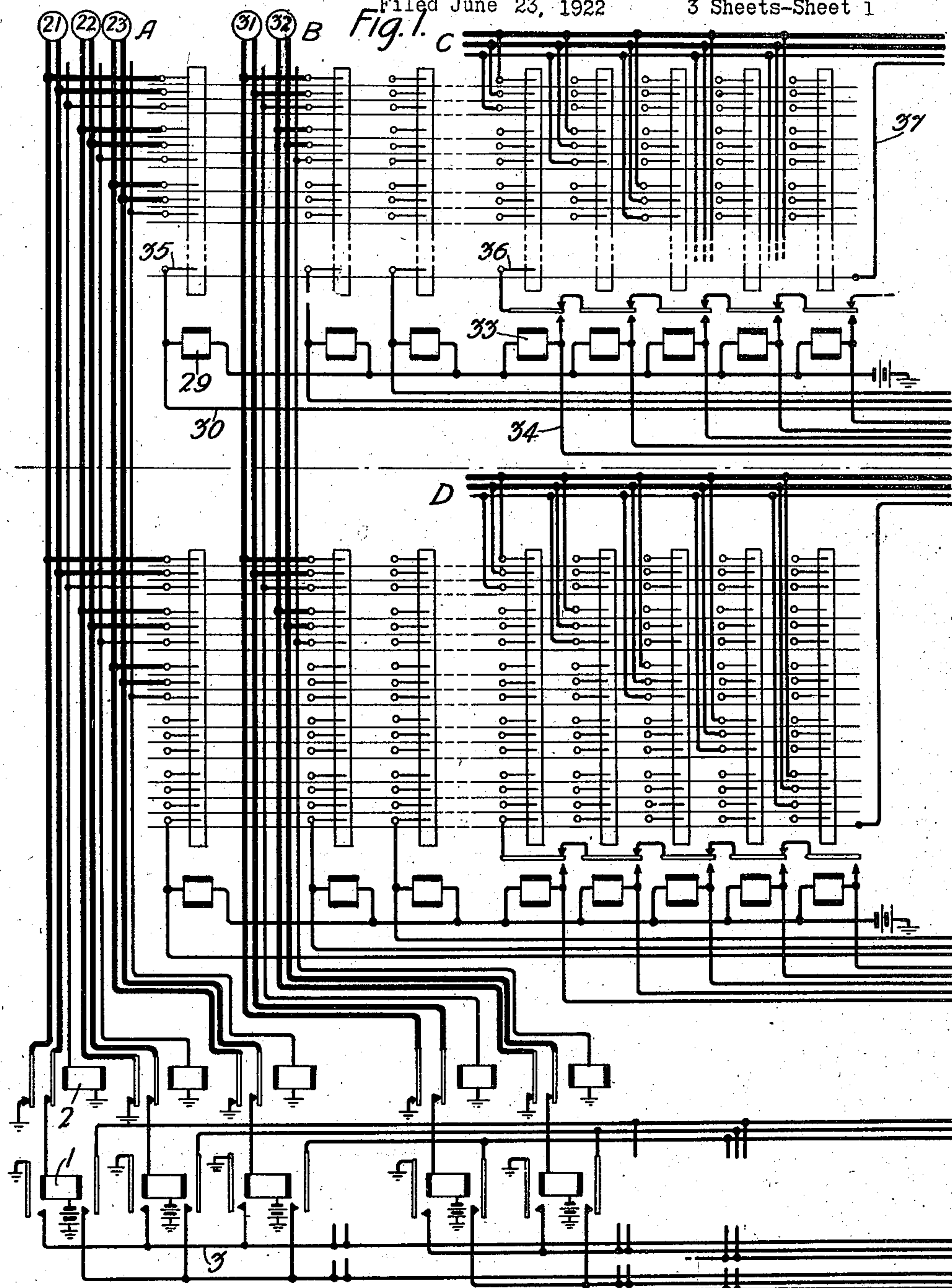
1,611,252

P. M. SNAVELY

SWITCHING SYSTEM

Filed June 23, 1922

3 Sheets-Sheet 1



Inventor:

Paul M. Snavely.

by

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Atty.

Dec. 21, 1926.

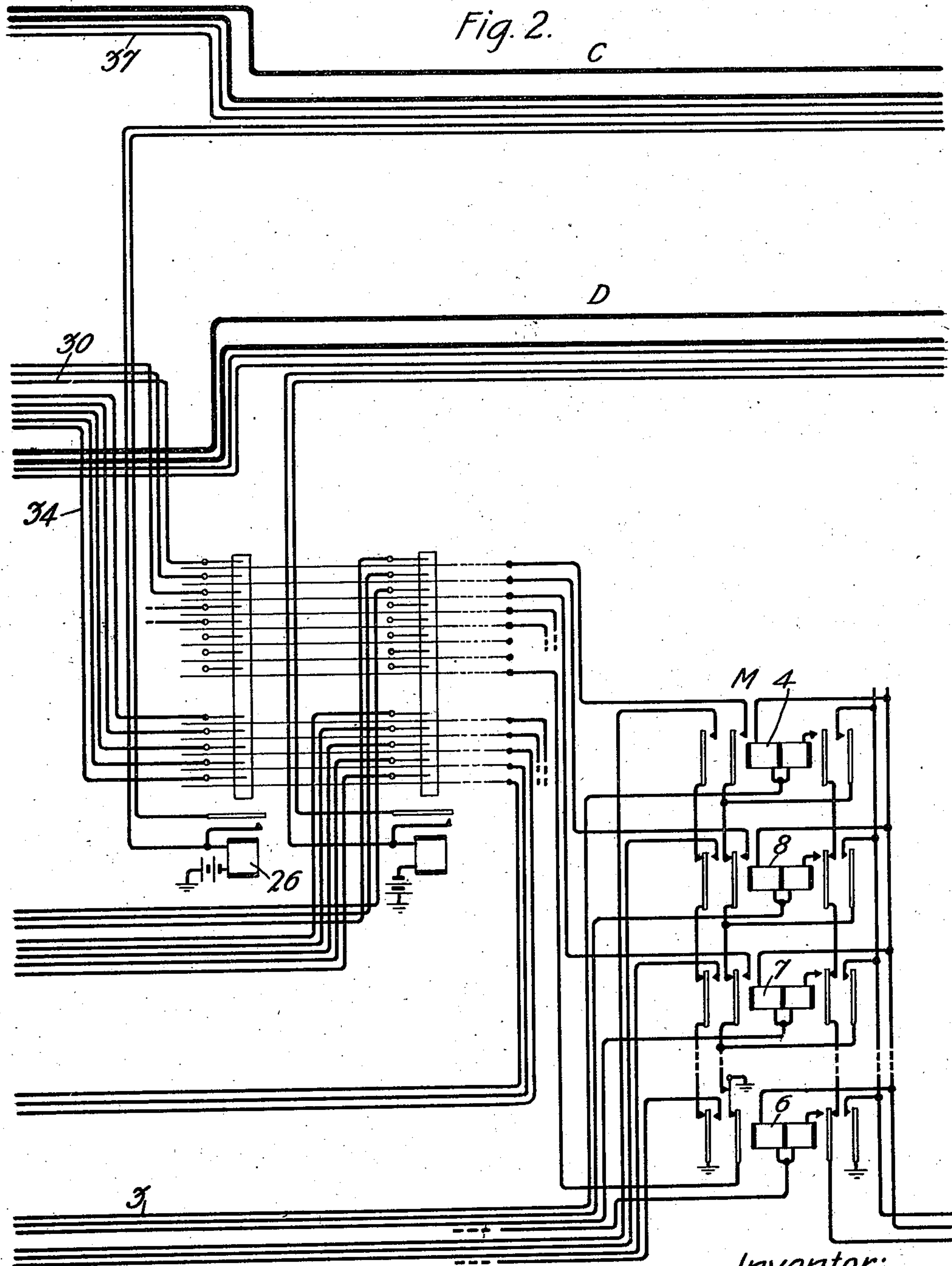
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3 Sheets-Sheet 2



Inventor:
Paul M. Snavely.
by *JEH* Att'y.

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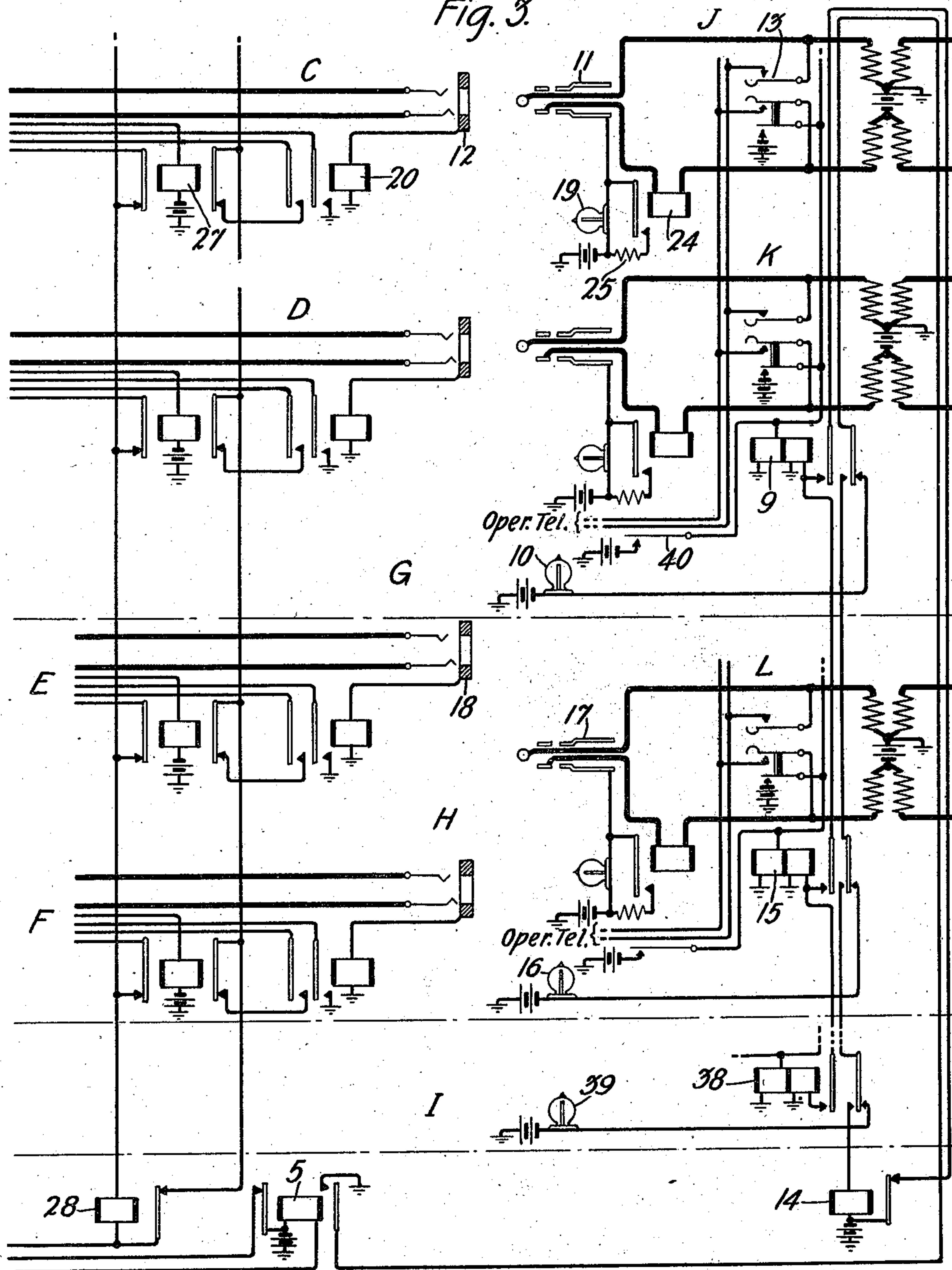
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Fig. 3.



Inventor:
Paul M. Snavely.

by *geston* Att'y.

UNITED STATES PATENT OFFICE.

PAUL M. SNAVELY, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SWITCHING SYSTEM.

Application filed June 23, 1922. Serial No. 570,289.

This invention relates to improvements in switching systems and has particular reference to methods and means for controlling the signals for telephone transmission lines.

5 An object of the invention is to control the connection of a subscriber's line to a link circuit by a change in the condition of said circuit.

10 Another object is to identify one of a plurality of groups of subscribers' lines and a line in said group by a change in the condition of a link circuit serving said group.

15 Another object is to equally distribute incoming calls amongst a plurality of operators' positions, each of which has a signaling device common to a number of link circuits terminating thereat, by signaling a different position each time a call is initiated.

20 The above and other objects will clearly appear from the following detailed description when taken in connection with the accompanying drawings wherein Figures 1 to 3, when arranged side by side as indicated by the lines extending to the margins of the drawings, illustrate a preferred embodiment of the inventive idea.

25 In carrying out the invention, the subscribers' lines are divided into groups, two of which are designated by the characters A and B, there being only three of the lines shown in group A and two in group B. Common to the various groups of lines are a plurality of link circuits, two of which are shown at C and D while others are partially indicated at E and F (Fig. 3). It will, of course, be understood that as many of these links may be provided as is necessary to adequately handle the calls originating in the various groups of subscribers' lines. At 40 the exchange where the link circuits terminate, operators' positions are provided, three of which are indicated at G, H and I in Fig. 3. Each position has terminating thereat a number of link circuits to which cord circuits such as J, K and L are adapted to be connected in order to extend the calls from the subscribers' lines. Due to economy in space, none of the link circuits for position I, which are similar to the links at the other positions, have been shown. The links associated with each position have a line signaling device common thereto which is operated, when a line is taken for use, to indicate to the operator at the position where the 55 signal is operated that a call is awaiting at-

tention. The invention contemplates the equal distribution of calls amongst the various operators, and to this end, means are provided, when one operator is busy responding to a call, to operate the signaling device before the next operator's position in the order of its appearance. That is, if the operator at position G is busy the signaling device at position H will be operated and so on until each operator has answered a call, 60 whereupon the operator at position G will then receive the next call incoming to the exchange and the sequence of operation throughout the various positions will be repeated as other calls are initiated. 70

When an operator receives an indication that a call is awaiting attention she connects one of her available cord circuits to the jack of an idle link circuit appearing before her position and then actuates her listening key 75 to prepare for the establishment of a connection from her telephone head set to the calling line. The insertion of the plug of the cord circuit into the jack of a link circuit initiates the operation of line finding apparatus associated with the seized link circuit. This apparatus is partly under the control of a mechanism M (Fig. 2) comprising a number of relays each of which is individual to a group of subscribers' lines. 85 Each line finding apparatus includes a number of multi-contact relays, certain of which are assigned to the several groups of lines, while others are individual to certain lines of each group. In the drawings (Fig. 1) 90 only three of the relays assigned to the groups and five of the number (say ten) which would ordinarily be assigned to the lines of the several groups are shown. Thus, when a link is taken by an operator one 95 group and one line identifying relay is operated under the control of the relay of the mechanism M common to the group of lines in which the call has been initiated. The closure of the contacts of the two operated 100 relays then connects the calling line through the link circuit to the operator's cord circuit and telephone head set. It is believed that the invention will now be fully understood from the following detailed description of the operation. 105

Assuming that a call is initiated on the subscriber's line designated 21 in group A, when the receiver is removed from its switch-hook at the subscriber's substation, the line 110

relay 1 individual to line 21 operates through contacts of the cut-off relay 2. The closure of the left-hand contact of relay 1 grounds the conductor 3 which is common to the subscribers' lines in group A. This ground connection is now extended through the left-hand winding of relay 4 of the mechanism M common to the lines of group A, and from thence to grounded battery through the normal contact of relay 5 which is common to the telephone lines of all of the groups. Relay 4 energizes in this circuit and in closing its inner right-hand contact establishes a locking circuit extending from grounded battery through the winding of relay 5, the right-hand normal contacts of relays 6, 7 and 8 of the mechanism M, the inner right-hand contact and right-hand winding of relay 4 and from thence to ground at the left-hand contact of relay 1. Assuming that the operators at the various positions G, H and I are idle and that no cord circuits are connected to the various links appearing at said positions, the operation of relay 5 connects ground through the right-hand contact of said relay, the normal contact of relay 9 individual to position G and from thence to grounded battery through the signaling device or lamp 10 which is common to the various link circuits such as C and D terminating at position G. The operator at the latter position is notified by the lighting of the lamp 10 in the circuit described therefor that a call is awaiting attention.

The operator at position G now inserts the plug 11 of a cord circuit J into the jack 12 of an idle link C and then operates the listening key 13 of the cord circuit to connect the tip and ring conductors thereof to her telephone head set indicated at OT. The closure of the lower contact of the key 13 connects battery to the left-hand winding of relay 9 which thereupon operates to open at its normal contact the circuit for lamp 10 which is then extinguished. The closure of the inner alternate contact of relay 9 establishes a locking circuit for said relay independent of the lower contact of the key 13, said circuit being traceable from ground through the right-hand winding and inner alternate contact of relay 9 and from thence to battery through the contact of relay 14 which is common to the various operators' positions. The closure of the outer alternate contact of relay 9 switches the conductor grounded at the alternate contact of relay 5 through said contact of relay 9 to the normal contact of relay 15 associated with position H. This action will not take place, however, before the link circuit C has been connected to the calling subscriber's line which results in the release of relay 5 as will hereinafter appear, since the time interval between the insertion of the plug 11 into jack 12 and the operation of the key 13 is ordi-

narly sufficient to permit of the complete operation of the line finding apparatus. Should the operator succeed in operating the key 13 before the calling line is connected to the link and relay 5 is released, the line signaling device or lamp 16 associated with the position H will be momentarily lighted through the normal contact of relay 15, but as soon as relay 5 releases lamp 16 will be extinguished. If the operator at position H should, in response to the lighting of the lamp 16, insert the plug 17 of the cord circuit L into jack 18 of an idle link circuit such as E, this operation will have no effect upon the system and the operator at said position will be unsuccessful in establishing a connection to the calling subscriber's line, as will later be described in detail. When the operator at position G connects the cord circuit J to link C a circuit is established from grounded battery through supervisory lamp 19, sleeve contacts of plug 11 and jack 12 and the winding of relay 20 to ground. The lamp 19 is lighted in this circuit and remains in this condition until the calling line is connected to the link circuit by the operation of the line finding apparatus, whereupon the supervisory relay 24 of the cord circuit J operates in a manner well known in the art to include the resistance 25 in parallel with lamp 19 whereupon said lamp is extinguished. The extinguishment of this lamp then serves as an indication to the operator that she may converse with the calling subscriber.

Relay 20 also operates in the circuit above described and in closing its left-hand contact, establishes a circuit for multi-contact relay 26 individual to link C, said circuit extending from grounded battery through the winding of relay 26, the outer left-hand contact of relay 20, the right-hand contact of relay 27, the contact of relay 28, the outer right-hand contact of relay 4 and from thence to ground through the inner left-hand normal contacts of relays 8, 7 and 6 in series. Relay 26 energizes and establishes a locking circuit for itself extending from grounded battery through its winding and lowermost contact, the left-hand contact of relay 27, the winding of relay 28 and from thence to ground over the energizing circuit of relay 26. Relay 28 energizes in this circuit and in so doing disconnects the left-hand contacts of the sleeve relays associated with all of the other link circuits from the outer right-hand contacts of relays 4, 6, 7 and 8. This disconnection prevents any other relay similar to relay 26 of the other link circuits from operating should an operator at one of the other positions make a connection to one of said link circuits before the link circuit C is connected to the calling line 21, which circumstance may occur if, as previously described, the lamp 16 should be

lighted. The operation of relay 26 establishes a circuit for group identifying relay 29 of the link circuit C, which relay is assigned to group A, said circuit being traceable from grounded battery through the winding of relay 29, conductor 30, the uppermost switching contact of relay 26, the inner left-hand contact of relay 4 and from thence to ground at the left-hand normal contact of relay 6 through the inner left-hand normal contacts of relays 8 and 7. Simultaneously with the closure of the circuit of relay 29 another circuit is established for the line identifying relay 33 of the link C assigned to the line of each group, the units digit of which is 1. This circuit is traceable from grounded battery through the winding of relay 33, conductor 34, lowermost switching contact of relay 26, the right-hand contact of line relay 1, the outer left-hand contact of relay 4 and the outer left-hand normal contacts of relays 8, 7 and 6 to ground. Relays 29 and 33 lock through their windings and respective lowermost switching contacts 35 and 36 and from thence over the common conductor 37 to ground at the inner left hand contact of relay 20. The operation of relays 29 and 33 results in the connection of the tip, ring and sleeve conductors of the telephone line 21 through the uppermost sets of switching contacts of relays 29 and 33 to the three conductors of the link circuit C. A circuit is now established for relay 27 and cut-off relay 2 of the line 21, said circuit extending from grounded battery through the winding of relay 27, the third from the uppermost switching contacts of relays 33 and 29 and the winding of cut-off relay 2 to ground. The latter relay in operating causes the release of relay 1 and the removal of ground from the conductor 3, thus opening the locking circuit of relay 4 and the holding circuit of relay 5, said relays thereupon releasing. The opening of the left-hand contact of relay 27 causes the release of relays 26 and 28, the latter of which in closing its normal contact, now permits of the operation of a relay such as relay 26 associated with some other link circuit when the latter is taken for use.

If, during the establishment of the connection of line 21 with the link circuit C, another call should be initiated in group A, the line relay individual to the calling line would be operated to also ground the common conductor 3 so that when relay 1 is released, said conductor would remain grounded and relays 4 and 5 would remain operated. The continued operation of the latter relay would cause the lighting of the lamp 16 at position H through the outer alternate contact of relay 9 and the normal contact of relay 15. Following the connection of line 21 to the link circuit C relay 28 would release as pre-

viously described regardless of the continued connection of ground to the conductor 3. In response to the lighting of the lamp 16, the operator at position H may now connect the plug 17 of her cord circuit L with the jack 18 and the operation of the line finding apparatus associated with the link circuit E would then be effected in the same manner as that described in connection with the link circuit C. The operator at position H, in actuating the listening key of cord circuit L, causes the energization and locking of relay 15 which thereupon switches the conductor grounded by the operation of relay 5 to the normal contact of relay 38 located at the operator's position I. In this manner the next call incoming to the exchange would cause the lighting of the lamp 39 at position I so that said call would be handled by the operator at this position. After each one of the operators has answered a call and the relay 38 has operated (assuming that this relay is associated with the last operator's position) a circuit is established for relay 14 extending from grounded battery through its winding the right-hand alternate contacts of relays 38, 15 and 9 in series and the alternate contact of relay 5 to ground, the latter relay being operated in response to the last call incoming to the exchange which was taken care of by the operator at position I. Relay 14 operates in the circuit described therefor and in opening its contact disconnects battery from the locking windings of relays 9, 15 and 38, whereupon these relays all release followed by the release of relay 14. The next call received at the exchange will now cause the lighting of lamp 10 at position G and succeeding calls will thereafter be distributed to the other operators' positions in the order of their appearance as has been previously described. Should an operator leave her position, means are provided for preventing the signaling device at her position, such as the lamp 10, from lighting and for passing an incoming call on to the next position in order. This means may comprise a device, such as the key 40 which, when operated, energizes relay 9 which remains energized until the key is released. The opening of the normal contact of relay 9 prevents the lamp 10 from being lighted and transfers the ground at relay 5 to the normal or outer alternate contact of relay 15.

When the call has been terminated on the line 21 the supervisory relay 24 of the cord circuit is released, thus causing the lamp 19 to be lighted as a signal to the operator that the link circuit C is no longer engaged. The operator then withdraws the plug 11 from the jack 12 following which the relay 20 releases to remove ground from its right-hand contact and thus open the

locking circuits of relays 29 and 33. These relays thereupon release to restore their switching contacts to normal and thus disconnect the line 21 from the link circuit C. Relays 2 and 27 then release and the apparatus is again in its normal condition.

What is claimed is:

1. In a telephone system, subscribers' lines, operators' positions, link circuits for interconnecting said subscribers' lines and said positions, cord circuits at said positions, and switching means directly and jointly responsive to a connection between one of said cord circuits and one of said link circuits, and a calling condition of one of said lines for connecting said calling line to said one of said link circuits.

2. In a telephone system, subscribers' lines, operators' positions, link circuits for interconnecting said subscribers' lines and said positions, cord circuits at said positions, and a line finder directly and jointly responsive to a connection between one of said cord circuits and one of said link circuits, and a calling condition on one of said lines for connecting said calling line to said one of said link circuits.

3. In a telephone system, subscribers' lines, operators' positions, link circuits for interconnecting said subscribers' lines and said positions, cord circuits at said positions and a relay line finder directly and jointly responsive to a connection between one of said cord circuits and one of said link circuits, and a calling condition on one of said lines for connecting said calling line to said one of said link circuits.

4. In a signaling system, groups of subscribers' lines, operators' positions, a plurality of link circuits common to said groups of lines, a plurality of cord circuits, means responsive to a connection between one of said cord circuits and one of said link circuits for connecting a subscriber's line to said circuit and a plurality of relays, each common to the lines of a group for controlling the last named means.

5. In a signaling system, groups of subscribers' lines, operators' positions, a plurality of link circuits for interconnecting said lines and said positions, and switching devices, certain of which are individual to different groups of lines and others to lines in each group, operable in response to a connection to one of said link circuits for connecting a subscriber's line to an operator's position through said link circuit.

6. In a signaling system, groups of subscribers' lines, operators' positions, a plurality of link circuits for interconnecting said lines and said positions, and switching devices, certain of which are individual to different groups of lines and others to lines in each group, operable in response to a connection to one of said link circuits by

an operator for connecting one of said lines to an operators' position through said link circuit.

7. In a signaling system, groups of subscribers' lines, operators' positions, a plurality of link circuits for interconnecting said lines and said positions, switching devices, certain of which are individual to different groups of lines and others to lines in each group, operable in response to a connection to one of said link circuits for connecting a subscriber's line to an operator's position through said link circuit and means common to said group of lines for controlling said switching devices.

8. In a signaling system, groups of subscribers' lines, operators' positions, a plurality of link circuits for interconnecting said lines and said positions, switching devices, certain of which are individual to different groups of lines and others to lines in each group, operable in response to a connection in one of said link circuits for connecting a subscriber's line to an operator's position through said link circuit and a plurality of relays, each common to the lines of a group, for controlling said switching devices.

9. In a signaling system, groups of subscribers' lines, a line relay for each line, operators' positions, a plurality of link circuits for interconnecting said lines and said positions, a mechanism common to said groups of lines, switching devices associated with each link circuit and responsive to a connection to a link circuit for joining a subscriber's line to said link circuit, certain of said switching devices being individual to groups of lines and controlled by said common mechanism and others of said switching devices being individual to lines in each group and jointly controlled by said common mechanism and said line relays.

10. In a signaling system, a plurality of subscribers' lines, a plurality of operators' positions, a group of link circuits terminating at each of said positions, a plurality of cord circuits at each of said positions, a signaling device at each position common to the group of link circuits terminating thereat, means responsive to a call on one of said lines for operating the signaling device at only one of said positions, means for connecting any of the said cord circuits to any idle link circuit at said position, means responsive thereto for extending the said calling subscriber's line through the said idle link circuit to the said cord circuit, and means for operating the signaling devices at other operators' positions in rotation.

11. In a signaling system, a plurality of subscribers' lines, a plurality of operators' positions, a group of link circuits terminating at each of said positions, a plurality of cord circuits at each of said positions, a

- signaling device at each position common to the group of link circuits terminating thereat, means responsive to a call on one of said lines for operating the signaling device at only one of said positions, means for connecting any of the said cord circuits to any idle link circuit at said position, means responsive thereto for extending the said calling subscriber's line through the said idle link circuit to the said cord circuit, and means for operating the signaling device at the next operator's position in the order of its appearance when another call is initiated on one of said lines.
12. In a signaling system, a plurality of subscribers' lines, a plurality of operators' positions, a group of link circuits terminating at each of said positions, a plurality of cord circuits at each of said positions, a signaling device at each position common to the group of link circuits terminating thereat, means responsive to a call on one of said lines for operating the signaling device at only one of said positions, means for connecting any of the said cord circuits to any idle link circuit at said position, means responsive thereto for extending the said calling subscriber's line through the said idle link circuit to the said cord circuit, means for operating the signaling device at another operator's position in response to another call on one of said lines, and means for preventing the operation of the signaling device at the first-named position until the signaling devices at all of the other positions have been operated.
13. In a signaling system, a plurality of subscribers' lines, an operator's position, a plurality of link circuits terminating at said position, an operator's cord circuit, a signaling device associated therewith, means responsive to the connection of said cord circuit to one of said link circuits for joining a subscriber's line to said link circuit, and means for disabling said signaling device when said subscriber's line is joined to said link circuit.
14. In a signaling system, a subscriber's line, an operator's position, a link circuit terminating thereat, a cord circuit, a signaling device, means responsive to a connection between said cord circuits and said link circuits at said operator's position for joining said subscriber's line to said link circuit, and means for disabling said signaling device when said subscriber's line is joined to said link circuit.
- In testimony whereof, I have signed my name to this specification this 21st day of June, 1922.
- PAUL M. SNAVELY.