H. E. HERSHEY.

AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED NOV. 28, 1913.

1,251,023.

Patented Dec. 25, 1917.

2 SHEETS—SHEET 1.

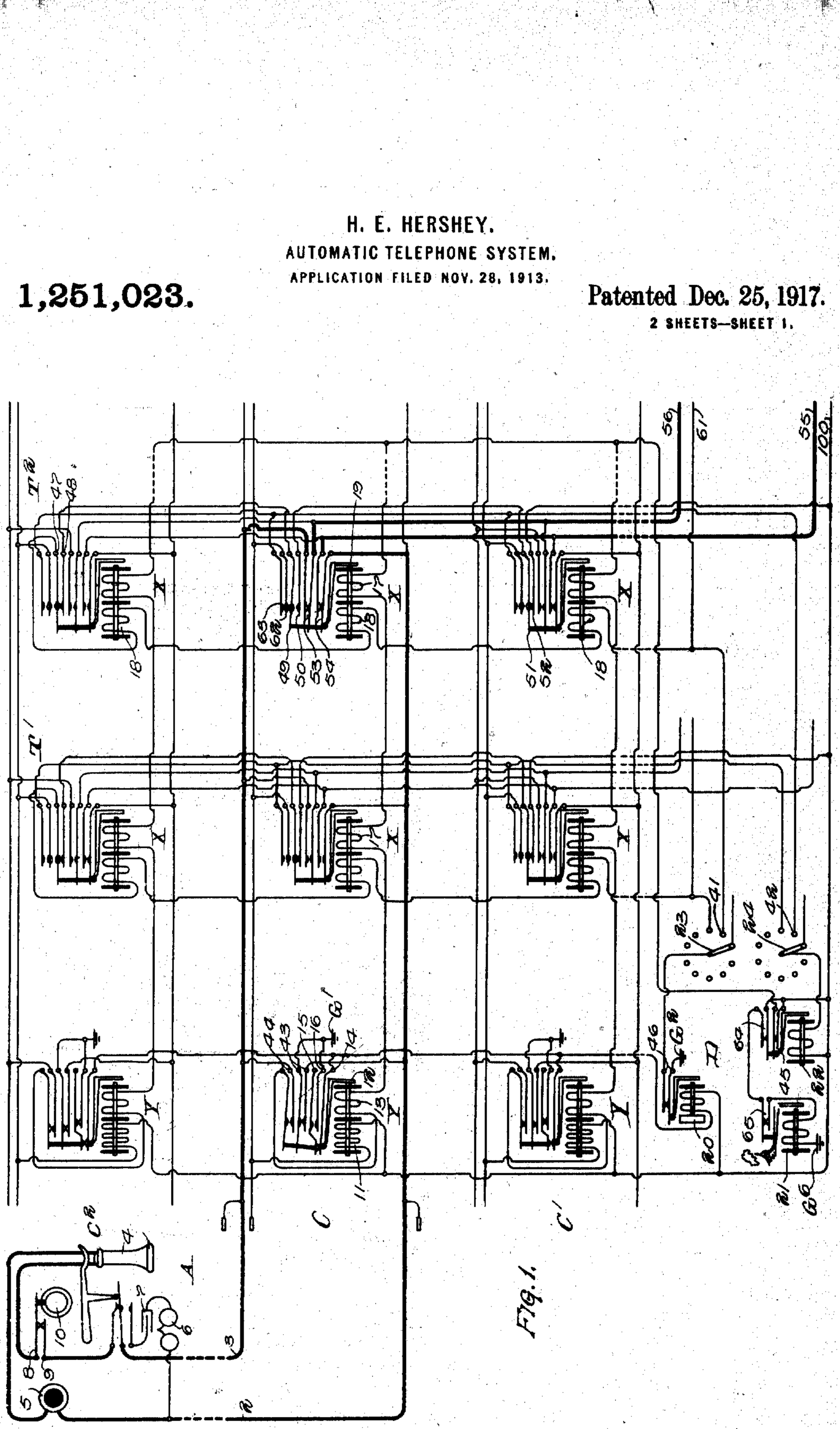

FIG. 1.

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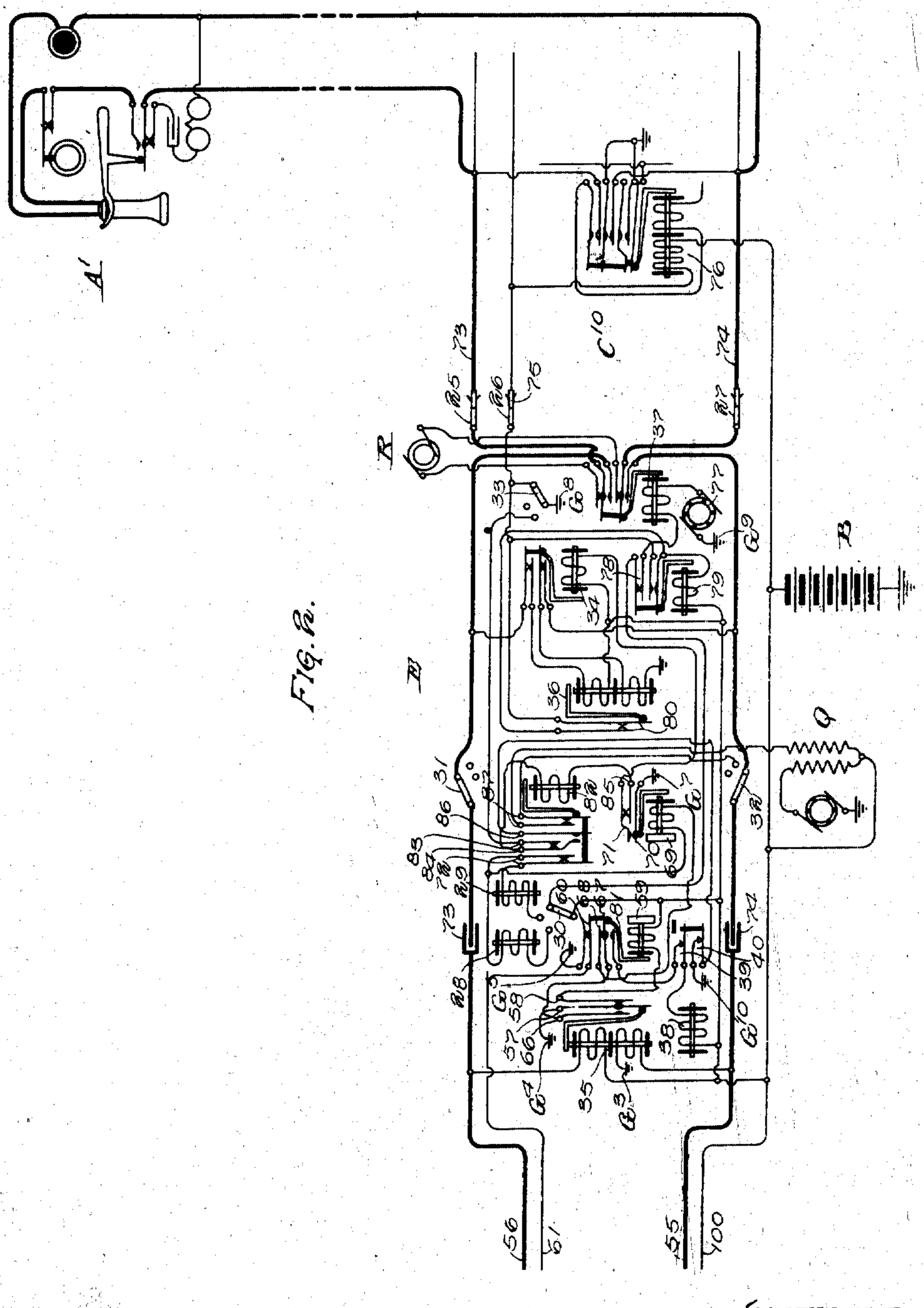

FIG. 2.

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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE SYSTEM.

1,251,023. Specification of Letters Patent. Patented Dec. 25, 1917.

Application filed November 28, 1913. Serial No. 803,523.

To all whom it may concern:

Be it known that I, HARRY E. HERSHEY, a citizen of the United States of America, and resident of White Water, Butler county, Kansas, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

My invention relates to improvements in automatic telephone systems, and more particularly to means employed for selecting an idle trunk.

Heretofore, in an automatic telephone system, it has been customary to provide rotary or other forms of movable line switches for automatically selecting an idle trunk. By my invention I avoid the use of such line switches, and accomplish the trunk-selecting by means of a group of relays. With this arrangement each subscriber's line is provided with such a group of relays and when the receiver is removed from the hook, certain of these relays are operated in order to extend connection from the subscriber's line to an idle trunk. In order to avoid interference between subscribers having access to the same group of trunks, these groups of relays are controlled by a master switch in such a manner that no two subscribers can establish connection with the same trunk at one and the same time.

My invention will be more clearly understood by reference to the accompanying drawings, in which I have shown my invention in connection with an automatic telephone system in which my improved relay arrangement is employed for selecting an idle trunk extending from a subscriber's line to a connector switch, through which connector switch the connection is completed with the called line. It will, of course, be understood that in larger exchanges, instead of having the selected trunk extend directly to a connector switch in this manner, suitable selector switches can be interpolated and thus increase the capacity of the exchange. Likewise, my improved means for selecting an idle trunk could be equally as well employed in other places in the system where, heretofore, the usual non-numerical trunk-selecting switches have been employed.

Referring to the drawings, Figures 1 and 2 represent a complete connection between a calling substation A and a called substation A′ in a telephone system embodying the principles of my invention.

The substation A is connected with the central office through the conductors 2 and 3 which terminate in a group of relays C governed by the master switch D. By means of these relays the line is extended to the connector E, which latter then completes the connection to the called subscriber's station.

The substation A shown herein may be of any suitable or approved type and comprises the usual receiver 4, transmitter 5, ringer 6 and condenser 7. Being an automatic substation it is also provided with an impulse transmitter or calling device which is represented herein by a pair of impulse springs 8 and 9 and an impulse wheel 10, which latter is assumed to be controlled through the medium of a finger hole dial (not shown) in such a manner that the impulse springs 8 and 9 may be momentarily separated a number of times, corresponding to each digit of the number to be called.

At the central office the line is provided with a bridge-cut-off relay Y and a number of relays X, there being one relay for each trunk that the line of the substation A may be connected with. The bridge-cut-off relay Y consists of a double-wound coil, the bridge-cut-off winding 11 of which operates the armature 12 to the limit of its motion, while the line winding 13 is only strong enough to cause the armature 12 to bring the springs 14 and 15 into engagement without breaking contact between the springs 15 and 16. Each relay X consists of a line winding 17 and a trunk winding 18, it requiring the combined efforts of the two windings to operate the armature 19.

The master switch D consists of the slow acting control relay 20, the motor magnet 21 and the starting relay 22. The motor magnet 21 operates a shaft (not shown), which causes the wipers 23 and 24 to be rotated over their respective banks of contacts. The apparatus is so designed that, upon the energization of the motor magnet 21, the wipers 23 and 24 are rotated a distance equal to the space between two adjacent bank contacts.

The connector switch E is of the same general type of connector switch disclosed in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson

and Erickson, the circuits, however, being modified to adapt the switch to operate in a system in which the central office apparatus is controlled by impulses delivered over two sides of the line in series, in the manner shown in British Patent No. 1419 of 1910 to T. G. Martin. The connector is provided with a shaft (not shown) carrying the wipers 25, 26 and 27. The shaft is controlled by the vertical magnet 28 and the rotary magnet 29. The usual side switch comprising the wipers 30, 31, 32 and 33 is controlled by the private magnet 34 in the usual and well-known manner. The operations of the switch are controlled through the medium of the double-wound line relay 35, through which the calling subscriber receives talking current. The called subscriber receives talking current through the so-called back-bridge relay 36. The ringing relay 37 is the means through which ringing current is applied to the called line. Means for permitting the switches to be restored to normal position are provided in the release magnet 38, which, upon energizing, withdraws the retaining pawls from the shaft. The springs 39 and the springs 40 are permitted to close only when the switch shaft has been raised one or more steps from its lowest position.

Having given a general description of the apparatus, I will now explain in detail the operations by which one substation establishes connection with another in a system embodying the principles of my invention. It will be explained how the substation A may obtain connection with the substation A′. It will be assumed that the number of the substation A′ is 22.

The drawings indicate a complete connection between a calling and a called line. Under these conditions the wiper 23 of the master switch D has been moved from the contact corresponding to the trunk line employed in establishing this connection onto the next succeeding contact, which operation will be more fully hereinafter described. Accordingly, in explaining the manner in which this connection between the substation A and the substation A′ is established, it will be assumed that the wiper 23 of the master switch D is at this time resting upon the contact 41 and that the wiper 24 is resting upon the contact 42.

Upon the removal of the receiver from the switch-hook at the substation A preparatory to making a call, a circuit is formed from ground G' through the springs 43, conductor 2 to and through the substation A, conductor 3, springs 44, the line winding 13 of the bridge-cut-off relay Y of the line A, through the line winding of the relay X of the line A (which is associated with the trunk T'), through the line winding of the relay X of the line A (which is associated with the trunk T^2) and through the springs 45 of the master switch start relay 22 to battery B. The flow of current over this circuit does not energize the relays X sufficiently to operate their armatures, but this current through the line winding of the bridge-cut-off relay Y causes the armature 12 to force the spring 14 into engagement with the spring 15 without separating the spring 15 from the spring 16. A circuit is thus formed from ground G' through the springs 16, 15 and 14 and the control relay 20 to battery B. The relay 20, upon energizing, closes a circuit from ground G^2 through the springs 46, wiper 23, contact 41 (assuming the wiper 23 to be resting on the contact 41 at the time), through the trunk winding 18 of the relay X of the group C' associated with the trunk T^2, through the trunk winding 18 of the relay X of the group C associated with the trunk T^2, through the trunk winding 18 of the relay X of the group C^2 associated with the trunk T^2, through the springs 47 and 48, springs 49 and 50 and the springs 51 and 52 to battery B. The flow of current over this circuit does not alone energize the relays X sufficiently to operate their armatures, but it will readily be seen that the relay X of the group C associated with the trunk T^2 has both its line winding 17 and the trunk winding 18 energized, and as a result the armature 19 is operated. When the armature 19 forces the springs 53 and 54 into engagement, the line of the substation A is extended to the line relay of the connector E. A circuit may now be traced from ground G^3 through the lower winding of the line relay 35, conductor 55, springs 54, conductor 2 to and through the substation A, conductor 3, springs 53, conductor 56 and the upper winding of the relay 35 to battery B. The line relay 35, upon becoming energized over the above circuit, closes a circuit from ground G^4 through the springs 57 and 58 and the relay 59 to battery B. The relay 59, when energized, places ground from G^5 upon the bank contact 41 to take the place of ground G^2, which will presently be removed. This circuit may be traced from ground G^5 through the springs 60 and the conductor 61 to the bank contact 41. The relay 59 also prepares a circuit for the vertical magnet 28 at the spring 67 and 68 and opens the circuit of the release magnet 38 at the springs 67 and 81. The spring 49 is adjusted to make contact with the spring 62 before it breaks contact with the spring 50, and at the time the springs 49, 50 and 62 are in engagement it will be seen that the winding 11 of the bridge-cut-off relay Y of the group C is shunted by the battery B; but when the spring 50 breaks contact with the spring 49, a circuit may be traced from ground G^5 to the conductor 61, through the

trunk winding 18 of the relay X of the group C' associated with the trunk T^2, through the trunk winding 18 of the relay X of the group C associated with the trunk T^2, through the trunk winding 18 of the relay X of the group C^2 associated with the trunk T^2, through the springs 47 and 48, springs 49 and 62 and the bridge-cut-off winding 11 of the bridge-cut-off relay Y of the group C to battery B. The insertion of this comparatively high resistance bridge-cut-off winding 11 in the circuit decreases the current through the trunk windings of the relays X to a point which will hold the armature 19 in an operated position, but which, in combination with a line winding, will not be sufficient to operate an armature such as the armature 19 when said armature is at normal. Were this not the case, the relays X of the groups C' or C^2 would energize when the subscribers to whom these relays are allotted removed their receivers to make a call, regardless of the position of the master switch D. The flow of current in the circuit just traced causes the armature 12 to be operated to the full extent of its motion, thus removing battery and ground from the line at the springs 43 and 44, and also opening the circuit of the control relay 20 at the springs 15 and 16. The control relay being slow acting maintains the ground G^2 upon the bank contact 41 for an instant longer, to guard against any delay on the part of the relay 59 (Fig. 2) in putting ground on the trunk-release conductor 61. The springs 49, 50, 62 and 63 are so adjusted that at the time the spring 50 breaks contact with the spring 49, the spring 62 will be in engagement with the spring 63. At this time a circuit may be traced from the grounded trunk-release conductor 61 through the trunk winding 18 of the relay X of the group C' associated with the trunk T^2, through the trunk winding 18 of the relay X of the group C associated with the trunk T^2, through the trunk winding 18 of the relay X of the group C^2 associated with the trunk T^2, through the springs 47 and 48, springs 49, 62 and 63, bank contact 42, wiper 24 and the start relay 22 to battery B. The start relay 22, upon energizing, closes the springs 64, thus closing a circuit through the motor magnet 21 from ground G^5 through the motor magnet 21, springs 65 and the springs 64 to battery B. The motor magnet, upon energizing, rotates the wipers 23 and 24 from the bank contacts 41 and 42, respectively, to the next adjacent contacts. Assuming that this contact has a guarding ground upon it, the start relay 22 will remain energized. It will be seen that the motor magnet, upon energizing, also opens its own circuit at the springs 65. As a result the motor magnet will act in a manner similar to that of a buzzer to rotate the wipers 23 and 24 until an ungrounded bank contact is reached, at which point the start relay deënergizes and opens the circuit of the motor magnet at the springs 64. The start relay, upon energizing, also opens the springs 45, in this way removing battery from all the line relays while the master switch is rotating.

The calling subscriber now operates his calling device for the first digit 2 of the called number, whereby the substation impulse springs 8 and 9 are operated twice momentarily, each time breaking the circuit of the connector line relay 35. Each time the line relay 35 of the connector deënergizes in response to the breaking of its circuit by the impulse springs 8 and 9, a circuit is closed from ground G^4 through the springs 57 and 66, springs 67 and 68 (the slow acting relay 59 remaining energized between impulses), relay 69, vertical magnet 28 and the side switch wiper 30 (in first position) to battery B. The vertical magnet 28 is energized twice over this circuit and operates to raise the shaft wipers two steps. The slow acting relay 69 is energized in series with the vertical magnet 28 and does not deënergize until after the last impulse is delivered. Upon energizing, the relay 69 closes a circuit from ground G^7 through the springs 70 and 71 and the private magnet 34 to battery B. When this circuit is broken after the last vertical impulse has been delivered to the vertical magnet, the private magnet 34 deënergizes and the side switch passes to second position. By this action the side switch wiper 30 transfers the battery connection from the vertical magnet 28 to the rotary magnet 29. When the calling device is operated for the last digit, the relay 35 of the connector E operates in the same manner as for the previous digit. Each time the connector line relay 35 deenergizes in response to the impulses, a circuit is closed from ground G^4 through the springs 57 and 66, springs 67 and 68, relay 69, springs 72, rotary magnet 29 and the side switch wiper 30 (in second position) to battery B. The rotary magnet 29 is energized two times over this circuit and operates to rotate the wipers onto the contacts of the desired line. The relay 69 operates in the same manner as for the previous digit to close the circuit of the private magnet 34 while the rotary magnet is operating. If the called line is idle, the private magnet 34 deënergizes when its circuit is broken by the relay 69 after the last impulse is delivered to the rotary magnet, and the side switch passes to third position, completing the connection with the called line through the side switch wipers 31 and 32, shaft wipers 25 and 27 and the conductors 73 and 74. The movement of the side switch wiper 33 to third position provides a guarding potential

for the connector private bank contacts of the called line, and closes an energizing circuit for the bridge-cut-off winding of the bridge-cut-off relay of the line switch C^{10}. This circuit extends from ground G^8 through the side switch wiper 33 (in third position), private wiper 26, private bank contact 75 and thence to all multiples of the same. This circuit also extends through the bridge-cut-off winding 76 of the line A' to battery B. The winding 76, upon energizing, operates to disconnect the relay group C^{10} from the line. At the instant that the side switch wiper 30 of the connector E reaches third position, a circuit is closed from ground G^9, interrupter 77, through the ringer relay 37, springs 78 and the side switch wiper 30 (in third position) to battery B. Since this circuit includes the interrupter 77, the relay 37 is energized intermittently, each time operating to disconnect the calling line from the called line and to bridge the ringing generator R across the called line. When the called subscriber removes his receiver, the called substation is provided with talking current through the windings of the back-bridge relay 36, which relay, upon energizing, closes the circuit of the ringing cut-off relay 79, said circuit extending from ground G^8 through the side switch wiper 33 (in third position), springs 80 and the relay 79 to battery B. The relay 79, upon energizing, interrupts the circuit of the ringing relay 37 at the springs 78 and closes a locking circuit for itself through its own springs, independent of the springs 80 of the back-bridge relay 36.

After the conversation is completed, the connection is released by the hanging up of the receiver at the calling substation A in the following manner: When the receiver at the substation A is restored to the switch-hook, the energizing circuit of the connector line relay 35 is opened, which relay, upon deënergizing, breaks the circuit of the relay 59, which in turn deënergizes and closes the circuit of the release magnet 38. This circuit extends from ground G^4 through the springs 57 and 66, springs 67 and 81, off-normal springs 39 and the release magnet 38 to battery B. The release magnet 38, upon energizing, operates to release the connector, whereupon its own circuit is broken at the off-normal springs 39 when the switch shaft reaches its lowest position. The removal of ground G^5, due to the deënergizing of the relay 59, opens the circuit through the bridge-cut-off relay Y of the line A in series with all the trunk windings of the relays X associated with the trunk T^2, whereupon the cut-off relay Y returns to normal position.

It having been explained how one subscriber establishes connection and releases the same, it will now be explained how a connection is prevented from being made with a busy line and how the calling subscriber receives the busy signal when calling a busy number. If the number called is busy, there will be a guarding potential upon the connector private bank contact. The connector private wiper, upon engaging this guarding contact and before the side switch wipers have passed to third position, completes an energizing circuit through the busy relay 82. This circuit extends from ground at the private wiper 26, through the side switch wiper 33 (in second position), through the springs 83 and 84, relay 82, springs 85 and 71 and the private magnet 34 to battery B. The private magnet 34 remains energized, thus holding the side switch in second position, and keeping the line to the called subscriber open. The relay 82 energizes and opens the circuit of the rotary magnet 29 at the springs 72, and also forms a locking circuit for itself from ground G^{10} through the off-normal springs 40, springs 86 and 84, relay 82, springs 85 and 71 and the private magnet 34 to battery B. The engagement of the springs 87 serves to close a circuit for the busy tone from the busy machine Q through said springs and the side switch wiper 32 (in second position), through the calling telephone and back to the busy machine Q. The calling subscriber, upon receiving the busy signal, hangs the receiver upon the hook, thereby releasing the connection in the manner above described.

With the arrangement described, it will be seen that the master switch D, through the wiper 23, supplies a circuit which indicates the next idle trunk to be used in extending a connection to a selector. This master switch also, through the medium of the wiper 24, is driven from a busy trunk and continues to operate to carry the wiper 23 opposite the next idle trunk to be used.

While I have illustrated means by which three subscribers' lines can be connected with either one of two trunks, it will, of course, be understood that the number of lines in a group, and likewise the number of trunks to which this group of lines has access, can be increased to any desired number by merely adding the corresponding relays connected in the manner indicated in these drawings. Likewise, as previously stated, this same means could be employed for selecting idle trunks between selector switches, in the manner in which other forms of non-numerical switches are commonly employed, and various other modifications and changes can be made without departing from the spirit of my invention.

What I claim as my invention is:—

1. In a telephone system, a group of lines, a group of trunk lines, a group of double-wound relays for each line, one winding of the relays of each group being connected in

series, and the other winding of each relay in a group being connected in series with the winding of the corresponding relay in the other group, and means controlled by said relays for extending the connection from said lines to an idle one of said trunks.

2. In a telephone system, a group of lines, a group of trunk lines, a group of double-wound relays for each line, one winding of the relays of each group being connected in series, and the other winding of each relay in a group being connected in series with the winding of the corresponding relay in the other group, means controlled by said relays for extending the connection from said lines to an idle one of said trunks, and a master switch for controlling the operation of said relays.

3. In a telephone system, a group of lines, a group of trunk lines, a group of double-wound relays for each line, one winding of the relays of each group being connected in series, and the other winding of each relay in a group being connected in series with the winding of the corresponding relay in the other group, means controlled by said relays for extending the connection from said lines to an idle one of said trunks, and a cut-off relay for cutting off said relays from the line.

4. In a telephone system, a group of lines, a group of trunk lines, a group of double-wound relays for each line, one winding of the relays of each group being connected in series, and the other winding of each relay in a group being connected in series with the winding of the corresponding relay in the other group, means controlled by said relays for extending the connection from said lines to an idle one of said trunks, a master switch for controlling the operation of said relays, and a cut-off relay for cutting off said relays from the line.

5. In a telephone system, a line, a plurality of trunks associated with said line, means for locating an idle trunk, a magnetic coil for said line corresponding to said idle trunk, a magnetic coil individual to said trunk corresponding to said line, a circuit closer jointly controlled by said coils, an energizing circuit for said line coil comprising the line circuit, and a line relay in said circuit for controlling said means.

6. In a telephone system, a line, a plurality of trunks associated with said line, means for locating an idle trunk, a magnetic coil for said line corresponding to said idle trunk, a magnetic coil individual to said trunk corresponding to said line, a circuit closer jointly controlled by said coils, an energizing circuit for said line coil comprising the line circuit, a line relay in said circuit for controlling said means, and an energizing circuit for said trunk coil under the control of said means.

7. In a telephone system, a line, a plurality of trunks associated with said line, means for locating an idle trunk, a magnetic coil for said line corresponding to said idle trunk, a magnetic coil individual to said trunk corresponding to said line, a circuit closer jointly controlled by said coils, an energizing circuit for said line coil comprising the line circuit, and a line relay in said circuit for controlling said means, the joint action of said coils always operating to connect said particular line with said particular trunk.

8. In a telephone system, a line, a plurality of trunks associated with said line, means for locating an idle trunk, a magnetic coil for said line corresponding to said idle trunk, a magnetic coil individual to said trunk corresponding to said line, a circuit closer jointly controlled by said coils, an energizing circuit for said line coil comprising the line circuit, a line relay in said circuit for controlling said means, and an energizing circuit for said trunk coil under the control of said means, the joint action of said coils always operating to connect said particular line with said particular trunk.

9. In a telephone system, a plurality of lines, a plurality of trunks for said lines, means common to said lines for locating an idle trunk, an electromagnetic coil for each line corresponding to said idle trunk, electromagnetic coils for each trunk, one for each line, a circuit closer for each line corresponding to said trunk, each controlled jointly by the coil of the corresponding line and by the trunk coil corresponding to said line, energizing circuits for said line coils, each circuit including the corresponding line, and a line relay in the line circuit for controlling said means.

10. In a telephone system, a plurality of lines, a plurality of trunks for said lines, means common to said lines for locating an idle trunk, an electromagnetic coil for each line corresponding to said idle trunk, electromagnetic coils for each trunk one for each line, a circuit closer for each line corresponding to said trunk, each controlled jointly by the coil of the corresponding line and by the trunk coil corresponding to said line, energizing circuits for said line coils, each circuit including the corresponding line, a line relay in the line circuit for controlling said means, and an energizing circuit for said trunk coils under the control of said means.

11. In a telephone system, a plurality of lines, a plurality of trunks for said lines, means common to said lines for locating an idle trunk, an electromagnetic coil for each line corresponding to said idle trunk, electromagnetic coils for each trunk one for each line, a circuit closer for each line corresponding to said trunk, each controlled jointly by

the coil of the corresponding line and by the trunk coil corresponding to said line, energizing circuits for said line coils, each circuit including the corresponding line, and a line relay in the line circuit for controlling said means, said means comprising a master switch common to said lines.

12. In a telephone system, a plurality of lines, a plurality of trunks for said lines, means common to said lines for locating an idle trunk, an electromagnetic coil for each line corresponding to said idle trunk, electromagnetic coils for each trunk one for each line, a circuit closer for each line corresponding to said trunk, each controlled jointly by the coil of the corresponding line and by the trunk coil corresponding to said line, energizing circuits for said line coils, each circuit including the corresponding line, a line relay in the line circuit for controlling said means, and an energizing circuit for said trunk coils under the control of said means, said means comprising a master switch common to said lines.

13. In a telephone system, a line, a plurality of trunks associated with said line, means for locating an idle trunk, a magnetic coil for said line corresponding to said idle trunk, a magnetic coil individual to said trunk corresponding to said line, a circuit closer jointly controlled by said coils, an energizing circuit for said line coil comprising the line circuit, a line relay in said circuit for controlling said means, and means for making the trunk busy.

14. In a telephone system, a line, a plurality of trunks associated with said line, means for locating an idle trunk, a magnetic coil for said line corresponding to said idle trunk, a magnetic coil individual to said trunk corresponding to said line, a circuit closer jointly controlled by said coils, an energizing circuit for said line coil comprising the line circuit, a line relay in said circuit for controlling said means, an energizing circuit for said trunk coil under the control of said means, and means for making the trunk busy.

15. In a telephone system, a line, a plurality of trunks associated with said line, means for locating an idle trunk, a magnetic coil for said line corresponding to said idle trunk, a magnetic coil individual to said trunk corresponding to said line, a circuit closer jointly controlled by said coils, an energizing circuit for said line coil comprising the line circuit, a line relay in said circuit for controlling said means, the joint action of said coils always operating to connect said particular line with said particular trunk, and means for making the trunk busy.

16. In a telephone system, a line, a plurality of trunks associated with said line, means for locating an idle trunk, a magnetic coil for said line corresponding to said idle trunk, a magnetic coil individual to said trunk corresponding to said line, a circuit closer jointly controlled by said coils, an energizing circuit for said line coil comprising the line circuit, a line relay in said circuit for controlling said means, an energizing circuit for said trunk coil under the control of said means, the joint action of said coils always operating to connect said particular line with said particular trunk, and means for making the trunk busy.

17. In a telephone system, the combination with a plurality of lines and a plurality of trunk lines, of means for connecting a calling line with an idle trunk line, said means comprising a relay having one winding individual to the calling line and a second winding individual to the idle trunk line, and means for energizing said windings upon the initiation of the call.

18. In a telephone system, the combination with a plurality of lines and a plurality of trunk lines, of means for connecting any line with any trunk line, said means comprising a plurality of relays individual to each line, a plurality of relays individual to each trunk line, each relay being included in two pluralities, and means responsive to the initiation of a call for operating the proper relay to connect the calling line with an idle trunk line.

19. In a telephone system, a subscriber's line, a plurality of trunk lines, means comprising a plurality of relays one for each trunk for connecting said line when calling with any one of said trunk lines, and means for controlling the selection of trunk lines, whereby the said line upon the initiation of successive calls will be connected with said trunk lines in rotation.

20. In a telephone system, a plurality of subscribers' lines, a plurality of trunk lines, means comprising a plurality of relays one for each trunk for connecting any calling subscriber with any trunk line, and means for selecting idle trunk lines for connection in regular order without regard to the number of simultaneous calls.

21. In a telephone system, a subscriber's line, a plurality of trunk lines, means comprising a plurality of relays for connecting said line when calling with any one of said trunk lines, and means for controlling the selection of trunk lines, whereby the said line upon the initiation of successive calls will be connected with said trunk lines in rotation, each time by a different one of said relays.

22. In a telephone system, a plurality of subscriber's lines, a plurality of trunk lines, means comprising a plurality of relays for connecting any calling subscriber with any trunk line, and means for selecting idle trunk lines for connection in regular order without regard to the number of simultane-

ous calls, each time by a different one of said relays.

23. In a telephone system, a plurality of subscribers' lines, a plurality of trunk lines associated with said lines, means for locating an idle trunk line, as many magnetic coils individual to each subscriber's line as there are trunk lines accessible to each subscriber's line, as many magnetic coils individual to each trunk line as there are subscribers' lines having access to said trunk line, and a circuit closer jointly controlled by a pair of said coils.

24. In a telephone system, a plurality of subscribers' lines, a plurality of trunk lines associated with said lines, means for locating an idle trunk line, as many magnetic coils individual to each subscriber's line as there are trunk lines accessible to each subscriber's line, as many magnetic coils individual to each trunk line as there are subscribers' lines having access to said trunk line, and a circuit closer jointly controlled by a pair of said coils for connecting a calling subscriber's line with an idle trunk line

25. In a telephone system, a plurality of subscribers' lines, a plurality of trunk lines associated with said lines, means for locating an idle trunk line, as many magnetic coils individual to each subscriber's line as there are trunk lines accessible to each subscriber's line, as many magnetic coils individual to each trunk line as there are subscribers' lines having access to said trunk line, and a circuit closer jointly controlled by a pair of said coils, the joint action of said pair of coils always operating to connect a particular subscriber's line with a particular trunk line.

26. In a telephone system, a plurality of subscribers' lines, a plurality of trunk lines associated with said lines, means for locating an idle trunk line, as many magnetic coils individual to each subscriber's line as there are trunk lines accessible to each subscriber's line, as many magnetic coils individual to each trunk line as there are subscribers' lines having access to said trunk line, a circuit closer jointly controlled by a pair of said coils, and an energizing circuit for the coils individual to a particular trunk line under control of said means.

27. In a telephone system, a plurality of subscribers' lines, a plurality of trunk lines associated with said lines, means for locating an idle trunk line, as many magnetic coils individual to each subscriber's line as there are trunk lines accessible to each subscriber's line, as many magnetic coils individual to each trunk line as there are subscribers' lines having access to said trunk line, a circuit closer jointly controlled by a pair of said coils, and an energizing circuit for the coils individual to a particular line, said circuit including the said line.

Signed by me at Chicago, Cook county, Illinois, this 17th day of November, 1913.

HARRY E. HERSHEY.

Witnesses:
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GEORGE A. YANOCHOWSKI.