Nov. 18, 1924. 1,516,245

W. T. POWELL

AUTOMATIC TELEPHONE SYSTEM

Filed Nov. 17, 1920 2 Sheets-Sheet 1

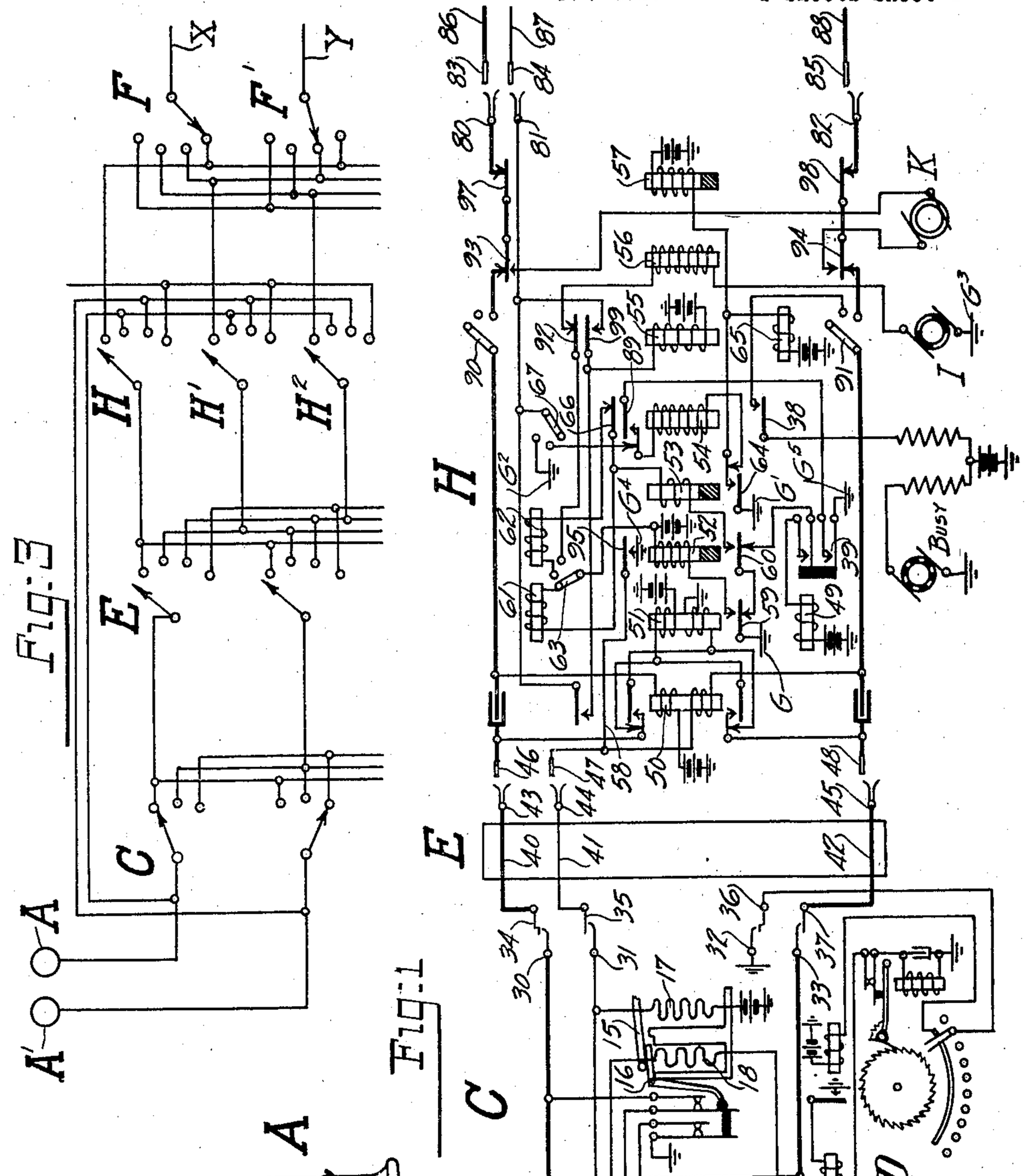

FIG. 3

FIG. 1

Inventor
Winfred T. Powell
Chas. Tu. Candy.
Atty.

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W. T. POWELL

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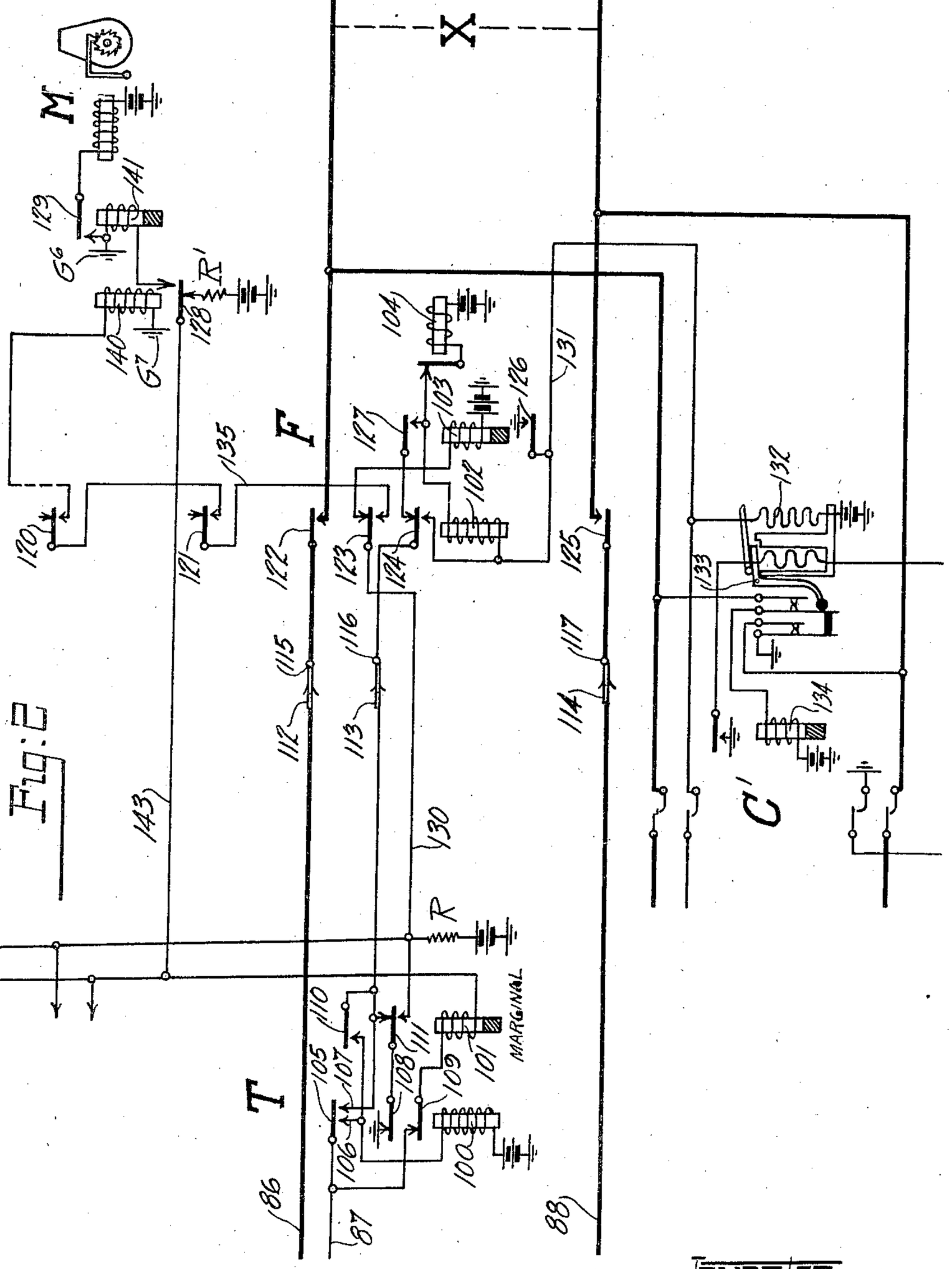

Fig. 2

Inventor
Winfred T. Powell
Chas. Tu. Candy
Atty.

Patented Nov. 18, 1924. 1,516,245

UNITED STATES PATENT OFFICE.

WINFRED T. POWELL, OF ROCHESTER, NEW YORK, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

Application filed November 17, 1920. Serial No. 424,744.

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 Rochester, Monroe County, and State of New York, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

This invention relates in general to automatic telephone systems, and the object of the invention, broadly stated, is to provide a new and improved method of completing a connection to an idle one of a plurality of lines or trunk lines extending to the same point and having the same telephone number.

Heretofore so called rotary connectors have been used for this purpose. The lines of a certain group, for example, which may be trunk lines extending to a private branch exchange, are terminated in separate contact sets in the banks of a group of these rotary connectors, and a telephone number is assigned in accordance with the first contact set in the group. When the number is called the rotary connector taken for use will connect with the first contact set and therefore with the first trunk line in the group, if such trunk line is idle, but if the trunk line is busy the connector will automatically operate to test the rest of the trunk lines in order and will connect with the first one found idle.

The above describes the usual method of handling calls to private branch exchange trunk lines, and this is perhaps the preferred method in most cases. It may happen, however, that there are only one or two groups of such trunk lines and the provision of a special group of connectors for handling the traffic will be unduly expensive. Other situations also may arise where the new method of handling these calls, which will now be explained, can be used to good advantage. In accordance with the present invention ordinary standard connectors which have no automatic rotary movement are used, and only one set of contacts is assigned to an entire group of perhaps five or six trunk lines. This contact set is not multipled between the several connectors of the group, but separate lines lead away from the contact set in each connector to finder switches, one of which is associated with each of the private branch exchange trunk lines in the group, and these separate lines, or link circuits, of which there will obviously be as many as there are connector switches, are multipled in the banks of all the finder switches. When the number assigned to the group of private branch exchange trunk lines is called the connector taken for use will connect with the contact set in its own bank in the usual manner, whereupon the finder switch associated with an idle trunk line is started and such finder will locate the link circuit coming from the particular connector in use, and will connect it through to the trunk line associated with the finder switch.

A further feature of the invention, used preferably in connection with the main feature just pointed out, although its use is not necessarily so limited, relates to metering arrangements; and consists in the provision of a meter and suitable controlling means therefor whereby the meter is operated to count the number of calls directed to a group of lines which fail because all the lines in the group are busy. This particular feature, however, is not claimed herein, but is claimed in my divisional application Serial No. 703,894, filed April 3, 1924.

These are the principal features of the invention. There are other features also, which together with the above will be fully described hereinafter with reference to the accompanying drawings, in which Figs. 1 and 2 are circuit diagrams of the equipment in use, while Fig. 3 is a schematic diagram of the trunking arrangement.

Referring first to Fig. 3; the trunking arrangement will first be briefly explained, as this will render it easier to understand the circuits. This diagrammatic layout shows in simple form the trunking between local subscribers in an automatic exchange, and also the trunking arrangements by which such local subscribers are given access to a group of trunk lines extending to a private branch exchange. Considering first the means by which the local subscribers are interconnected, let us assume that the subscriber at substation A desires to obtain connection with a subscriber at substation A'. The connection may be established by

means of the individual line switch C, a first selector switch such as the first selector E, and a connector switch such as the connector H. This is the ordinary percentage trunking system in common use.

Considering now the means by which connections are extended to the private branch exchange trunk lines, each of these trunk lines is provided with a finder switch such as the finder switch F which is associated with the trunk line X. In the connector switches such as connectors H, H′, and H² of the group which is to handle private branch exchange calls, a certain contact set in one of the levels is reserved and is assigned to these private branch exchange trunk lines, the remaining contact sets being assigned to ordinary subscribers' lines in the usual manner. Thus in the drawing, which shows only part of one level in each of the connector switches, the second, third and fourth contact sets in the connectors are multipled together and are assigned to subscribers' lines, while the first contact set is not multipled but separate conductors extend from this contact set in each connector switch to multiply connected contact sets in the banks of the finder switches F and F′. With this explanation the process of extending a connection from substation A to the private branch exchange trunk line X for example will readily be understood, at least so far as the general method is concerned. The connection is extended by means of the individual line switch C, a selector switch such as the selector E, a connector switch such as the connector H, and the finder switch F. If the trunk line X had happened to be busy when the call was made the finder switch F′ would have operated to extend the connection to the trunk line Y, or some other finder switch not shown would have been operated to extend the connection to one of the other trunk lines.

Having explained the trunking arrangement adopted, the apparatus shown in the circuit diagrams may now be briefly described. The substation A, Fig. 1, is an ordinary automatic telephone substation having the usual talking instrumentalities and a calling device S for controlling the automatic switches. The line conductors terminate at the exchange in the individual line switch C, which may be of any well known type, such for example as the rotary type of line switch indicated in Fig. 3. In developing the present invention, however, the well known plunger type of line switches have been used, such as are shown and described in the U. S. Patent to Newforth, No. 13901, reissued April 13th, 1915, and accordingly this is the type which has been shown in the drawing.

The first selector E and the connector H are of the usual Strowger vertical and rotary type so far as their mechanical construction is concerned and any well known type of two wire circuits may be used. In view of the fact that these circuits are well known only the circuit of the connector switch H is shown in full, and reference is made to the previously mentioned patent to Newforth for the circuits of the selector switch.

The connector H and the other connectors of the same group have access in common to a plurality of subscribers' lines, and each of these connectors also has access to a separate line or link circuit which is used for extending calls to the private branch exchange trunk lines. Only one of these separate or individual lines is shown in the drawings, this being the line associated with the connector H and comprising conductors 86, 87, and 88. Each of these lines is provided with a pair of relays, and the relays associated with the line shown are indicated by the reference character T. These relays control the starting of the finder switches of which, as before stated, there will be as many as there are private branch exchange trunk lines. The finder switch F associated with the trunk line X is a simple rotary switch of the type in which the wipers have no normal position and move in a forward direction only. The operation of the circuits will be fully described later on.

The line switch C′ is individual to the trunk line X, and is provided for the purpose of handling connections from the private branch exchange to the main exchange. This line switch is similar to the line switch C associated with the substation A, and it may have access to the same group of first selector switches.

The reference character M indicates a meter which is common to all the finder switches associated with the group of trunk lines under consideration. Its function is to register the number of times the private branch exchange is called when all the trunk lines are busy.

Having briefly explained the purpose of the invention and the apparatus involved in carrying it out, the operation of this equipment may now be explained more in detail. For this purpose it will be assumed that the subscriber at substation A desires to obtain connection with a subscriber in the private branch exchange served by the trunk line X and other associated trunk lines.

When the calling subscriber at substation A removes his receiver to initiate the call, an energizing circuit is completed over the line conductors 11 and 12 for the line relay 14 of the line switch C. Upon energizing, the line relay 14 closes a circuit for the pull-in winding 18 which, upon energizing, operates both the plunger arm 15 and the cut-off armature 16; the former through the

medium of its plunger (not shown) forces the bank springs 30—33, inclusive, into engagement, respectively, with the contacts 34—37, inclusive, and the latter disconnects the line conductors 11 and 12 from the line relay 14 and from ground, respectively. By the engagement of bank springs 30 and 33 with contacts 34 and 37, respectively, the line conductors 11 and 12 are extended to the line relay (not shown but corresponding to relay 51 of connector switch H) of the selector E.

The selector E now places ground on release trunk conductor 41 in the well known manner to close a holding circuit for the line switch C extending from grounded release trunk conductor 41 through the bank contact 35, bank spring 31, and through the holding winding 17 to battery. Since the line relay 14 is slow acting, it keeps its armature attracted until after the above holding circuit has been established. A branch of the holding circuit extends by way of conductor 13 to multiple test contacts in the banks of connector switches having access to the line of substation A, where, by a ground potential on these contacts, the said line is made busy. By the engagement of bank spring 32 with contact 36 a circuit is closed whereby the master switch D is operated in the well known manner to advance the plungers of all the remaining idle line switches into position before the terminals of the next idle trunk line.

The calling subscriber may now operate his calling device in accordance with the first digit of the number assigned to the private branch exchange, which we will assume is #241. In response to the operation of the calling device, the selector E raises its wipers 43, 44, and 45 to the second level and connects them to contacts 46, 47, and 48, respectively, of the first idle trunk line, assumed to be the trunk line extending to the connector H, which has access, through finder switches, to the trunk lines leading to the desired private branch exchange.

When the connection is extended to connector H as above described, the line relay 51 energizes in the usual manner and closes the circuit of relay 52. Relay 52 grounds the release trunk conductor 58, thus holding the switches C and E in their operated positions, and prepares the circuit for the vertical magnet. When the calling subscriber operates his calling device in accordance with the second digit 4 of the desired number, the line relay 51 of the connector H deenergizes four times momentarily. The relay 52, being slow acting, does not have time to deenergize during the momentary interruptions of its circuit by the line relay, and, therefore, each time the relay 51 deenergizes, a circuit is extended from ground at G through armature 59 and its resting contact, armature 60 and its working contact, relay 53, vertical magnet 61, and thence through side switch wiper 63 to battery. Since the digit called is four, the vertical magnet receives four impulses over the circuit and operates to raise the switch shaft and its wipers 80, 81, and 82 four steps. The relay 53, which is energized in series with the vertical magnet, is a slow acting relay and remains in its operated position until after the last impulse is delivered to the vertical magnet. The relay 53, upon energizing, completes a circuit extending from ground at G′ through armature 64 and its working contact, and through private magnet 65 and relay 57, in multiple, to battery. The relay 53 deenergizes and breaks the circuit of the private magnet 65 and the relay 57 shortly after the last impulse is delivered to the vertical magnet. The private magnet, upon energizing and deenergizing, causes the side switch to pass from first to second position.

When the calling subscriber operates his calling device for the last digit 1, the circuit of the line relay 51 is broken once. Since the side switch is now in second position, each time the line relay deenergizes a circuit is closed from ground at G through armature 59 and its resting contact, armature 60 and its working contact, relay 53, armature 66 and its resting contact, rotary magnet 62, and through the side switch wiper 63 to battery. The rotary magnet 62 operates in response to the one impulse received over this circuit to rotate the switch shaft one step to carry the wipers 80, 81, and 82 onto the bank contacts 83, 84 and 85, respectively, which give access to the desired private branch exchange 241 through the first idle finder switch such as the finder switch F, Fig. 2. The relay 53 is energized in series with the rotary magnet 62 and operates in the same manner as before to maintain the circuit of the private magnet 65 and the relay 57 closed during the entire time the rotary magnet is operating. The circuit of the private magnet 65 and the relay 57 is broken shortly after the last impulse is delivered to the rotary magnet, and the private magnet 65, upon deenergizing, permits the side switch to pass to third position. The side switch wiper 67, upon reaching third position, completes a circuit extending from ground G^2 through said side switch wiper, private wiper 81, connector private bank contact 84, conductor 87, resting contact of armature 109 and said armature, relay 101, conductor 143, armature 128 and its resting contact, and through resistance R′ to battery. The relay 101, upon energizing, removes ground at its armature 111 from the test contact 113 and places ground upon the common starting wire 130 leading to the first finder switch, which is the finder

switch F. When ground is placed upon the starting wire, relay 103 is energized over the following circuit: grounded starting wire 130, armature 123 and its resting contact, and thence through relay 103 to battery. When this relay pulls up, armature 126 grounds the release trunk conductor 131 leading to battery through coil 132 and armature 133 of line switch C' is therefore operated to remove the bridge of the line relay 134 from the trunk line X. A branch of this circuit extends from grounded conductor 131, through the switching relay 102 and motor magnet 104 in series to battery. Armature 127 connects the test wiper 116 to the last named circuit at a point between the switching relay 102 and motor magnet 104. The operation now depends upon whether the test wiper 116 is standing upon ungrounded contact 113 or upon some other contact which will, of course, be grounded. We will assume the latter, in which case relay 102 will be short circuited and motor magnet 104 will operate as a buzzer to advance the switch wipers step by step in search of the calling line. When wiper 116 arrives at ungrounded contact 113 the relay 102, being no longer short circuited, will energize over its above traced circuit. The relay 102 is of such high resistance that the motor magnet 104 will not energize in series with it. Upon energizing, relay 102 extends the trunk line X by way of respective resting contacts of armatures 122 and 125 and said armatures, wipers 115 and 117, contacts 112 and 114, and conductors 86 and 88 to contacts 83 and 85 in the bank of connector H; disconnects the starting conductor 130, at its armature 123, from relay 103 and connects it to the conductor 135 leading to the next switch; and shifts the test wiper 116 at armature 124 to the grounded release trunk conductor 131, thus closing a circuit for relay 100 which extends by way of test contact 113, through armature 110 and its working contact, and relay 100 to battery. Relay 100, upon energizing, opens the circuit to relay 101 at armature 109, removes ground from the starting wire 130 at its armature 108, and locks itself to ground from the grounded conductor 87 at armature 105. Armature 105 also grounds the test contact 113, and does so before the slow acting relay 103 of the finder F has had time to fall back; thus it is seen that the established connection of the finder switch is held up.

Returning to the connector we find that the passage of the side switch wipers 90 and 91 to third position and the closing of contact at armatures 97 and 98 by the deenergization of the slow acting relay 57 finally completes the connection between the calling line and the called trunk line. The passage of the side switch wiper 63 into third position completes the circuit for the ringing relay 56. This circuit extends from ground G^3 through interrupter I, relay 56, resting contact of armature 92 and said armature, and through side switch wiper 63 to battery. The relay 56, upon energizing, disconnects the calling line from the called trunk, and connects ringing current generator K with the latter through the armatures 93 and 94 and their working contacts, armatures 97 and 98 and their resting contacts, wipers 80 and 82, and over previously traced circuit to trunk line X and thence to a ring down drop or some other visual or audible signal in series with a condenser at the switchboard of the private branch exchange. Since the circuit of the ringing relay 56 includes the interrupter I, said relay is energized only intermittently. When the operator plugs in to answer the call she closes a conductive bridge across the line, and as soon thereafter as the ringing relay 56 deenergizes, a circuit is completed over the heavy talking conductors for the double wound back bridge relay 50. Relay 50 is accordingly energized and closes the circuit of ring cut-off relay 55. The relay 55, upon energizing, opens the circuit of the ringing relay 56 at its armature 92 and closes a locking circuit for itself, independent of relay 50, at its armature 99, so as to not fall back and start the ringing again in case the operator at the branch exchange should disconnect before the calling party replaces his receiver. The operation of relay 50 serves also to reverse the direction of the calling party's battery flow for the purpose of operating registers, or for other purposes familiar to those skilled in the art.

The operator at the branch exchange will complete the connection to the desired party in the usual manner, and after the conversation is finished the connection is released by the hanging up of the receiver at the calling substation A. When the receiver is replaced the line and release relays 51 and 52 of the connector H deenergize and the latter relay closes a circuit for release magnet 49, which operates to restore the connector H to normal position in the usual manner. Relay 52 also disconnects ground from the release trunk conductor 58, thereby breaking the holding circuit of the selector E and the line switch C and these two switches are restored to normal also. When the connector H releases ground is removed from conductor 87, thus breaking the holding circuit extending forward to the relay combination T and finder switch F. Relay 100 accordingly deenergizes, likewise relay 102 of finder switch F, and the cut-off winding 132 of the line switch C'.

In the foregoing it has been assumed that the first trunk line leading to the private branch exchange is idle when the call is made. In case the first trunk line is busy,

the starting wire 130 will have been extended to the next finder switch, and the connection will be completed in the same manner but over a different trunk line. In case all trunk lines are busy the connector H will not complete the connection but will give the calling subscriber a busy signal and also will operate the meter M, which registers the number of times that the private branch exchange is called when all the trunks are busy. In order to explain this we will assume that the subscriber at substation A makes the same call as before, but that all the trunk lines leading to the private branch exchange 241 are busy, in which case armatures 120, 121, and 123, located in the first, second, and last finder switches, respectively, are in their respective working positions. When the last trunk line becomes busy a circuit for the relay 140 is completed as follows: from ground G^7, through relay 140, working contact of armature 120 and the said armature, working contact of armature 121 and said armature, working contact of armature 123 and said armature, conductor 130, and through resistance R to battery. Relay 140, upon energizing, disconnects its armature 128 from battery through resistance R′ and connects it to ground through relay 141. This ground extends through relay 141, working contact of armature 128 and said armature, conductor 143, relay 101, armature 109 and its resting contact, and through conductor 87 to test contact 84 in the bank of connector H. Now when connector H in response to the last digit 1 of the called number 241 rotates its wipers 80, 81, and 82 into engagement with contacts 83, 84, and 85, respectively, and the slow acting relay 53 falls back, a ground potential is extended from grounded contact 84, through side switch wiper 67 (which is in second position), normally closed contacts controlled by armature 89, relay 54, normally closed contacts controlled by armature 64, and through private magnet 65 to battery. Armature 64 closes this circuit before it disconnects ground from private magnet 65 and, therefore, magnet 65 does not deenergize and does not permit the side switch wipers to pass into third position, thus preventing the connection from being completed. When the above named busy test circuit is completed, relay 141 associated with the meter M operates to close the circuit of the operating magnet of the meter, whereupon the said magnet attracts its armature and registers the call. Relay 101, however, being marginally adjusted, does not operate at this time. At the connector, relay 54, upon energizing over the circuit previously traced for it, transfers the locking ground for itself and the private magnet from the private bank contact 84 to ground G^5 by way of off normal spring 39 and its working contact, and armature 89 and its working contact, thus locking itself and the private magnet over a new path which is independent of the private bank contact 84. When the normally closed contacts controlled by armature 89 are opened the circuit of the relay 141 is broken, and this relay, although it is slow acting to insure the operation of the meter M, soon falls back and opens the circuit, thus leaving the meter M free to register another call should it come in while all the trunks are still busy. In addition to the operations described relay 54 also completes a connection from the busy signalling machine through the armature 38 and its working contact, and through side switch wiper 91 to the calling line, to notify the calling subscriber that the called private branch exchange is busy. After having called a busy line, the calling subscriber causes the release of the switches by hanging up his receiver in the same manner as if an idle line had been called.

As explained before, the line switch C′ is provided for handling calls from the private branch exchange to the main exchange, the trunk line X being what is known as a two way trunk line. The process of establishing a connection of this kind is according to well understood practice, and since it has nothing particular to do with the invention it need not be explained herein. It may be pointed out, however, that when the release trunk conductor 131 is grounded during a branch to main exchange call, relay 102 of the finder switch F does not fully operate its several armatures, due to a mechanical locking device controlled by the line relay 103, such as is disclosed in the patent to Lamb, No. 1,193,160, and the wipers of the switch are not connected up. Armature 123, however, is so adjusted that under these circumstances it engages its front contact in order to properly extend the starting wire to the next finder switch.

Having described my invention, what I consider to be new and desire to have protected by Letters Patent will be pointed out in the appended claims.

What I claim as my invention is:

1. In a telephone system, a subscriber's line, a plurality of link circuits, a like plurality of connector switches each having access to a different one of said link circuits when operated in accordance with the same directory number, and having access to said line when operated in accordance with another directory number, a plurality of lines having common access to said link circuits, and means responsive to the connection of one of said switches with one of said link circuits for automatically connecting an idle one of said lines with the connected link circuit.

2. In a telephone system, an automatic switch, a link circuit accessible to said switch, a plurality of lines having access to

said link circuit, means for operating said switch to connect with said link circuit, means controlled by the connection with the link circuit for automatically connecting an idle one of said lines to said link circuit, and means in said switch controlled when all of said lines are busy, for preventing connection with said link circuit and for giving a busy signal to a calling subscriber.

3. In a telephone system, selector and final connector switches, subscribers' lines accessible to said connectors, a group of trunk lines, a contact set in each connector assigned to said trunk group, and a finder switch for each trunk line having access to the contact sets in all of said connectors.

4. In a telephone system, selector and final connector switches, subscribers' lines accessible to said connectors, a group of trunk lines, a contact set in each connector assigned to said trunk group, a finder switch for each trunk line having access to the contact sets in all of said connectors, means for operating a selector and connector to establish connection with a contact set assigned to the trunk group, and means for automatically starting one of said finders when the connection is completed.

5. In a telephone system, a group of connector switches, each operable in accordance with the two final digits in called telephone numbers, a link circuit terminating in a bank contact set of only one of said connectors, a similar link circuit terminating in the corresponding bank contact set in each of the other connectors, a group of trunk lines, and a finder switch individual to each trunk line having access to all of said link circuits.

6. In a telephone system, connector switches adapted exclusively for directive control by calling subscribers, subscribers' lines terminating in contact sets of said switches, a group of trunk lines, a contact set in each connector assigned to said trunk group, a link circuit terminating in each of said contact sets, and a finder switch for each trunk line having access to all of said link circuits.

7. In a telephone system, a group of connector switches, a group of subscribers' lines directly accessible in common to all of said connectors, a group of link circuits, one for each connector, each link circuit being individual to a different connector, a group of trunk lines, and a finder switch for each trunk line having access to all of said link circuits.

8. In a telephone system, a group of connectors, multiple connections between certain of the contact sets of said connectors, there being also certain contact sets which are not multipled, subscribers' lines terminating in the multiply connected contact sets, a link circuit for each connector terminating in a contact set which is not multipled, a group of trunk lines, and a finder switch for each trunk line having access to all of said link circuits.

9. In a telephone system, a group of connector switches, each having direct access to called subscribers' lines, a link circuit terminating in a bank contact set of only one of said connectors, a similar link circuit terminating in the corresponding bank contact set in each of the other connectors, a group of trunk lines, a finder switch individual to each trunk line having access to all of said link circuits, means for operating any connector to connect with its associated link circuit, and means in the operated connector for starting an idle one of said finder switches over a conductor of the connected link circuit.

10. In a telephone system, a group of connector switches, a link circuit terminating in a bank contact set of only one of said connectors, a similar link circuit terminating in the corresponding bank contact set in each of the other connectors, a group of trunk lines, a finder switch individual to each trunk line having access to all of said link circuits, a common starting circuit for said finders, and a plurality of branches of said starting circuit, each branch including a conductor in a different one of said link circuits.

11. In a telephone system, a link circuit accessible to automatic switches at both ends, a test contact at each end of said link circuit, the test contact at one end being normally grounded, means for grounding the test contact at the other end when the link circuit is connected with at that end, and means responsive to the grounding of said last mentioned test contact for removing the normal ground connection from the other test contact.

12. In a telephone system, a group of link circuits, automatic forward selecting switches for connecting with said link circuits at one end thereof, automatic backward selecting switches for connecting with connected link circuits at the other end thereof, and means for rendering all said link circuits busy to said forward selecting switches when all of said backward selecting switches are busy.

13. In a telephone system, a group of link circuits, automatic forward selecting switches for connecting with said link circuits at one end thereof, automatic backward selecting switches for connecting with connected link circuits at the other end thereof, a chain relay circuit closed when all of said backward selecting switches are busy, and a relay controlled over said chain circuit for rendering said link circuits busy to said forward selecting switches.

14. In a telephone system, a trunk line,

backward and forward selecting switches individual to said trunk line at the same end thereof, a cut-off relay in the forward selecting switch, a starting relay in the backward selecting switch, and a circuit for said cut-off relay controlled by said starting relay.

15. In a telephone system, a trunk line, backward and forward selecting switches individual to said trunk line at the same end thereof, a cut-off relay in the forward selecting switch, and means for energizing said relay whenever the backward selecting switch is operated.

16. In a telephone system, a trunk line, backward and forward selecting switches individual to said trunk line at the same end thereof, a starting circuit for said backward selecting switch, other backward selecting switches controlled over said starting circuit, and means for transferring said starting circuit to one of said other backward selecting switches whenever said forward selecting switch is operated.

17. In a telephone system, a trunk line, backward and forward selecting switches individual to said trunk line at the same end thereof, a starting circuit for said backward selecting switch, other backward selecting switches controlled over said starting circuit, a relay for transferring said starting circuit to one of said other backward selecting switches, and a circuit for energizing said relay whenever said forward selecting switch is operated.

18. In a telephone system, a backward selecting finder switch, a forward selecting line switch, a two-way trunk having one end connected in multiple to both of said switches, means for operating said finder switch for extending calls to said trunk line, and means for operating said line switch to extend calls away from said trunk line.

19. In a telephone system, a two-way trunk line, a backward selecting finder switch at one end of said trunk line for handling calls in one direction, and a forward selecting line switch at the same end of said trunk line for handling calls in the opposite direction.

20. In a telephone system, a trunk line, backward and forward selecting switches individual to said trunk line at the same end thereof, a cut-off relay in the forward selecting switch, and means for energizing said relay as soon as the backward selecting switch is taken for use.

21. In a telephone system, a trunk line, backward and forward selecting switches individual to said line at the same end thereof, a switching relay in the backward selecting switch, a cut-off relay in the forward selecting switch, and means for energizing said relays simultaneously when the backward selecting switch is taken for use.

22. In a telephone system, a trunk line, backward and forward selecting switches individual to said trunk line at the same end thereof, a starting circuit for said backward selecting switch, other backward selecting switches controlled over said starting circuit, and means associated with said trunk for transferring said starting circuit to one of said other backward selecting switches whenever either the backward selecting switch or the associated forward selecting switch is operated.

Signed by me at Rochester, Monroe County, New York, this 5th day of November, 1920.

WINFRED T. POWELL.