

W. T. POWELL.
AUTOMATIC TELEPHONE SYSTEM.
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2 SHEETS—SHEET 1.

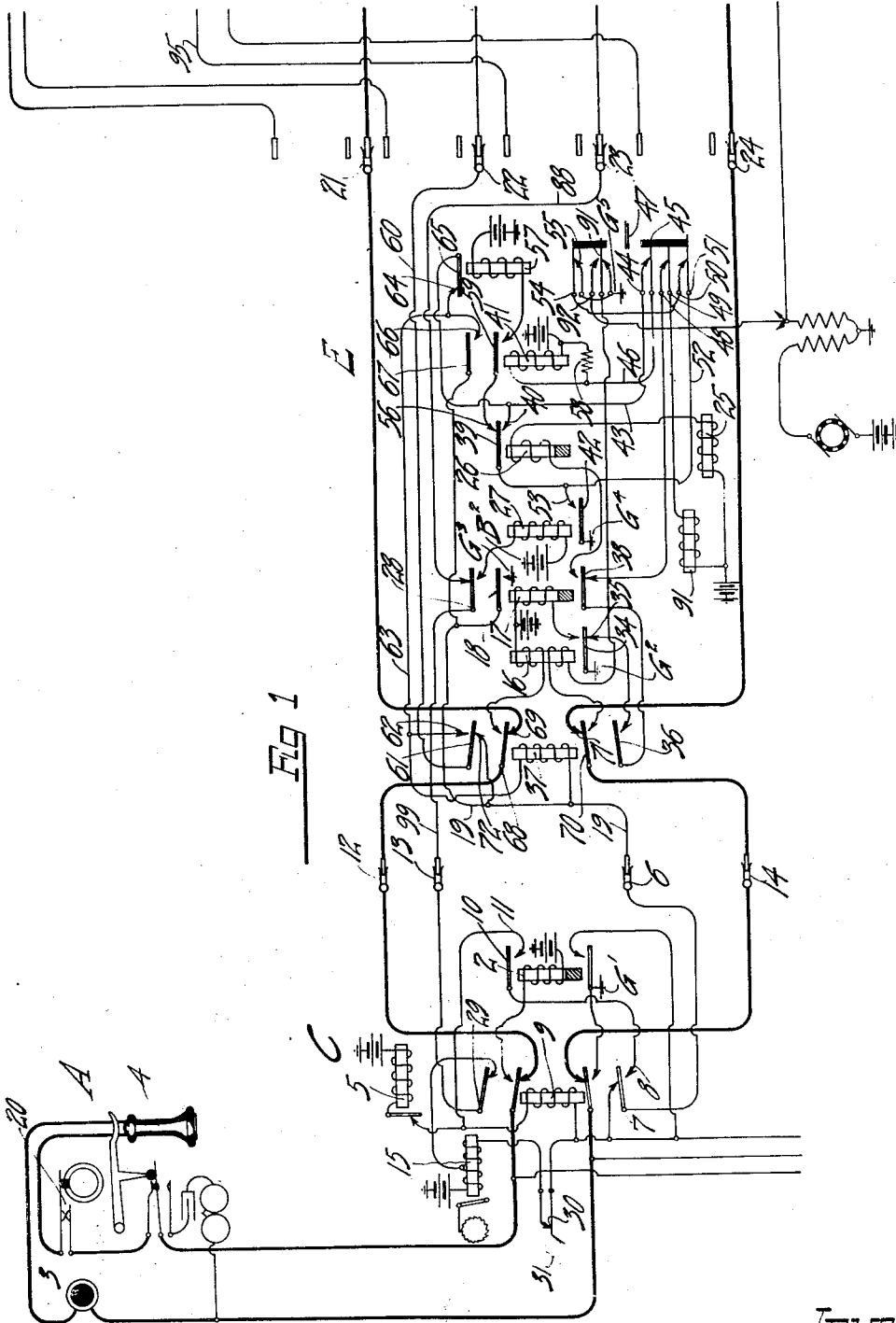
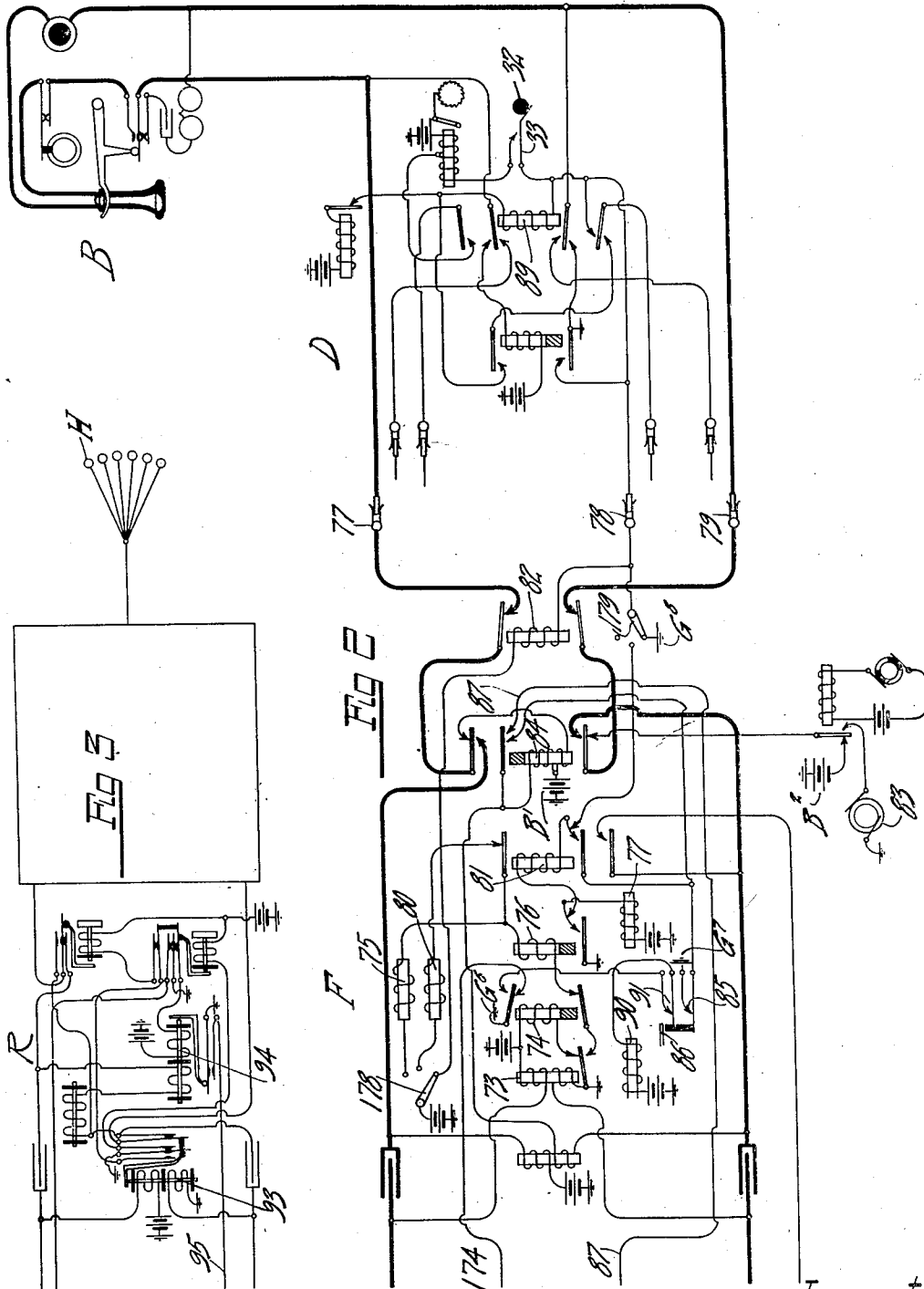


FIG 1

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1,350,882.

2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE SYSTEM.

1,350,882.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, WINFRED T. POWELL, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

My invention relates to automatic telephone systems. It relates to improvements in switches for such systems, and also to means for giving discriminating service.

Sometimes in a system where there are two or more exchanges the subscribers of one exchange are divided into two classes, those who are permitted to make calls automatically to both exchanges and those that are restricted to calling only in the local exchange. My improvement is designed to meet such a condition and to supply service of this kind. Furthermore, the arrangement is such that a subscriber can be easily switched from one kind of service to another. Another object of my invention is to provide equipment whereby service of the above character may be given in a system of the measured service type.

Another object of my invention is to provide details of improvement tending to increase the efficiency and serviceability of an automatic telephone system.

To accomplish the foregoing and other useful ends my invention embraces matters hereinafter more particularly set forth and claimed.

Referring to the drawings, I show in Figure 1 a calling subscriber A, and in Fig. 2 a called subscriber B. Both of these subscribers belong to one exchange. In Fig. 3 I indicate a distant automatic exchange. The equipment in this distant exchange may be of the standard type designed to work in connection with the equipment shown in Fig. 1. Apparatus of this kind is shown in United States Letters Patent No. 1,186,471 granted June 6, 1916, to John Erickson. Between the local exchange and the distant exchange is shown inserted a repeater R. The calling subscriber A is provided with a rotary line switch C, and the called subscriber B is provided with a duplicate line switch D. In order to extend the connection from the line switch C to the line of the called subscriber B the calling subscriber makes use of one of a number of

first selectors E, which are common to the line switches, C, D, etc., and also makes use of one of a number of connectors F which are likewise common to the subscribers of the local exchange. It will be understood that the subscribers of the local exchange may be divided into several hundred groups. As a matter of fact the subscriber A may be in one hundred group and the subscriber B in a different hundred group, there being a separate group of connectors F for each hundred group of subscribers, each of which group of connectors is accessible through a different level in the first selectors, the first selector banks being of course, multiplied so that any subscriber in the local exchange may obtain access to any connector in the local exchange.

The operation of the equipment in extending a connection from the subscriber A to the subscriber B is as follows: When the subscriber A removes his receiver he closes an energizing circuit through the line relay 2 of the line switch C. This energizing circuit coincides between the line switch C and the station A, with the talking circuit, and passes through the talking transmitter 3 as well as through the receiver 4. When the line relay 2 energizes it prepares an energizing circuit for the rotary magnet 5 of the switch C in order to advance the switch C in the event that its wipers are in engagement with a busy trunk at the time the receiver is removed from the hook. Assuming that such is the condition and there is a ground on the private bank contact engaged by the private wiper 6, which ground has been placed on the said contact through one of the switches E. Consequently the energizing circuit is set up through the rotary magnet 5 extending from the grounded private bank contact through the private wiper 6 of the line switch C, thence through the contacts 7 and 8 of the switching relay 9, through the contacts 10 and 11 of the line relay 2 and the rotary magnet 5. This rotary magnet then operates to advance the wiper 6 together with the other wipers 12, 13 and 14, which are on the same shaft that is controlled by the rotary magnet 5. Each time that the rotary magnet 5 energizes it advances the wipers one step and breaks its own circuit in a manner well known. This operation of the rotary magnet continues as long as the private wiper 6 continues to engage busy

contacts. As soon as the private wiper 6 is advanced on to the idle contact however, the energizing circuit for the magnet 5 is broken, and the line switch C stops in engagement with an idle first selector E. It will be observed that while the switch is rotating the switching relay 9 is short circuited through ground. However, as soon as the ground disappears from the private wiper 6 the switching relay 9 pulls up through the rotary magnet 5, thereby cutting off the line relay 2 and switching the talking conductors of the line A through to the first selector E by way of the talking wipers 12 and 14. It also switches the holding circuit for the switching relay 9 from the ground G' under the control of the line relay 2 to the private wiper 6 which private wiper is supplied with ground from the switch ahead as soon as the talking conductors are cut through as will presently be explained. The switching relay also connects the wiper 13 through to the meter magnet 15.

As soon as the switching relay 9 cuts the talking conductors through an energizing circuit is provided through the telephone A for the line relay 16 of the first selector E. This relay upon energizing, closes an energizing circuit for the slow acting relay 17 from the ground G². This slow acting relay 17 upon energizing, closes the contact 18 to ground G³ which ground extends over the private bank conductor 19 to a private contact engaged by the private wiper 6 for making the selector E busy and for holding the switching relay 9 of the line switch C energized. The relay 17 also upon energizing prepares a circuit for the vertical magnet 25 through the so-called private magnet control relay 26. Furthermore, the relay 17 closes a circuit through the relay 27 from the battery B² through said relay, through the contact 28 of the relay 17, and through the wiper 13 of the switch C; thence through the contact 29 of the switching relay 9 to the mid-point of the meter magnet 15, thence through the right hand winding of said magnet, and through the springs 30 under the control of the key 31, spring 7 of the relay 9 to the private wiper 6, and thence over the conductor 19 to the ground terminal G³ under the control of the relay 17 in the selector E. The action of the relay 27 may be ignored except when a calling subscriber is provided with a line switch C arranged to permit calls to be extended to the distant exchange. This can be done whenever the key 31 at the line switch C has been thrown so as to permit the springs 30 to be closed. In connection with the line switch D the key 32 is shown thrown so as to hold the springs 33 open, thereby restricting the subscriber B to local calls. The subscriber B, then, upon trunking to a selector E would not be able to control the relay 27.

The meter magnet 15 of the line switch C, is so wound that it will not attract its armatures when current flows through both its windings in series, but only when current is connected to the mid-point thereof; also when the right hand winding thereof is connected in series with the high resistance relay 27 there is not enough current flow to operate said meter magnet. Thus it will be seen that when direct ground is connected through springs 30, the meter is not operated, nor does it operate until direct ground is applied to the mid-point of its winding.

The connection having been extended to the selector E, the apparatus is now in condition for the subscriber A to turn his dial. Upon turning his dial the impulse springs 20 are operated so as to make and break the talking circuit a number of times, depending upon the number of the subscriber B. Assuming that the number of the subscriber is 220, two impulses are transmitted, thereby operating the line relay 16 twice, thereby raising the wipers 21, 22, 23, and 24 of the switch E two steps. This is accomplished in the following manner. Each time that the talking circuit is broken at the spring 20, the line relay 16 falls back, whereupon the spring 34 strikes the contact 35 each time, thereby sending two impulses from the ground G² through the springs 36 of the relay 37, and through the spring 38 of the relay 17 to the relay 26, thence through the vertical magnet 25 to battery. In this manner the vertical magnet is operated twice, which acts to raise the wipers two steps as already stated. It will be seen that at the first impulse through the vertical magnet 25 the relay 26, which is in series with that magnet, energizes, shifting the contact 39 into engagement with the contact 40, thereby closing a circuit through the interrupter relay 41 from ground G⁴, through the springs 42 of the relay 27, which, as already stated, is now energized, thence through the springs 39 and 40, and over conductor 43, through the off-normal springs 44 and 45 to the conductor 46, through the interrupter relay 41 to battery. It should be explained that the switch shaft (not shown), carries an arm 47 that controls the springs 44 and 45 and a number of other springs associated therewith, so that at the first vertical step of the shaft the springs 44 and 45 are brought into electrical engagement. In like manner the springs 48 and 49 are closed into contact and also springs 50 and 51 are closed into contact.

It will be observed that the spring 51 is connected to the conductor 52 to which the contact 53 controlled by the relay 27 is also attached. Now, if the relay 27 had not energized, in other words, if the subscriber A has been a limited service subscriber, the interrupter relay 41 would not have been

energized from ground G^4 , but instead would energize over a circuit extending from ground at G^5 , shaft springs 55 and 54, off normal springs 50 and 51, conductor 52, contacts 39 and 40 of relay 26, conductor 43, off normal springs 44 and 45, conductor 46, and winding of relay 41 to battery.

Now if the subscriber A had been a limited service subscriber and had attempted to make a call to the distant exchange he would have raised the wipers 21 and 22 etc. to the tenth level which is assumed to be the line in which the trunks to the distant exchange terminate. Relay 27 would not be energized as hereinbefore stated and the energizing circuit for interrupter relay 41 would be opened since the springs 54 and 55 are opened through the medium of the shaft arm 47 on the tenth vertical step of the shaft. Therefore if the relay 41 is not energized at this time it follows that the rotary magnet will not be energized and the wipers will not be brought into engagement with the contacts associated with the trunk lines, also by the engagement of springs 91 and 92 controlled by the shaft arm 47 the busy signal is applied to the calling line in a manner well known to notify the calling subscriber that he cannot make connections with the distance exchange.

It should be observed that when once the interrupter relay 41 has been energized as a result of the action of the relay 26, it provides a locking circuit for itself, inasmuch as it connects the conductor 43, to which the contact 40 and spring 44 are connected, with the private trunk conductor 19 between switches C and E', by way of the interrupter springs 64 of the rotary magnet 57, and by way of its own springs 66 and 67. As soon as the subscriber's dial comes to a standstill after the impulses for the first digit have been transmitted, the series relay 26 falls back, whereupon the contact 39 engages the contact 56 thereby closing a circuit through the rotary magnet 57. The impulse that energizes the rotary magnet 57 extends from ground G^4 make springs 53 under the control of the relay 27, thence through the springs 39 and 56 under the control of relay 26, and through the contact 59 to the rotary magnet 57 to battery. As a result of this the rotary magnet rotates the wipers 21, 22, etc., one step, carrying the private wiper 22 into engagement with the private bank contact of the first trunk. The rotary magnet upon energizing, of course, breaks the locking circuit of the interrupter relay 41, which latter then falls back and in turn breaks the energizing circuit of the rotary magnet. The rotary magnet armature thereupon falls back and closes a new circuit for the interrupter relay 41 by way of the private wiper 22, provided the private wiper 22 has been rotated by the rotary

magnet onto a busy private bank contact, upon which some switch is holding ground. This energizing circuit for the interrupter relay extends as follows: from the private wiper 22, over the conductor 60, thence over the contacts 61 and 62, to the conductor 63, through the interrupter springs 64 of the rotary magnet over conductor 43 and off-normal springs 44 and 45, through the interrupter relay 41, and thence to battery. The interrupter relay thereupon energizing as before again locking itself by way of its own contacts 66 and 67. This, of course, closes a circuit for the rotary magnet from ground G^4 as before. This see-saw action between the interrupter relay and rotary magnet continues as long as the private wiper continues to encounter busy trunks. Finally, when the private wiper is carried beyond the last busy trunk, the interrupter relay cannot be again energized, and consequently the energizing circuit of the rotary magnet is permanently broken. If relay 27 were not energized at this time as is the case when a restricted line calls, the interrupter relay 41 would operate in the same manner, from ground on the private wiper, but, the rotary magnet circuit would be completed from ground G^5 , shaft springs 55 and 54, off normal springs 50 and 51, conductor 52, contacts 39 and 56 of relay 26, make contacts 59 of relay 41, through the rotary magnet 57 to battery. At this stage of the operation the conductor 43, over which the interrupter relay 41 is energized, is left in engagement, through the rotary magnet interrupter contacts, with the conductor 63, which is connected to the winding of the switching relay 37. As a result, the relay 37 energizes through the interrupter relay 41, the resistance of relay 37 being sufficiently high to prevent interfering with the action of the relay 41. The energizing circuit for this switching relay 37 may be traced from ground G^3 under the control of the slow acting relay 17, thence to the conductor 19, and through the winding of the switching relay 37 to the conductor 63. From this point the circuit extends through the rotary magnet interrupter springs 64 to the conductor 43, and through the off-normal springs 44 and 45, and interrupter relay 41 to battery. The relay 37, upon energizing, performs the function of cutting the talking conductors that extend through the wipers 12 and 14 of the line switch C to the wipers 21 and 24 of the selector E. This extension is accomplished when the relay 37 switches the contact 68 into engagement with the contact 69, and the contact 70 into engagement with the contact 71. The switching relay also performs another important function, namely, the extension of the test conductor 19 between the switches C and E to the private wiper 22. This is

done when the relay 37 switches the contact 61 into engagement with the contact 72. This action of the switching relay cuts off the line relay 16 of the selector E, opens a point in the release circuit to prevent the selector from releasing, and at the same time it provides an energizing circuit for the line relay 73 of the connector switch F. This relay energizes over the talking conductors by way of the telephone A and responds to the operations of the dial in the usual manner. This line relay 73 corresponds to the one in connector switch F in United States Letters Patent No. 1,186,471, already mentioned.

The relay 73 upon energizing, energizes a release relay 74, which in turn applies a ground potential from ground G^6 to the trunk release conductor 174 which conductor extends to the private trunk contact engaged by the private wiper 22. This potential on this contact protects the connector F from seizure and it also extends its influence over the conductor 60 of the switch E to the switching relay 37, holding the latter energized as long as the connection is extended. Slow acting relay 74 prepares a circuit for the vertical magnet 75 by way of the slow acting relay 76. In response to the operation of the dial to call the second digit of the called subscriber, the line relay 73 responds, thereby energizing the vertical magnet 75 to raise the wipers 77, 78 and 79 of the connector switch to the proper level in which the line of subscriber B is located; in this case the second level. Upon the cessation of the impulses the slow acting relay 76, which upon the first impulse closed a circuit for the private magnet 77, now falls back, breaking the circuit of said private magnet, thereby causing the side switch to pass to second position. The wipers of the side switch are two in number, and identified by the reference characters 178 and 179. The side switch wiper 178, upon passing to second position, prepares the circuit for the rotary magnet 80, which responds to the operation of the dial in accordance with the last digit. While the rotary magnet 80 is being operated through the usual action of the line relay 73, the relay 76 is, of course, again energized, and consequently the private magnet 77 is energized during the rotation. When the impulses stop coming in, the wipers having reached the terminal of the called line, the relay 76 falls back, but if the called line is busy the private wiper 78 will encounter a grounded contact which will cause the busy relay 81 to pull up, opening the rotary magnet circuit, placing the busy tone on the calling subscriber's line, and locking itself up in series with the private magnet 71 before the private magnet has time to release the side switch to third position.

However, assuming that the called line is not busy, the private magnet is deenergized and the side switch goes to third position, whereupon the side switch wipers 179 and 178 close an energizing circuit for the ringing relay 82. As a result, ringing current is transmitted to the called line from the ringing generator 83. When the called subscriber answers he closes an energizing circuit through the lower winding of the ring cut-off relay 84, either as a result of current from the ringing generator 83 and the battery B' , or as a result of current from the batteries B' and B^2 . The relay 84, upon energizing, locks itself through the off-normal springs 85 which are closed as soon as the switch shaft 86 goes off normal at the first vertical impulse. The locking circuit extends from ground G^7 to the battery B' . The ring cut-off relay 84 also as a result of energizing, connects the conductor 87 with the ground G^7 , thereby operating the meter magnet 15 at the line switch C. This circuit may be traced from ground G^7 , through the conductor 87, thence over wiper 23 in the switch E and conductor 88 to the conductor 99, through the wiper 13 of the switch C and the contact 29 of the magnet 9 to the winding of magnet 15, and thence to battery. It will be noted that when the side switch wiper 179 of the connector F passes to third position, a guarding potential is placed on the private contact of the called line from ground G^8 through the side switch 179 and private wiper 78. This prevents any other connector from cutting in on the line B. This same guarding potential causes the cut-off relay 89 of the line switch D to energize so that the line relay of the called subscriber is disconnected from across the talking conductors of the called line. After the subscribers are through talking the calling subscriber upon hanging up his receiver will break the energizing circuit of the line relay 73 of the connector F causing this relay to fall back. As a result, the release relay 74 will deenergize, removing the holding potential from the release conductor 174, and at the same time connecting the ground terminal G^9 with the release magnet 90, by way of the off normal springs 91. As a result, the release magnet 90 energizes restoring the connector to normal and removing the potential from the called line, thereby permitting the cut-off relay 89 to fall back. The removal of the holding potential from the conductor 174 also causes the switching relay 37 in selector E to fall back, with the result that the ground terminal G^2 is connected to the release magnet 91 by way of the contacts 34, 35, 36, and 38, and off normal springs 48 and 49, whereupon a circuit is closed through the release magnet to battery. As a result, of course, the selector switch E is restored to normal, the releas-

ing apparatus being well known, and of the type referred to in the patent cited. For the same reason that the switching relay 37 in the selector E fell back, the switching relay 9 in the line switch C falls back, restoring the switch C to normal condition.

wiper 22 of the switch E, with the result that the switching relay 37 of the switch E and the switching relay 9 of the switch C both fall back, as already explained, releasing the connection.

What I claim as my invention is:

1. In an automatic telephone system, subscribers' lines, selector switches accessible to said subscribers' lines, trunks accessible to said selector, means whereby one of said subscribers may operate said selector to extend a connection from his line to any one of said trunks, means whereby another one of said subscribers is prevented from operating said selector to extend connection to a portion of said trunks while not precluded from access to others, a measured service device for said other subscriber, a circuit for said measured service device, and a circuit for controlling said means, both of said circuits extending over a common conductor.
2. In a telephone system, a subscriber's line, a selector switch, means for connecting said subscriber's line to said selector switch, a measured service device, trunks accessible to said selector switch, means in said selector switch for automatically selecting an idle trunk, a second device for rendering said means inoperative, a circuit for said second device, and a circuit for said measured service device, said circuits having a section in common.
3. In a telephone system, a subscriber's line, a selector switch, means for connecting said subscriber's line to said selector switch, a measured service device, trunks accessible to said selector switch, means in said selector switch for automatically selecting an idle trunk, a magnet for rendering said means inoperative, a circuit for said magnet, and a circuit for said measured service device, said circuits having a section in common.
4. In a telephone system, a subscriber's line, a selector switch, means for connecting said subscriber's line to said selector switch, a measured service device, trunks accessible to said selector switch, means in said selector switch for automatically selecting an idle trunk, a magnet for rendering said means inoperative, a circuit for said magnet, and a circuit for said measured service device, said circuits having a section in common, said magnet individual to said selector.
5. In a telephone system, a subscriber's line, a selector switch, means for connecting said subscriber's line to said selector switch, a measured service device, trunks accessible to said selector switch, means in said selector switch for automatically selecting an idle trunk, a magnet for rendering said means inoperative, a circuit for said magnet, and a circuit for said measured service device, said circuits having a section in common.

Assuming that the subscriber A had desired to establish connection with a subscriber H, he raises the selector switch E to the level from which the trunks of the distant exchange extend, which in this case, it will be assumed, is the tenth level. Upon reaching the tenth level the switch shaft arm 47 strikes the springs 54 and 92, disconnecting 54 from 55, and thereby breaking the connection to ground G⁵. The shaft also causes the spring 91 to leave the ground G⁵ and engage spring 92, which latter is connected to ground through one of the windings of the busy coil. The object of this latter arrangement is to enable the calling subscriber to receive the busy signal if all the trunks on the tenth level are busy. The switch shaft having been raised to the tenth level, the slow acting relay 26 deenergizes as in the previous instance, thereby closing the circuit for the rotary magnet 57. This magnet cuts the wipers in on to the first trunks leading to the distant exchange. If the first trunk is busy, the relay 41 will be energized, again causing the rotary magnet to operate and so on the reciprocal action continues as previously explained until the wiper 22 finds an idle trunk, whereupon the connection is extended to the distant exchange through the repeater R. This repeater has the usual line relay 93 across the line, which responds to impulses from the telephone A to repeat them to a selector which is at the other end of the trunk. The selector is operated and the connection is finally extended to a connector switch which is operated to find the subscriber H. Apparatus of this kind may be similar to the selector switch M and connector switch K shown in United States Letters Patent No. 1,203,166, granted October 31, 1916, to Bernard D. Willis. The subscriber H is signaled in the usual manner, and when he answers he cuts off the ringing current and reverses the connections on the first bridge of the connector to unbalance the relay 94 which energizes, putting ground on the conductor 95, which conductor 95 extends back to the wiper 23 and energizes the meter 15. After the connection has been completed the calling subscriber, by hanging up his receiver will cause the line relay in the repeater to fall back, breaking the talking circuit that leads to the distant exchange. This causes the connector at the distant exchange to release all the switches at the distant exchange. The line relay at the repeater also removes the ground from the holding conductor which passes through the

mon, said measured service device individual to the line, and said magnet individual to the selector.

6. In a telephone system, a subscriber's line, a selector switch, means for connecting said subscriber's line to said selector switch, a measured service device, trunks accessible to said selector switch, means in said selector switch for automatically selecting an idle trunk, a second device for rendering said means inoperative, a circuit for said second device, a circuit for said measured service device, said circuits having a section in common, said second device individual to said selector, and said measured service device individual to the line.

7. In a telephone system, a subscriber's line, a selector switch, means for connecting said subscriber's line with said selector, trunk lines for said selector, means for selecting an idle one of said trunk lines, means for rendering said second means inoperative, a circuit for controlling said third means, said circuit having a branch individual to said subscriber's line, and means in said branch for rendering said third means effectual to render said second means ineffectual, and a separate circuit for releasing said first means.

8. In a telephone system, subscribers' lines, a first selector, means for connecting any subscriber's line with said selector, trunks accessible to said selector, means in said selector for automatically selecting an idle trunk, means for rendering said second means ineffectual, a circuit for controlling said third means, said circuit having a plurality of branches, one branch individual to each subscriber, and means individual to each branch for controlling said third means to render said second means effectual or ineffectual automatically to control said second means, and a separate circuit for releasing said first means.

9. In a telephone system, subscribers' lines,

a first selector, means for connecting any subscriber's line with said selector, trunks accessible to said selector, means in said selector for automatically selecting an idle trunk, means for rendering said second means ineffectual, a circuit for controlling said third means, said circuit having a plurality of branches, one branch individual to each subscriber, means individual to each branch for controlling said third means to render said second means effectual or ineffectual automatically to control said second means, and a measured service device individual to each branch, said measured service device also controlled over said branch.

10. In a telephone system, lines, first selectors accessible thereto, trunk lines accessible to said selectors, means in each selector for automatically selecting an idle one of said trunks, a relay for preventing the operation of said trunk selecting means, a circuit for said relay, said circuit having a branch individual to each line, means in each branch for controlling said relay automatically to either prevent or permit the operation of said selecting means, and a measured service device in each branch also controlled thereover.

11. In a telephone system, lines, meters therefor, a selector switch accessible to said lines, trunk lines accessible to said selector, means in the selector for automatically selecting an idle one of said trunks, a relay in the switch for preventing the operation of said means, a circuit for said relay including the meter of any line connected to the selector, said relay normally inoperative over the said circuit, and a shunt for the meter on certain of the said lines for permitting said relay to operate when said selector is seized by the corresponding lines.

Signed at Chicago, Cook county, Illinois, this 31st day of March, 1917.

WINFRED T. POWELL.