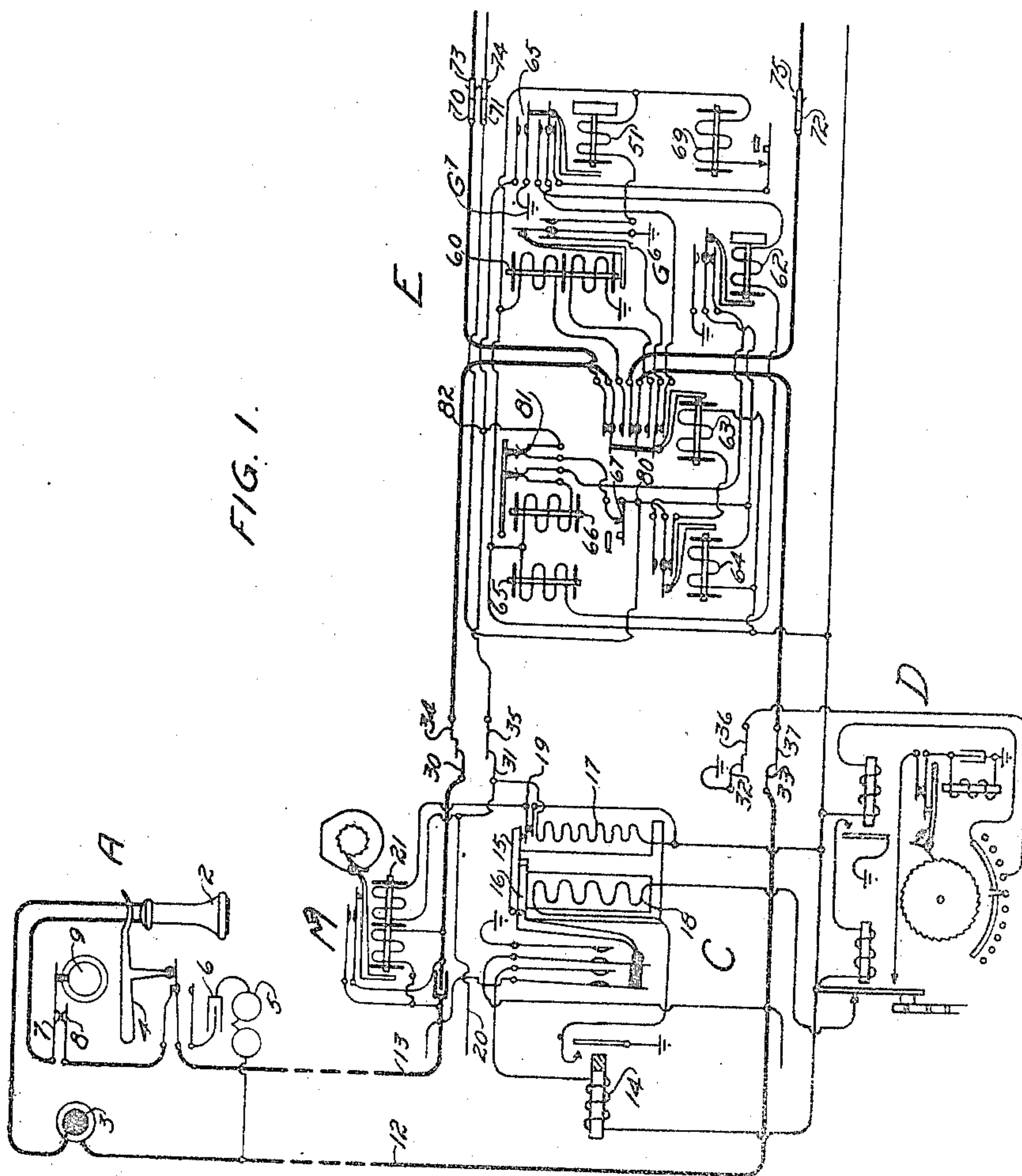


1,269,245.

A. ANDERSEN.
AUTOMATIC TELEPHONE SYSTEM.
APPLICATION FILED JUNE 7, 1916.

Patented June 11, 1918.
2 SHEETS—SHEET 1.



WITNESSES
R. Richardson
H. W. Hacks

INVENTOR:
Albert Andersen
By Charles C. Bullock
ATTORNEY

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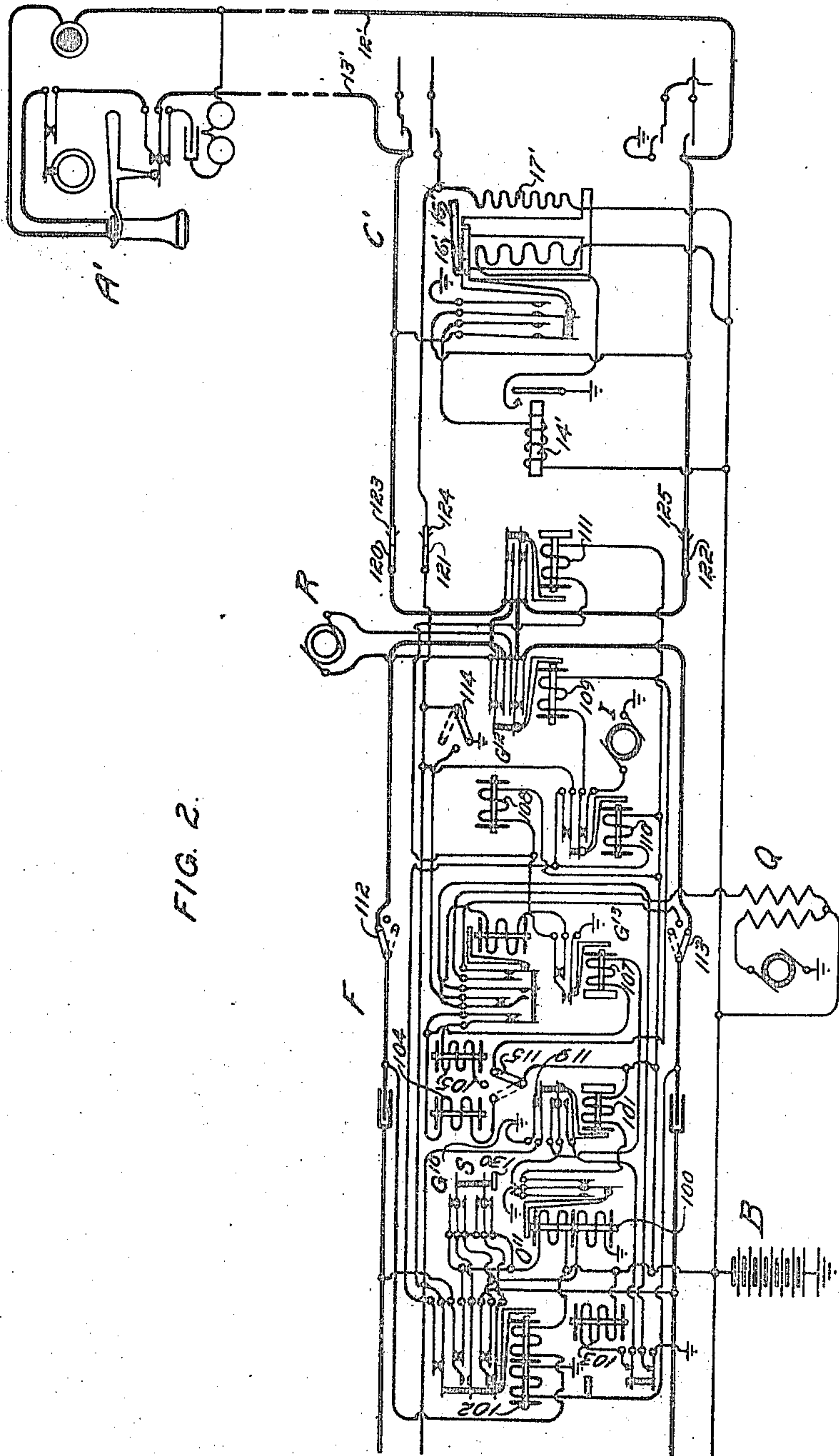


FIG. 2.

WITNESSES
Re Richardson
Herbert W. Maacke

INVENTOR:
Albert Andersen
By Charles E. Belknap
ATTORNEY

UNITED STATES PATENT OFFICE.

ALBERT ANDERSEN, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

1,269,245.

Specification of Letters Patent.

Patented June 11, 1918.

Application filed June 7, 1916. Serial No. 102,181.

To all whom it may concern:

Be it known that I, ALBERT ANDERSEN, 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 in general to automatic telephone systems, but is particularly concerned with such automatic systems as employ meters or other measured service devices in connection with the individual subscribers' stations. A measured service system in common use employs a meter at the exchange for each subscriber's line, which is operated when the associated line is calling, by the reversal of current in the line when the called subscriber answers.

In systems of the foregoing character there are usually a number of telephones, such for example, as the telephones at fire or police headquarters, or those assigned to officials of the telephone company, to which it is desired that all subscribers should have free access without being charged. In the past it has been customary to place all the free telephones in one group and so arrange the connector switches serving that group that they will not reverse the current in calling lines. This plan is open to the objection of inefficiency, for the free telephones are usually very few, or at least are generally considerably less in number than the capacity of a connector switch. It is desirable, therefore, to provide a connector switch capable of serving both kinds of telephones—the ordinary subscribers' stations, connections to which are charged for, and the special telephones to which free access is given.

My invention has for its object the provision of an improved type of connector switch which will ordinarily reverse the current in the calling line to operate the meter associated therewith. When my improved connector is used to establish connection with one of a number of special free service lines, however, it will not so reverse the current in the calling line and conversation may be held without charge.

The particular means and circuit arrangement by which the foregoing and other useful ends are accomplished will be fully ex-

plained and described hereinafter, reference being had to the accompanying drawings, which show diagrammatically a complete circuit connection between a calling substation A (Figure 1) and a called substation A' (Fig. 2). The latter substation is assumed to be a special telephone to which all subscribers are given free access. The switching equipment used in setting up the complete connection shown comprises the individual line switch C, the selector switch E, and the connector switch F.

Referring now to Fig. 1, the substation A may be of any suitable type or construction such, for example, as the type disclosed in British patent to T. G. Martin, #1419 of 1910. As shown herein it comprises essentially the receiver 2, transmitter 3, switch hook 4, ringer 5 and condenser 6. Being an automatic substation there is also provided a pair of impulse springs 7 and 8 controlled by the impulse wheel 9 through the medium of a finger hole dial (not shown).

The line conductors 12 and 13 of the substation A are connected at the exchange to the individual line switch C which may be of the general type of line switch disclosed in British patent to R. W. James, #26,301 of 1906; being, however, of the particular type shown in United States Letters Patent #1,078,690, granted Jan. 17, 1912, to Frank Newforth. Since line switches of the above type are well known and form no part of my invention an extended description will not be given. It will suffice to say that through the medium of line switch C the line of substation A, when calling, is given access to a plurality of selector switches, one of which is shown at the right of Fig. 1 and is indicated by reference character E.

Being a measured service substation, the substation A is also provided at the exchange with a meter M, which as shown herein is similar to the reverse current controlled meter shown and described in the British patent to the Automatic Telephone Mfg. Co., #29,354 of 1912.

The master switch D is of the general type of master switch disclosed in the above mentioned British patent to James, #26,301 of 1906; being, however, more nearly of the particular type disclosed in the British patent to Martin, #1419 of 1910. As is well understood, the function of the master

switch is to maintain the plungers of all idle line switches in position before the terminals of an idle trunk line.

The selector switch E is of the general type of selector switch disclosed in U. S. Letters Patent #815,321, granted March 13, 1906, to Keith, Erickson, and Erickson, being, however, of the particular type disclosed in British patent to the Automatic Telephone Mfg. Co., #2543 of 1914. Such a selector switch, as is well known, may be operated in response to the first digit of a called number to select one of a number of groups into which the subscribers' lines terminating in the exchange are divided. For this purpose the selector E may be given access to a number of groups of trunk lines, the trunk lines of each group being extended to a group of connector switches.

One of these trunk lines is shown as extending to the connector F (Fig. 2), which may be of the general type of connector switch disclosed in U. S. Letters Patent #815,176, granted March 13, 1906, to Keith, Erickson, and Erickson; being, however, of the particular type disclosed in U. S. Letters Patent #13,901, reissued April 13, 1915, to Frank Newforth. A connector switch of the foregoing type may be given access to a group of one hundred subscribers' lines and is operable in response to the two last digits of a called number to establish connection with any line in the group. As before mentioned, in accordance with my invention the lines accessible to the group of connectors of which connector F is one may be of two kinds, viz., lines to which connections may be made free of charge and the ordinary subscribers' lines, for connections to which a charge is made. The lines of the latter type have their terminals arranged in the connector banks in rows or levels in the usual manner, being restricted, however, to the first nine levels. The upper or tenth level is reserved for the special free service lines. Inasmuch as the special lines all have their terminals located in the tenth level of the connector banks, it only remains to provide means in each connector switch whereby when connection is completed to a line in that level, the reversal of current in the calling line will be prevented. This means as shown in the connector F (Fig. 2) comprises the shaft controlled springs S which are operated by the cam 130 when the switch shaft reaches its extreme upward position. The effect of the operation of the springs S will appear more clearly in the description of the operation which is to follow.

The substation A' and the associated individual line switch C' may be similar, respectively, to the substation A and the line switch C which have already been briefly described. As shown in Fig. 2 the substation A' is not provided with a meter, for it

will usually be the case that where no charge is made for incoming calls, the outgoing calls will not be charged for either. A meter similar to the meter M (Fig. 1) may be provided, however, if so desired.

For the purpose of supplying current for operating and talking purposes I have shown a battery B having its positive pole grounded. The auxiliary apparatus comprising the ringing current generator R, the ringing interrupter I, and the busy signaling machine Q are of the ordinary type and perform the same functions as the same named pieces of apparatus in other automatic exchanges.

Having given a brief description of the apparatus, I will now proceed to an explanation of the operation of the same. Inasmuch as the automatic equipment shown herein, excepting a certain modification of the connector F, is well known in the art, having been fully described in the publications above referred to, the operation will be described in a more or less general manner.

When the calling subscriber at substation A removes his receiver to initiate the call an energizing circuit is completed over the line conductors 12 and 13 for the line relay 14 of the line switch C. Upon attracting its armature, the line relay 14 closes a circuit for the pull-in winding 18. Upon energizing, the pull-in winding operates both the plunger arm 15 and the cut-off armature 16; the former through the medium of its plunger (not shown) forcing the bank springs 30—33, inclusive, into engagement, respectively, with contacts 34—37, inclusive, and the latter disconnecting the line conductors 12 and 13, respectively, from the line relay 14 and from ground. By the engagement of bank springs 30 and 33 with contacts 34 and 37, respectively, the line conductors 13 and 12 are extended through normally closed contacts of the switching relay 63 to the double wound line relay 60 of the selector E.

The line relay 60 is accordingly energized over the loop circuit including substation A and, upon attracting its armature, closes a circuit for the slow-acting release relay 51. Upon energizing, the release relay closes a holding circuit for the line switch C which may be traced from ground G' by way of contact springs 65, contact 35, bank spring 31 and the holding winding 17 to battery B. Since the line relay 14 is slow-acting, it retains its armature to maintain the pull-in winding 18 energized until after the above holding circuit has been established. A branch of the holding circuit extends by way of conductor 20 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 test

contacts the said line is made busy. A second branch of the holding circuit extends by way of the right hand winding of the meter magnet 21 and the contact springs 19 (now closed by the plunger arm 15) to the battery B. It will be observed that line conductor 13, as extended to the line relay 60, includes the left hand winding of meter magnet 21. The two windings are so connected, however, that at this time their magnetizing effects are in opposition, wherefore the meter is not operated. It should be mentioned, also that neither winding of the meter magnet is sufficiently powerful to operate it alone.

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 foregoing operations whereby the line conductors 12 and 13 have been extended through to the line relay 60 of the selector E have taken place in response to the removal of the receiver at substation A. The calling subscriber may now manipulate his dial in accordance with the first digit of the desired number, thereby separating momentarily the impulse springs 7 and 8 a number of times and interrupting each time the circuit of line relay 60 of selector E. As a result of these interruptions of its circuit the line relay 60 is deenergized a corresponding number of times, sending an impulse at each deenergization from ground at G⁶ to the slow-acting relay 62 and the vertical magnet 65 in series. The vertical magnet in response to these pulses, steps up the switch shaft until the wipers 70, 71, and 72 stand opposite the horizontal level in which are located contacts which are terminals of the desired group of trunk lines. The relay 62, being slow-acting retains its armature during the series of impulses and closes a circuit for the test relay 64, which latter relay prepares a circuit for the rotary magnet 66 and locks itself to ground at G⁷. At the end of the series of impulses the relay 62 deenergizes, thereby completing the aforementioned circuit of the rotary magnet 66, whereupon the wipers 70, 71, and 72 start rotating in search of an idle trunk line. As is well known, the rotary magnet interrupts its own circuit and also the locking circuit of the test relay at every energization, the contacts in the latter circuit, however, being short-circuited by the test or private wiper 71 while passing over grounded busy contacts. As soon, therefore, as the test wiper 71 arrives at an ungrounded test contact the test relay 64 deenergizes and opens the rotary magnet circuit, thereby bringing the wipers to rest upon the terminals of an idle

trunk line, assumed to be in this case the contacts 73, 74, and 75. As a further result of the deenergization of the test relay 64, a circuit is completed for the line switching relay 63 which relay, upon energizing, disconnects the extended line conductors 13 and 12 from the windings of the line relay 60 and further extends them by way of wipers 70 and 72 and bank contacts 73 and 75 to the double wound line relay 100 of the connector F.

The line relay 100 thereupon energizes over the line circuit extending back through substation A and completes an energizing circuit for the slow-acting relay 101. Relay 101, upon attracting its armature, prepares a circuit for the vertical and rotary magnets 104 and 105 and also completes a new holding circuit as follows: ground at G¹⁰, contact springs 119, bank contact 74 and wiper 71 to wire junction 80, where the circuit divides, one branch extending by way of a back contact of relay 64 through the winding of line switching relay 63 to battery B, and the other branch extending by way of off-normal contact 67 and interrupter contact 81 to wire junction 82 where it joins the previously described holding circuit extending back to the line switch C.

The subscriber at substation A may now operate his dial in accordance with the second digit of the desired number, assumed in this case to be the digit 0, resulting in deenergizations of the line relay 100 of the connector F. At each deenergization, the line relay 100 sends an impulse from ground at G¹¹ to the slow-acting relay 107 and the vertical magnet 104 in series, side switch wiper being in its first position. The vertical magnet, in response to these impulses, steps up the shaft until the wipers 120, 121, and 122 stand opposite the tenth horizontal level of bank contacts, this being the level in which the line of substation A terminates. Relay 107, being slow-acting, retains its armature during the series of impulses and maintains a circuit from ground at G¹³ for the private magnet 108 and the wiper cut-off relay 111 in parallel. At the end of the series of impulses, the relay 107 deenergizes and breaks the circuit of the private magnet, which latter controls the side switch wipers in the usual manner to advance them to their second position.

The subscriber at substation A may now operate his dial in accordance with the third and final digit of the desired number, resulting as before in deenergizations of the line relay 100. Now, however, side switch wiper 115 being in its second position, the line relay sends impulses to the slow-acting relay 107 in series with the rotary magnet 105. The rotary magnet operates in response to these impulses to rotate the wipers 120, 121, and 122 until they rest, respectively, upon

bank contacts 123, 124, and 125, these contacts forming the terminal of the line of substation A' in the bank of connector F. The private magnet 108 and the wiper cut-off relay 111 are energized during the last series of impulses as before, the latter disconnecting the line wipers during rotation and the former, upon deenergizing, controlling the side switch wipers to advance them to their third position, it being assumed that the line of substation of A' was idle when called.

As side switch wiper 114 comes into engagement with its third position contact point, a circuit is completed for the holding winding 17' of line switch C' as follows: ground at G¹², side switch wiper 114 (in third position), wiper 121, bank contact 124, and holding winding 17' to battery B. By the attraction of the cut-off armature the line conductors 12' and 13' are disconnected, respectively, from ground and from the line relay 14'. The holding winding 17' is not sufficiently powerful to operate the plunger arm 15' of the line switch C'. Ground at G¹² also extends to multiples of bank contact 124 in the banks of other connectors of the group, thereby making the line of substation A' busy to other calls.

By the engagement of side switch wipers 112 and 113 with their third position contact points the connection between the calling and the called substations is completed, relay 111 being deenergized. By the engagement of side switch wiper 115 with its third position contact point, a circuit is completed for the ringing relay 109 in series with the interrupter I, whereby ringing current is projected intermittently out over the line of substation A' to operate the signal in bridge thereof.

The subscriber at substation A has now established the required connection with substation A' and the bell at the latter substation is being rung to attract the attention of the called subscriber. Before proceeding further it will be well to consider the condition of the shaft controlled springs S. When the connector F was operated in response to the second digit 0 of the called number the shaft was raised to the uppermost or tenth level as described. At the last step, by means of a suitable cam 130 carried on the shaft, the springs S are shifted to the position shown in the drawing. The springs S, as regards their wiring connections, are associated with the usual line reversing springs of the back bridge relay 102, and are so connected that when operated the said back bridge relay will not be effective to reverse the incoming lines upon the response of the called subscriber.

To proceed with the operation, when the called subscriber removes his receiver from

the hook a circuit is completed for the double wound back bridge relay 102 in the well known manner. Upon attracting its armature, the relay 102 closes a circuit for the ring cut-off relay 110 which relay locks itself to ground at G¹² and also opens the circuit of the ringing relay 109, thereby stopping the ringing operation. The back bridge relay also shifts its line reversing springs which operation would ordinarily result in the reversal of the incoming line conductors as regards their connections to the windings of the line relay 100. Now, however, since the shaft controlled springs S have been operated, the operation of the back bridge line reversing springs is of no effect and the current in the called line continues to flow in the same direction as before. It follows that the meter M will not be operated.

The calling and called subscribers may now converse without further effort. Current for the transmitter at substation A is supplied through the windings of the line relay 100, while current for the transmitter at substation A' is supplied through the windings of the back bridge relay 102. The voice currents follow the path shown in the heavy lines which, it is thought, will be apparent without further amplifying the explanation. It may be mentioned, however, that the left hand winding of the meter magnet 21 is bridged by a small condenser in order to provide a good talking circuit when the meter is not operated.

When the conversation is completed both subscribers will hang up their receivers. By the replacement of the receiver at substation A the circuit of the line relay 100 of the connector F is broken. Upon deenergizing, relay 100 breaks the circuit of slow-acting relay 101. Upon the deenergization of relay 101, the connector F is restored to normal in the regular manner through the medium of the release magnet 103, and as a further result ground is removed from the holding trunk extending back to selector E and the line switch C. By the removal of ground from the holding trunk, relay 63 of the selector E is deenergized, whereby the selector E is restored to normal in the usual manner through the medium of release magnet 69. As a further result of the removal of ground from the holding trunk, the holding winding 17 of the line switch C is deenergized, thereby allowing the plunger to be withdrawn from the bank and restoring the line switch to its normal position.

The operation of a connector switch such as the connector F when connection is attempted with a busy line is well known and has been described in the publications previously mentioned. My invention involves nothing new in connection with this feature,

consequently it is thought to be unnecessary to describe such operation here.

If the called line had been an ordinary subscriber's line provided with multiple terminals in one of the lower levels of the connector F, the shaft controlled springs S would not have been shifted when the connector F was operated; for, as has been explained, the said springs are shifted only when the connector shaft is raised to the tenth level. It is evident that upon the response of the called subscriber in this latter case the back bridge relay 102 would be effective to reverse the incoming line conductors as regards their connections to the windings of the line relay 100. The direction of current flow in the calling line is accordingly reversed to operate the meter M in the usual manner through the cooperation of its two windings.

It will be seen from the foregoing that I have devised a simple and efficient connector switch capable of serving telephone lines of two classes, and able to discriminate between the lines of different classes in order to charge for connections to lines of one class while not charging for connections to lines of the other class.

While I have found it convenient in explaining my invention to show and describe a certain specific embodiment thereof, I consider it probable that the invention may be modified to suit other conditions or to adapt it to other types of apparatus without the exercise of any talent beyond ordinary mechanical ingenuity. For example, by means of a suitably designed cam 130, the springs S may be shifted at any other level instead of the tenth level, or, if desired, they may be shifted when connection is established to any one of a plurality of levels. In case connectors other than those of the vertical and rotary type are to be used the springs S may be so arranged that they will be shifted at any desired point in the travel of the movable contact carrying mechanism, the particular arrangement in each case depending on the mechanical construction of the connector to which the invention is being adapted.

In view of these considerations I do not wish to limit myself to the exact construction shown herein but desire to include and have protected by Letters Patent all modifications of my invention which may hereafter be devised, limited only by the scope of the appended claims.

What I claim as my invention is:

1. In a telephone system, a calling line provided with a toll assessing device, a plurality of other lines of two kinds, means for connecting the calling line with a called one of said other lines, automatic means for operating said device to register the call, and automatic means common to all of said

lines for preventing the operation of said device when the called line is of a particular kind.

2. In a telephone system, a calling line provided with a toll assessing device, a plurality of other lines of two kinds, means for connecting the calling line with a called one of said other lines, and controlling means for said device common to said other lines adapted to discriminate between the two kinds of lines whereby if the called line is of one kind the device is operated and if the called line is of the other kind the device is not operated.

3. In a telephone system, the combination with a calling line provided with a measured service device, a plurality of other lines, and means for connecting said calling line with any one of said other lines, of means for operating said device to register the call, and automatic means common to all of said other lines for preventing the operation of said device whereby certain of said other lines may be rendered accessible free of charge.

4. In a telephone system, an automatic connector switch, lines of two kinds accessible to said switch, a calling line and means for extending it to said switch, a toll assessing device for said calling line, means for operating said switch to connect with any one of said first lines, means for operating said device if connection is established with a line of one kind, and means individual to said switch for preventing the operation of said device if connection is established with a line of the other kind.

5. In a telephone system, a calling line provided with a registering device, a connector switch, a plurality of other lines accessible to said switch, means for extending the calling line to said switch, means for operating said switch to connect with any one of said other lines, means for operating said register when the called subscriber answers, and means common to said other lines for rendering said last means ineffective when a particular line is called.

6. In a telephone system, a calling line provided with a toll assessing device, a connector switch, a plurality of other lines divided into groups and accessible to said switch, means for extending the calling line to said switch, means for operating said switch to connect with any one of said other lines, means for operating said device when the called subscriber answers, and means common to said other lines for rendering said last means ineffective when a line in a particular group is called.

7. In a telephone system, a plurality of lines of two kinds, a calling line provided with a measured service device, a two motion connector switch and means for extending the calling line thereto, means for operating

- said switch to connect with any one of said lines, the kind of line connected with being dependent on the extent of the first movement of said switch, means for operating said device to register the call, and means in said switch for preventing the operation of said device if the first movement of said switch extends beyond a predetermined limit.
- 10 8. In a telephone system, a plurality of lines of two kinds, a calling line provided with a measured service device, a connector switch and means for extending the calling line thereto, means for operating said switch with a vertical and rotary motion to connect with any one of said lines, the kind of line connected with being determined by the vertical movement of said switch, means for operating said device to register the call, and means controlled in the said vertical movement of the switch to prevent the operation of said device if a line of a particular kind is called.
- 25 9. In a telephone system, a plurality of lines of two kinds provided with fixed terminals arranged in rows or levels, the lines of each kind being arranged in separate levels, an automatic connector switch provided with movable terminals, a calling line and means for extending the same to said switch, means for operating said switch to connect with any of said first lines through the medium of said fixed and movable terminals, a measured service device for the calling line, means for operating said device to register the call, and means individual to said connector switch for rendering said last means ineffective if the called line has its terminals located in a particular level.
- 40 10. In a telephone system, an automatic connector switch, a line terminating in said switch, a source of current for said line, means for transmitting series of current impulses over said line to operate said switch, a relay in said switch to reverse the current in said line, a device responsive to such reversal, and means individual to said switch for preventing such reversal when said switch is operated in response to a particular series of impulses.
- 50 11. In a telephone system, the combination with a calling line and a reverse current controlled measured service device therefor, of a called line, means including a connector switch for connecting the two lines, a source of current for talking purposes, means for reversing the flow of current in the calling line to operate said device, and means individual to said switch for preventing such reversal of current when connection is established with the said called line.
- 55 60

Signed by me at Chicago, Cook county,
State of Illinois, this 1st day of June, 1916.

ALBERT ANDERSEN.