Jan. 8, 1924. 1,480,202

C. L. GOODRUM

TELEPHONE SYSTEM

Filed Dec. 17, 1919 2 Sheets-Sheet 1

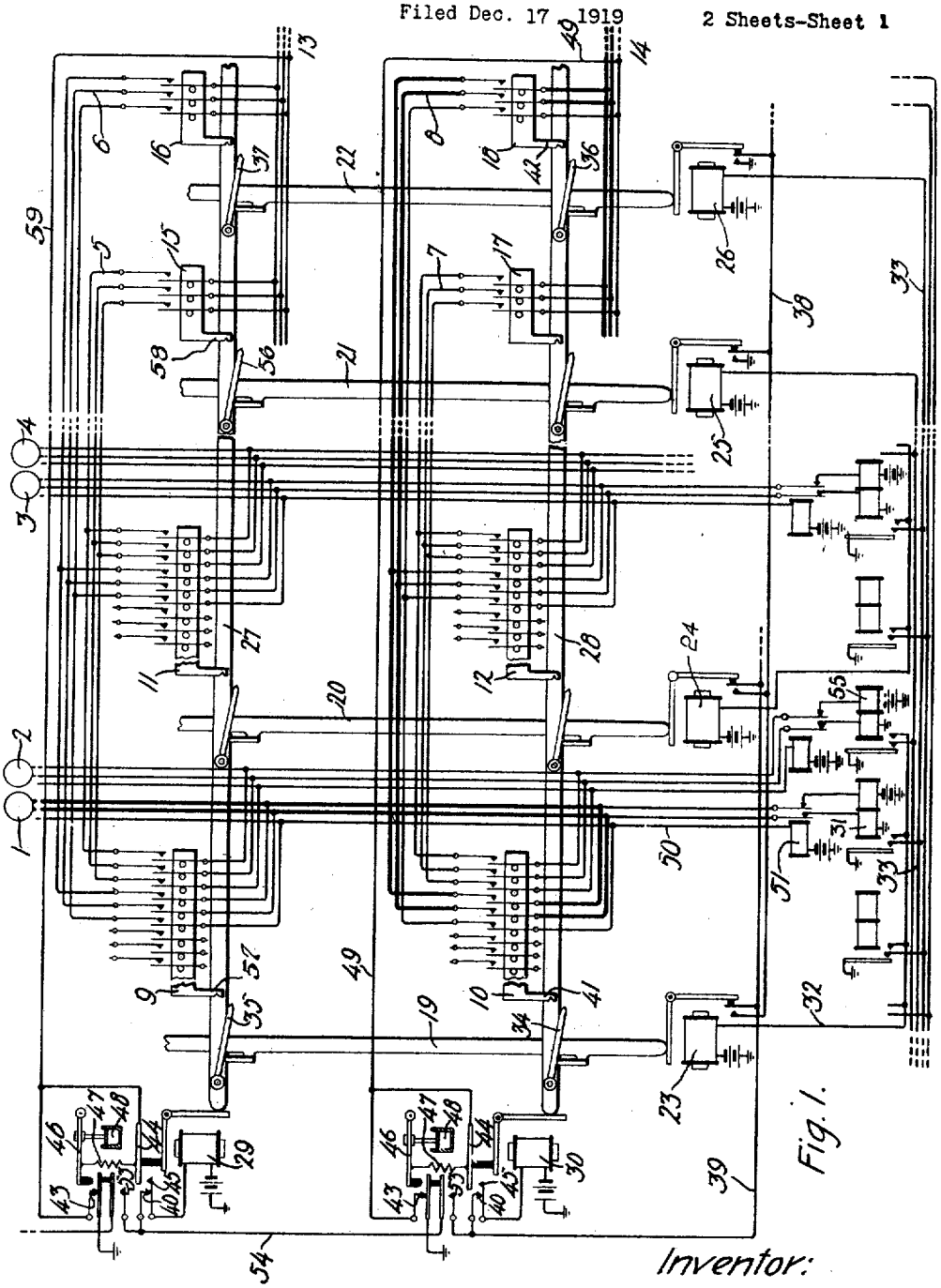


Fig. 1.

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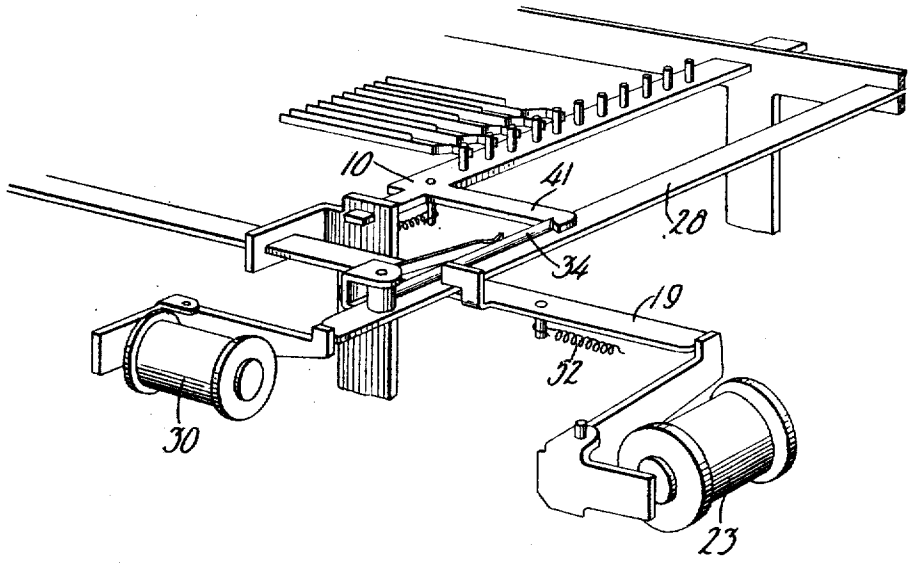
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Fig. 2.



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Patented Jan. 8, 1924.

1,480,202

UNITED STATES PATENT OFFICE.

CHARLES L. GOODRUM, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

Application filed December 17, 1919. Serial No. 345,499.

To all whom it may concern:

Be it known that I, CHARLES L. GOODRUM, a citizen of the United States, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to machine switching telephone systems and more particularly to a system in which all the switching operations are accomplished by means of relays and in which each operation is instantaneous, there being no time lost in trunk-hunting as all the trunks stand preselected and ready for instant use.

In my copending application, Serial No. 519,857, filed December 5, 1921, which is a continuation of application Serial No. 340,566, filed November 25, 1919, I have disclosed a system provided with an arrangement of mechanical bars operated by magnets common to a group of lines. In this disclosure it was necessary to have at least one bar always in an actuated position in order to have a trunk preselected.

The present invention is an improvement over the arrangement disclosed in the aforesaid application, Serial No. 519,857 in that the number of relay and magnet windings per line is still further reduced, the system of mechanical bars is greatly simplified and the normal condition of the apparatus is one of rest.

The object then of the present invention is to provide a system in which the interconnection of lines is accomplished through the use of simple movement mechanisms all of which are normally at rest. By simple movement is meant single movement in one direction—in extent something in the order of a fraction of an inch. Thus there is no step-by-step movement nor is there a movement over a distance more than sufficient to establish a single connection.

In accordance with this invention there is provided a switching mechanism at the crossing point of each group of lines and each group of transfer circuits. To actuate these switching mechanisms, there is provided a set of bars, one individual to each group of lines for preparing the switching mechanisms for operation, and a set of bars, one individual to each group of transfer circuits for actuating those switching mechanisms which have been prepared for operation by said first-named bars. These last bars also function to hold the operated switching mechanisms in position during the existence of a connection.

Also in accordance with this invention, the normal condition of the apparatus is one of rest, no trunk bars being operated to preselect an idle trunk. This invention contemplates a system in which the first idle trunk is always preselected, though no movement of the apparatus associated therewith has been made.

Further, in accordance with this invention, a magnet for operating the trunk bar has been provided having a plurality of armatures, one of which is quick to respond to the energization of the magnet and another of which is slow to respond to the energization of the magnet. The circuit for the energization of this magnet is originally closed when a call is initiated and is immediately broken by the quick-acting armature. However, a holding circuit is immediately established through the quick-acting armature and subsequently opened by the slow-acting armature. In the meantime or in response to the energization of the magnet, a third circuit is established for holding the magnet energized and this circuit is closed between the time of the operation of the quick-acting armature and the operation of the slow-acting armature. The original circuit for the energization of this trunk bar magnet, after being opened by the quick-acting armature, is subsequently closed by the slow-acting armature and extended to the magnet controlling the next trunk bar.

The drawings diagrammatically illustrate the preferred embodiment of the invention. Fig. 1 is a diagrammatic illustration of a small group of switching mechanisms together with the circuits for operating them; Fig. 2 is a perspective view of a single switching mechanism showing in detail the arrangement of the various bars for operating the same.

In Fig. 1 there is shown two grups of lines, the first group containing lines 1 and 2 and the second group containing lines 3 and 4. Crossing both of these groups of lines are two groups of transfer circuits, the first containing transfer circuits 5 and 6 and the second containing transfer circuits 7 and 8. There is a switching mechanism

9 at the crossing point of the first group of lines and the first group of transfer circuits; a switching mechanism 10 at the crossing point of the first group of lines and the second group of transfer circuits; a switching mechanism 11 at the crossing point of the second group of lines and the first group of transfer circuits; a switching mechanism 12 at the crossing point of the second group of lines and the second group of transfer circuits. The first group of transfer circuits 5 and 6 are individual to a trunk 13 and the second group of transfer circuits 7 and 8 are individual to a trunk 14. Transfer circuit 5 is connected to trunk 13 through a switching mechanism 15; transfer circuit 6 is connected to the trunk 13 through a switching mechanism 16; transfer circuit 7 is connected to the trunk 14 through the switching mechanism 17, and transfer circuit 8 is connected to the trunk 14 through the switching mechanism 18. Individual to the first group of lines 1 and 2, there is a bar 19 which prepares the switching mechanisms 9 and 10 for operation; individual to the second group of lines 3 and 4 there is a bar 20 which prepares the switching mechanisms 11 and 12 for operation; individual to the corresponding transfer circuits 5 and 7 there is a bar 21 which prepares the switching mechanisms 15 and 17 for operation, and individual to the corresponding transfer circuits 6 and 8 there is a bar 22 which prepares switching mechanisms 16 and 18 for operation. Magnets 23, 24, 25 and 26 are provided to actuate bars 19 to 22 inclusive, respectively.

Assuming that magnets 23 and 26 have been actuated and that switching mechanisms 9, 10, 16 and 18 have been prepared for operation, then either trunk bar 27 or 28, upon being operated, through the operation of magnets 29 or 30, would cause the actuation of switching mechanisms 9 and 16 or 10 and 18, whereupon the calling lines in the first group will be switched to either trunk 13 or 14.

We will assume that line No. 1 initiates a call. Thereupon the line relay 31 will be energized in the usual manner, and upon attracting its armature, will place a ground on conductors 32 and 33. Ground placed on conductor 32 will cause the energization of magnet 23, and ground placed on conductor 33 will cause the energization of magnet 26, thereupon bars 19 and 22 will become operated and lift the latches 34 and 35 associated with bar 19, and latches 36 and 37 associated with bar 22. The operation of magnets 23 and 26 also establishes a connection from ground, the contact and armature of magnet 26, conductor 38 and contact and armature magnet 23, conductor 39, contact 40 controlled by magnet 30, winding of magnet 30 to battery and ground. Magnet 30 actuates the bar 28 whereupon the lathes 34 and 36 come into engagement with the arms 41 and 42 of switching mechanisms 10 and 18 respectively and cause the actuation of switching mechanisms 10 and 18. Immediately upon the actuation of magnet 30, the contact 40 is opened but magnet 30 is held energized through a connection from ground, contact 43, armature 44, contact 45 and the winding of magnet 30. The armature 46 is put under a tension by the spring 47 and does not immediately move into its actuated position due to the retardation caused by the dash pot 48.

As soon as the switching mechanisms 10 and 18 are actuated, line 1 is extended through the middle set of three armatures and contacts of switching mechanism 10, over the transfer circuit 8, through the contacts and armatures of switching mechanism 18 to the trunk 14. Thereupon and in accordance with well-known practice, a ground will be placed on the third conductor 49. A circuit is now closed from this ground through the third conductor, contacts and armatures of switching mechanisms 18 and 10, to contact 50 and thence through the winding of cut-off relay 51 to battery and ground. Relay 51 attracts its armatures and causes the deenergization of line relay 31 whereupon magnets 23 and 26 are deenergized when the bars 19 and 22 return under the influence of springs such as 52, to their normal positions. Shortly after the bars 19 and 22 have returned to their normal positions, the armature 46 moves into its actuated position whereupon the ground of conductor 49 ordinarily provided through the contact 43 is removed, and the conductor 39 is extended through the contact 53 to conductor 54, whereby the magnet 29 is made available for the next incoming call.

During the existence of the connection, the ground on conductor 49 holds magnet 30 operated whereby the bar 28 is continuously operated and the switching mechanisms 10 and 18 are held in their actuated positions.

When the conversational period is over and the calling subscriber places the receiver on its hook in accordance with my previously filed invention, the ground is removed from conductor 49 whereupon magnet 30 and relay 51 become deenergized and the apparatus returns to its normal position.

If during the existence of a connection established as previously described from the substation 1 to the idle trunk 14, a second substation 2 in the same subgroup as substation 1 initiates a connection, line relay 55 individual to the line of substation 2 becomes energized and at its inner armature contact again establishes the previously traced circuit for the line bar magnet 23 which is common to all of the lines of the

subgroup to which substations 1 and 2 belong. At its outer armature contact, line relay 55 establishes a circuit for magnet 25. In the manner previously described magnets 23 and 25 become energized, magnet 23 lifting latch 35 and magnet 25 lifting latch 56. Latches 34 and 36 are not moved out of their operated positions at this time since they are locked in the notches in the arms 21 and 42 by the operated bar 28.

Upon the energization of magnets 25 and 23 a circuit is established for the magnet 29 associated with bar 27 individual to the next idle trunk 13 which may be traced from ground at the armature contact of magnet 25, conductor 38, the armature contact of magnet 23, conductor 39, contact 53, conductor 54, contacts 40 and 45, to battery through the winding of magnet 29. Magnet 29 operates bar 27 whereupon the latches 35 and 56 come into engagement with the arms 57 and 58 of switching mechanisms 9 and 15, respectively and cause their operation. A connection is now extended from the substation 2 to the trunk 13 and magnets 23 and 25 thereupon become deenergized, the established connection being maintained by the continued energization of magnet 29, this magnet being locked over conductor 59. In this manner magnet 23 may be repeatedly operated to serve in the establishment of a plurality of coexisting connections.

What is claimed is:

1. In a telephone system, groups of lines, groups of transfer circuits, a switching mechanism at the crossing point of each group of lines and group of transfer circuits for connecting said lines to said transfer circuits, a trunk line associated with each group of transfer circuits, a switching mechanism individual to each transfer circuit for connecting said transfer circuit to said trunk, a bar individual to each group of lines for preparing the switching mechanisms associated therewith for operation, a bar individual to each transfer circuit of a group and common to the corresponding transfer circuits of each group for preparing the switching mechanisms associated therewith for operation, and a bar individual to each group of transfer circuits for actuating the prepared switching mechanism.

2. In a telephone system, groups of lines, groups of transfer circuits, a switching mechanism at the crossing point of each group of lines and group of transfer circuits for connecting said lines to said transfer circuits, a trunk line associated with each group of transfer circuits, a switching mechanism individual to each transfer circuit for connecting said transfer circuit to said trunk, a bar individual to each group of lines for preparing the switching mechanisms associated therewith for operation, a bar individual to each transfer circuit of a group and common to the corresponding transfer circuits of each group for preparing the switching mechanism associated therewith for operation, a bar individual to each group of transfer circuits for actuating the prepared switching mechanisms, and magnets for operating said bars.

3. In a telephone system, groups of lines, groups of transfer circuits, a switching mechanism at the crossing point of each group of lines and group of transfer circuits for connecting said lines to said transfer circuits, a trunk line associated with each group of transfer circuits, a switching mechanism individual to each transfer circuit for connecting said transfer circuit to said trunk, a bar individual to each group of lines for preparing the switching mechanisms associated therewith for operation, a bar individual to each transfer circuit of a group and common to the corresponding transfer circuits of each group for preparing the switching mechanisms associated therewith for operation, a bar individual to each group of transfer circuits for actuating the prepared switching mechanism, said last named bar being arranged to lock said actuated switching mechanisms in position.

4. In a telephone system, groups of lines, groups of transfer circuits, a switching mechanism at the crossing point of each group of lines and group of transfer circuits for connecting said lines to said transfer circuits, a trunk line associated with each group of transfer circuits, a switching mechanism individual to each transfer circuit for connecting said transfer circuit to said trunk, a bar individual to each group of lines for preparing the switching mechanisms associated therewith for operation, a bar individual to each transfer circuit of a group and common to the corresponding transfer circuit of each group for preparing the switching mechanisms associated therewith for operation, a bar individual to each group of transfer circuits for actuating the prepared switching mechanism, means for operating said preparing bars, means for operating said actuating bars, and means responsive to the actuation of said last-named bars for releasing said first-named bars.

5. In a telephone system, groups of lines, groups of transfer circuits, a switching mechanism at the crossing point of each group of lines and group of transfer circuits for connecting said lines to said transfer circuits, a trunk line associated with each group of transfer circuits, a switching mechanism individual to each transfer circuit for connecting said transfer circuit to said trunk, a bar individual to each group of lines for preparing the switching mechanisms associated therewith for operation, a bar individual to each transfer circuit of a

group and common to the corresponding transfer circuits of each group for preparing the switching mechanisms associated therewith for operation, a bar individual to each group of transfer circuits for actuating the prepared switching mechanism, means under control of a line of one of said groups for operating the bar individual to that group of lines, and for operating a particular one of said bars individual to said transfer circuits, and means under the control of said operated bars for operating one of said bars individual to a group of transfer circuits whereby said line is connected to the trunk corresponding to the group of transfer circuits included in the said connection.

6. In a telephone system, groups of lines, groups of transfer circuits, a switching mechanism at the crossing point of each group of lines and group of transfer circuits for connecting said lines to said transfer circuits, a trunk line associated with each group of transfer circuits, a switching mechanism individual to each transfer circuit for connecting said transfer circuit to said trunk, a bar individual to each group of lines for preparing the switching mechanisms associated therewith for operation, a bar individual to each transfer circuit of a group and common to the corresponding transfer circuits of each group for preparing the switching mechanisms associated therewith for operation, a bar individual to each group of transfer circuits for actuating the prepared switching mechanism, means under control of a line of one of said groups for operating the bar individual to that group of lines, and for operating a particular one of said bars individual to said transfer circuits, and means under the control of said operated bars for operating one of said bars individual to a group of transfer circuits whereby said line is connected to the trunk corresponding to the group of transfer circuits included in the said connection, and means under control of said last operated bar for releasing said first operated bars.

7. In a telephone system, a group of trunks, a magnet individual to each trunk for controlling the connections of lines to said trunk, said magnet being provided with a plurality of armatures one quickly responsive to the energization of said magnet and another slowly responsive to the energization of said magnet, and a circuit for the energization of said magnet closed by said quick-acting armature and subsequently opened by said slow-acting armature.

8. In a telephone system, a group of trunks, a magnet individual to each trunk for controlling the selection of said trunk, said magnet being provided with a plurality of armatures one quickly responsive to the energization of said magnet and another slowly responsive to the energization of said magnet, a circuit closed upon the selection of the trunk for energizing the magnet of the first of said trunks, said circuit being broken by said quick-acting armature, a holding circuit for said magnet being thereupon closed by said quick-acting armature and subsequently opened by said slow-acting armature, a third circuit for holding said magnet energized and means for closing said third circuit, responsive to the energization of said magnet.

9. In a telephone system, a group of trunks, a magnet individual to each trunk for controlling the selection thereof, said magnet being provided with a plurality of armatures one quickly responsive to the energization of said magnet and another slowly responsive to the energization of said magnet, a circuit closed upon the selection of a trunk for energizing the magnet of the first idle one of said trunks, said circuit being opened by said quick-acting armature and subsequently closed by said slow-acting armature; said circuit being thereby extended to the next idle trunk.

10. In a telephone system a group of trunks, a magnet individual to each of said trunks for controlling the selection thereof, said magnet being provided with a plurality of armatures, one quickly responsive to the energization of said magnet, and another slowly responsive to the energization of said magnet, a circuit closed upon the selection of a trunk for energizing the magnet of the first idle one of said trunks, said circuit being thereupon broken by said quick-acting armature and subsequently extended by said slow-acting armature to the next idle one of said trunks, and means for opening said circuit after said quick-acting armature has operated and before said slow-acting armature has operated.

11. In a telephone system, telephone lines, a group of trunks to which said lines may be extended, a magnet individual to each trunk for controlling the selection of said trunk, said magnet being provided with a plurality of armatures, one quickly responsive to the energization of said magnet and another slowly responsive to the energization of said magnet, a circuit closed upon the initiation of a call on one of said lines for energizing the magnet of the first idle trunk, said circuit being thereupon opened by said quick-acting armature and subsequently extended by said slow-acting armature to the magnet of the next idle trunk, a holding circuit for said magnet being closed by said quick-acting armature and subsequently opened by said slow-acting armature, and a second holding circuit for said magnet and means for closing said last-named holding circuit responsive to the energization of said magnet.

12. In a telephone system, incoming lines, transfer circuits, an outgoing line having multiple contacts corresponding to said transfer circuits, separately movable switching mechanisms, incoming line magnets, outgoing line magnets, and means including a bar cooperating with said magnets to actuate and to maintain actuated a plurality of said switching mechanisms to extend said incoming lines through said transfer circuits to said outgoing line.

13. In a telephone system, incoming lines, groups of transfer circuits, outgoing lines, switching mechanisms, incoming line magnets, outgoing line magnets corresponding in number to the number of transfer circuits in a group, and means including a bar independent of said switching mechanisms cooperating with said magnets to actuate said mechanisms to extend said incoming lines through said transfer circuits to said outgoing lines, said bar also acting to maintain said mechanisms actuated throughout the connection.

14. In a telephone system, incoming lines, groups of transfer circuits outgoing lines, separately movable switching mechanisms, incoming line magnets, outgoing line magnets corresponding in number to the number of transfer circuits in a group, and means including a bar cooperating with said magnets to actuate a plurality of said switching mechanisms to extend said incoming lines through said transfer circuits to said outgoing line, said bar also acting to maintain said mechanisms actuated throughout the connection.

15. In a telephone system, incoming lines, transfer circuits, outgoing lines, separately movable switching mechanisms for connecting said incoming lines to said transfer circuits, separately movable switching mechanisms individual to each of said transfer circuits for connecting them to said outgoing lines, magnets for said switching mechanisms, and means including bars for cooperating with said magnets to actuate a plurality of said switching mechanisms whereby said incoming lines may be extended through said transfer circuits to said outgoing lines, said bars also acting to maintain said mechanisms throughout the connection.

In witness whereof, I hereunto subscribe my name this 12th day of December A. D., 1919.

CHARLES L. GOODRUM.