April 7, 1925. 1,533,079

R. G. RICHARDSON

AUTOMATIC TELEPHONE SYSTEM

Original Filed Feb. 6, 1920 3 Sheets-Sheet 1

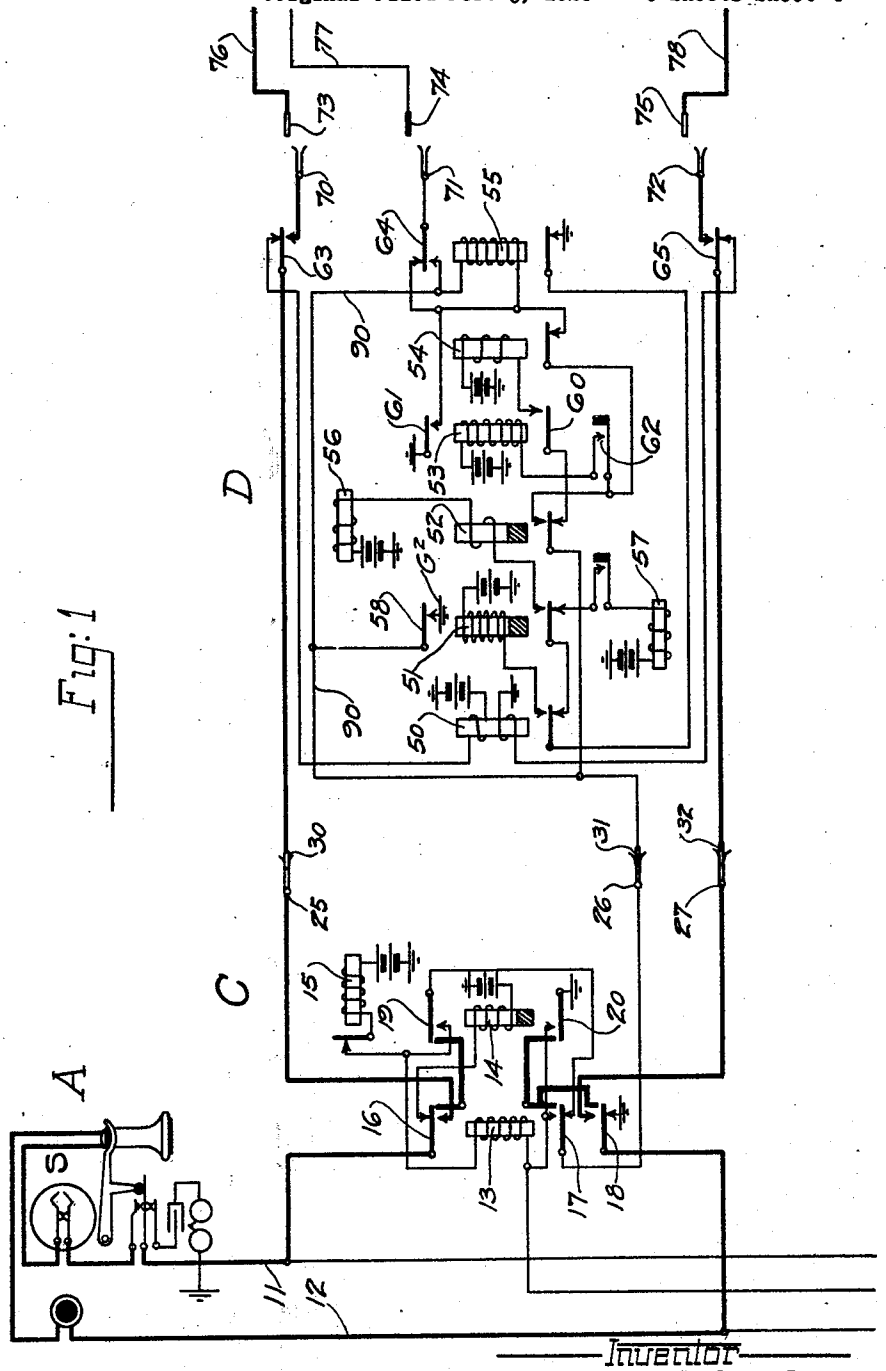


Fig. 1

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Original Filed Feb. 6, 1920 3 Sheets-Sheet 2

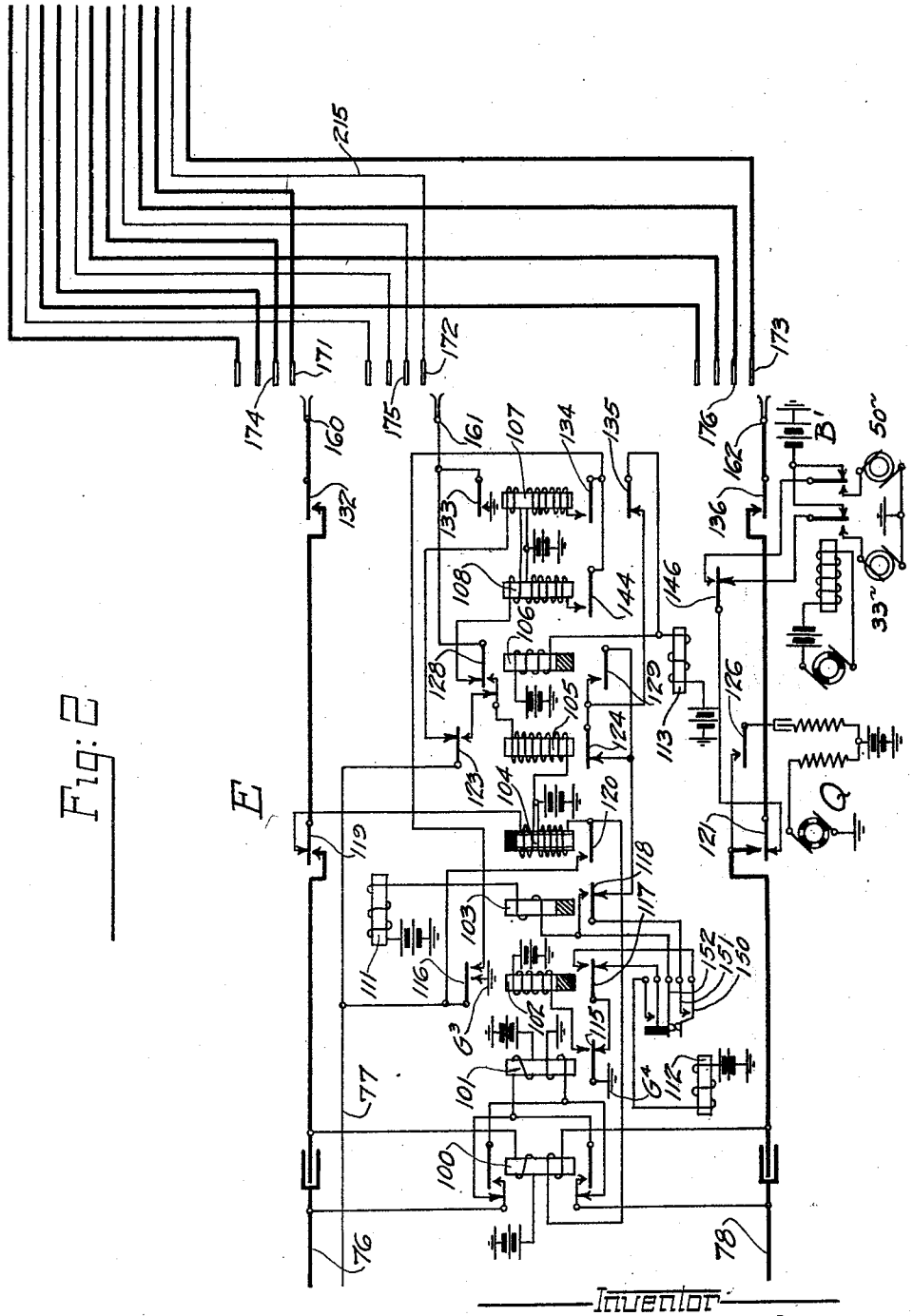


Fig: 2

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AUTOMATIC TELEPHONE SYSTEM

Original Filed Feb. 6, 1920 3 Sheets-Sheet 3

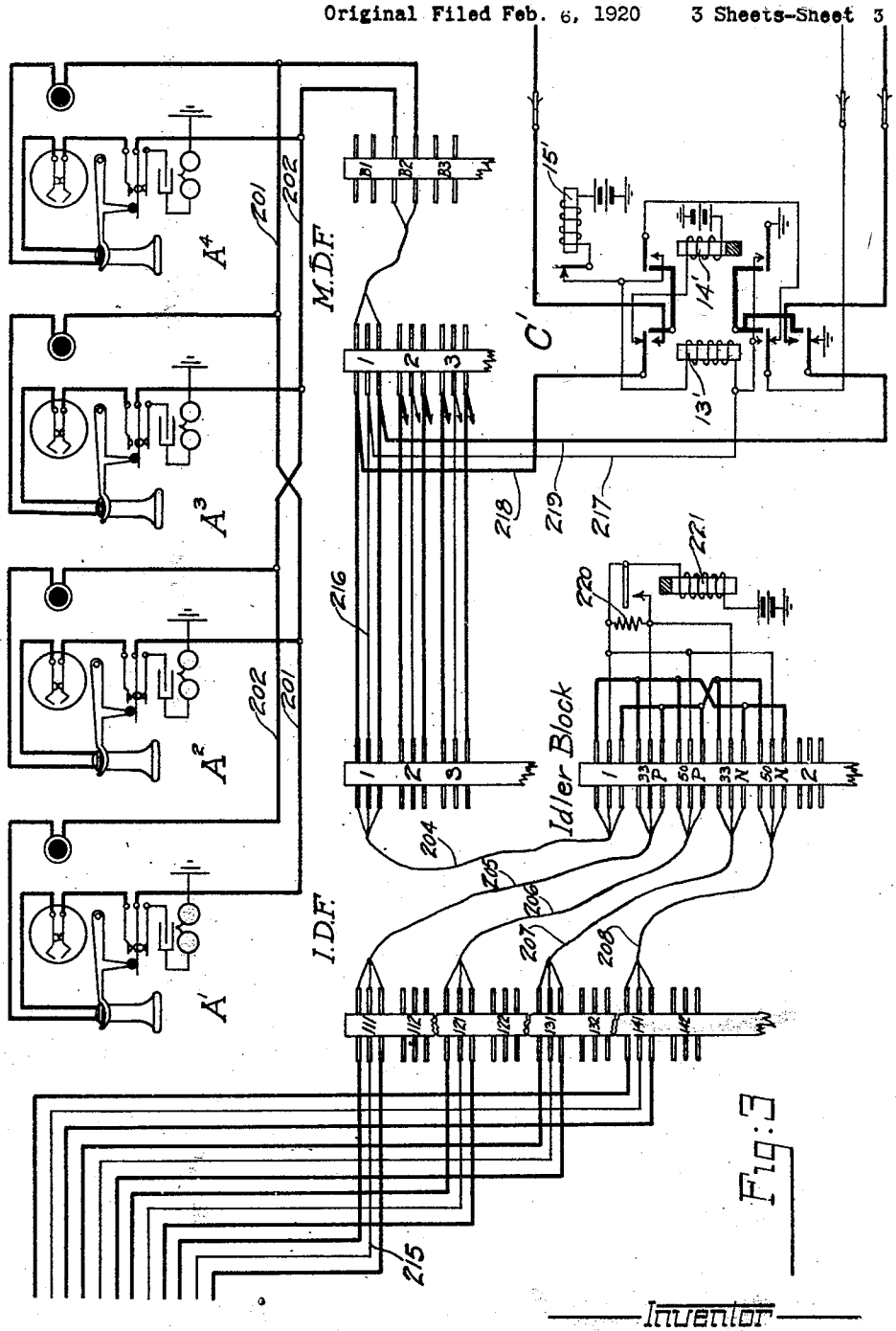


Fig. 3

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Patented Apr. 7, 1925. 1,533,079

UNITED STATES PATENT OFFICE.

RODNEY G. RICHARDSON, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

Application filed February 6, 1920, Serial No. 356,803. Renewed July 16, 1924.

To all whom it may concern:

Be it known that I, RODNEY G. RICHARDSON, a citizen of the United States of America, and a resident of Chicago, Cook County, 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 concerned more particularly with automatic party line telephone systems in which means is provided at the exchange for selectively signalling the different stations on the party lines; and the object of the invention may be stated to be the provision of a new and more efficient and flexible system of this kind than has hitherto been available.

In my prior United States Patent No. 1,528,343, issued March 3, 1925, I have described a system of party line selective signalling in which each party line is accessible by way of as many called line branches as there are stations on the line, the line and its several branches being connected at an intermediate distributing frame, and in which frequency selecting connectors are used whose frequency selecting operations are controllable over any called line branch connected with the frequency selection being determined by the manner in which the branches are connected to the line at said distributing frame. In a system of this kind the different call numbers or telephone numbers have no fixed relation to each other, or to any party line, or to any particular kind of ringing current; and such a system therefore provides for handling changing and fluctuating party line business with a maximum of convenience both to the company and to the subscribers, while securing a maximum efficiency in the utilization of the central office switches and in the outside cable plant.

The system above described, however, provides for full metallic circuit ringing on the harmonic principle and on that account the circuits are necessarily somewhat complicated. I have found that by connecting the ringers at two of the stations on a four party line from one side of the line to ground and the ringers at the other two stations from the other side of the line to ground, and by effecting corresponding changes in the central office equipment, I am able to simplify the circuits to a great extent without losing any of the advantageous features. The present system, then, may be considered to be an improvement on my prior system, described in the application above referred to, in which the desired results are obtained in a different manner and by using different and less complicated circuit arrangements.

Having stated in more or less general terms the object of the invention, the apparatus and improved circuits used to carry out the same will now be explained more in detail, reference being had to the accompanying drawings, comprising Figs. 1, 2, and 3, which are circuit diagrams showing the essential features of a telephone system embodying the invention.

Referring to the drawings, the substation A, Fig. 1, is an ordinary automatic substation, which, although shown for convenience as being individual to the line, may equally well be a party line substation. It comprises the usual talking equipment and ringer, and also a calling device indicated by the reference character S, through the medium of which the subscriber controls the central office switches.

The line conductors 11 and 12 extend to the exchange where they terminate in the rotary line switch C in a manner more clearly shown in Fig. 3 in the case of a called line. The line switch C may be briefly described as a rotary line switch whose movable terminals or wipers have no normal position, and which have movement in a forward direction only. The construction of a line switch of this type is well known in the art, and its function, also well understood, is to extend the associated line when calling to an idle trunk line. For this purpose, a plurality of these individual line switches may be given access to a group of trunk lines extending to first selector switches. One of the trunk lines to which the line switch C has access is shown in the drawings as extended to the first selector D,

which is a vertical and rotary selector switch of the usual construction. The selector D, together with a plurality of similar selectors, has access to a plurality of groups of trunk lines, the trunk lines of each group terminating in a group of connector switches. One of the trunk lines to which the selector D has access is shown extending to the connector E, Fig. 2. The connector E likewise is a vertical and rotary switch of well known construction, and, except for the circuits having to do with the selective ringing, is of the usual type which is in common use. It is understood that second and third selectors may be used if desired according to the capacity of the exchange; and it may be stated that the system of trunking employed is the same as the system commonly referred to as the percentage trunking system.

In Fig. 3, I have shown in detail the manner in which a party line is connected for both incoming and outgoing service at the main and intermediate distributing frames. The layout shown may be described briefly as follows: The four party line comprising conductors 201 and 202, which has the four substation A′ to A⁴, inclusive, connected in bridge thereof, is assumed to enter the exchange by way of cable pair B² which is terminated on the cable side of the main distributing frame in the usual manner. This cable pair is connected by means of a jumper with any desired pair on the switchboard side of the main distributing frame, as for example, pair 1. All the terminal sets on the switchboard side of the main frame are connected by means of cables with correspondingly numbered terminal sets on the vertical side of the intermediate distributing frame. The line switch cables which extend to the individual line switches are connected in multiple with these cables and may be terminated on the switchboard side of the main distributing frame as shown, or on the vertical side of the intermediate distributing frame, it is immaterial which. The jumper on the main distributing frame having been run, it will be evident that the party line shown will be connected for outgoing service by way of the individual line switch C′, which has access to a plurality of first selectors similar to the first selector D. The line is connected for incoming service at the intermediate distributing frame. On the horizontal side of this frame are terminated the normal cables coming from all the connector groups in the exchange. These cable pairs are preferably arranged in consecutive order on the horizontal side of the frame in accordance with the call numbers, and the terminal sets should be so numbered. This is shown clearly in the drawing wherein the first sets of bank contacts in the first four levels of the connector E are connected by cable conductors with terminal sets 111, 121, 131 and 141, respectively. There is also provided on the vertical side of the intermediate frame a series of so called "idler blocks", the terminal sets on which are arranged in groups of five each, each group being wired as shown in the drawing. The upper set in each group is preferably numbered in accordance with the number of the group according to any desired numbering scheme; while the other four sets of each group are preferably marked in accordance with the ringing characteristics of the four stations on the line. As shown in Fig. 3, the markings indicate 33 and 50 cycle ringers connected from the positive and negative sides of the line to ground. These markings are not necessary but are very convenient. The manner of connecting the line for incoming service will now be apparent. Terminal set 1 on the vertical side of the intermediate frame is connected by means of the triplex jumper 204 with the upper terminal set of some vacant group on an idler block as for example, the group shown, which is group #1. Then the other four terminal sets of this group are connected by means of jumpers 205, 206, 207 and 208 with the terminal sets on the horizontal side of the intermediate frame which correspond to the call numbers which have been asigned to the different stations on the party line. It is to be clearly understood that any call numbers whatever may be used. The line is now completely connected for both incoming and outgoing service.

I will now describe the operation of the circuits involved with the special object of explaining the method by which the stations on a line are selectively signaled. For this purpose it will first be assumed that the subscriber at substation A desires to call the subscriber at substation A′, whose ringer, tuned to the 33 cycle frequency, is connected from line conductor 201 to ground, and whose telephone number, therefore, when the line is connected as shown in the drawing, will be #111. When the receiver is removed from the hook at substation A, a 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 completes a circuit extending through the switching relay 13 and the stepping magnet 15 in series at its armature 20, and at its armature 19 connects the test wiper 26 to the above circuit at a point midway between the switching relay and the said stepping magnet. The operation now depends upon whether the test contact with which the test wiper 26 is in engagement is busy or is not busy. If this test contact is busy it will have a ground potential upon it,

the switching relay 13 will be short circuited, and the stepping magnet 15, which interrupts its own circuit, will operate as a buzzer to advance the switch wipers 25–27, inclusive, step by step in search of an idle trunk line. This operation will continue as long as the test wiper 26 engages grounded or busy test contacts. However, we may assume that in the present case when the call is initiated, the selector D is idle and the test contact 31 therefore is not grounded. Under these circumstances, when the line relay 14 is energized, the switching relay 13 is energized immediately afterwards, with the result that the line conductors 11 and 12 are disconnected from the winding of the line relay 14 and from ground, respectively, and are extended by means of armatures 16 and 18, wipers 25 and 27, bank contacts 30 and 32, and armatures 63 and 65 and their resting contacts to the upper and lower windings of the line relay 50 of selector D.

Immediately upon the extension of the line as above described the line relay 50 will be energized over the line circuit and will close the circuit of the slow acting release relay 51. Upon energizing, relay 51 prepares the circuits of the selector for the vertical operation in the usual manner, and at armature 58 completes a holding circuit extending back to the line switch C over the following path: ground at G^2, working contact of armature 58 and the said armature, conductor 90, test contact 31, test wiper 26, armature 17 and its working contact, winding of the switching relay 13, and the winding of the stepping magnet 15 to battery. It is understood that the above circuit is established before the slow acting line relay 14 has had time to deenergize.

The calling subscriber may now operate his calling device in accordance with the first digit of the desired number. A series of interruptions in the circuit of the line relay 50 is thereby produced, causing a corresponding series of deenergizations of the said ine relay, which at each deenergization sends a current impulse through the slow acting relay 52 and the vertical magnet 56 in series to battery. By the operation of the vertical magnet the selector shaft is raised step by step until the wipers 70–72, inclusive, stand opposite the desired level of bank contacts. The slow acting relay 52 is energized in series with the vertical magnet, retaining its armature attracted throughout the vertical movement of the switch, and upon the closure of the vertical off normal springs 62 completes a circuit for the stepping relay 53. Upon energizing, relay 53 prepares a circuit for the rotary magnet 54 at armature 60, and at armature 61 establishes a locking circuit for itself. At the end of the vertical operation of the switch the slow-acting relay 52 is deenergized and closes the circuit of the rotary magnet, which is thereupon energized to advance the wipers 70–72, inclusive, into engagement with the first set of bank contacts in the level opposite which they were raised. The rotary magnet also breaks the circuit of the stepping relay 53, which accordingly is deenergized to break the circuit of the rotary magnet, which thereupon deenergizes also and again closes its interrupter contact. The operation now depends upon whether the test contact with which the test wiper 71 is in engagement is or is not busy. If this test contact is busy it will have a ground potential upon it, and the stepping relay 53 will be energized again over a circuit which extends from the grounded test contact by way of the test wiper 71, armature 64 and its resting contact, the interrupter contact of the rotary magnet, the off normal springs 62, and the winding of the stepping relay 53 to battery. The stepping relay will therefore again close the circuit of the rotary magnet 54, which will operate to advance the switch wipers into engagement with the next set of bank contacts. This operation by which the stepping relay and the rotary magnet are alternately energized and deenergized will continue as long as the test wiper 71 engages busy or grounded test contacts. In the present case it will be assumed that the trunk line shown in the drawings is the first idle trunk line, and when, therefore, the test wiper 71 arrives at test contact 74 and the rotary magnet is deenergized, the stepping relay 53 will not again be energized; but instead the switching relay 55, which hitherto has been short circuited, will be operated by current flowing over the following path: grounded conductor 90, winding of the switching relay 55, interrupter contact of the rotary magnet, off normal springs 62, and the winding of the stepping relay 53 to battery. Owing to the high resistance of the switching relay 55, the stepping relay 53 is not operated. Upon energizing, relay 55 disconnects the incoming line conductors from the windings of the line relay 50, and extends them by way of armatures 63 and 65 and their working contacts, wipers 70 and 72, bank contacts 73 and 75, conductors 76 and 78, and normally closed contacts of the back bridge relay 100 to the upper and lower windings of the line relay 101 of the connector E, Fig. 2.

The calling line having been extended to the connector E, the line relay 101 is energized over the line circuit and completes a circuit for the slow-acting release relay 102. Upon energizing, relay 102 prepares the circuits of the connector for operation in its vertical movement, and also closes a holding circuit extending back to the selector D, which may be traced as follows: ground at

G^3, working contact of armature 116 and said armature, conductor 77, test contact 74, test wiper 71, and armature 64 and its working contact to conductor 90, where it joins the previously described holding circuit extending back to the line switch C, and serves to maintain relays 55 and 13 energized.

When the calling subscriber operates his calling device in accordance with the next digit in the desired number, a series of interruptions is produced in the circuit of the line relay 101, which accordingly deenergizes a corresponding number of times. At each deenergization the line relay transmits a current impulse through the vertical magnet 111 over the following circuit: ground at G^4, armature 115 and its resting contact, armature 117 and its working contact, off normal springs 150 and 152, winding of the slow acting relay 103, and the winding of the vertical magnet 111 to battery. This is the circuit over which the first impulse is transmitted. At the first upward step of the switch shaft, however, the off normal springs are shifted, and the circuit extends from the working contact of armature 117 by way of off normal contact springs 150 and 151, armature 118 and its working contact (relay 103 being now energized), winding of relay 103, and the winding of the vertical magnet 111 to battery. By the operation of the vertical magnet the switch shaft is raised step by step until the wipers 160–162, inclusive, stand opposite the desired level of bank contacts. At the end of the vertical movement of the switch the slow-acting relay 103 is deenergized and prepares the switch for operation in its rotary movement.

The calling subscriber may now operate his calling device in accordance with the last digit in the number, thereby producing as before a series of interruptions in the circuit of the line relay 101. At each resulting deenergization the line relay now sends a current impulse through the rotary magnet 113 over the following circuit: ground at G^4, armature 115 and its resting contact, armature 117 and its working contact, off normal springs 150 and 151, armature 118 and its resting contact, resting contact of armature 124 and the said armature, resting contact of armature 135 and the said armature, and the winding of the rotary magnet 113 to battery. In response to these impulses the rotary magnet operates to rotate the wipers 160–162, inclusive, into engagement with the desired set of bank contacts in the level opposite which they were raised. Since, in the present case, the desired station is 111, the wipers will have been raised opposite the first level, and they will be rotated into engagement with the first set of contacts in this level, or contacts indicated by reference characters 171, 172 and 173. The slow acting relay 106 is energized in parallel with the rotary magnet and retains its armatures attracted throughout the rotary movement of the switch. At armature 128 relay 106 connects the test wiper 161 to the winding of the busy test relay 105 and at its armature 129 relay 106 closes a shunt around armature 124 of the test relay and its resting contact to guard against the possibility of the said test relay being momentarily energized while the test wiper 161 is passing over busy test contacts. If the called line is busy when the test wiper 161 arrives at the test contact associated therewith, as, for example, the test contact 172, the test relay 105 will be energized, and when the slow-acting relay 106 deenergizes the said relay 105 will remain locked up over a circuit which includes its armature 123. The test relay also opens the rotary magnet circuit at armature 124 in order to prevent the switch wipers being rotated off the busy line by accidental manipulation of the calling dial, and at armature 126 connects a lead from the busy signaling machine Q to the lower line conductor. This operation gives the calling subscriber an audible busy signal in the usual manner and he will understand that the desired line is for the time being inaccessible and will replace his receiver.

Let it be assumed, however, that the called line is idle when the connector E is operated as before explained, to establish connection therewith. Under these circumstances when the switch wipers 160–162, inclusive, are brought to rest in engagement with bank contacts 171–173, inclusive, the test relay 105 will not be energized, for the test contact 172 will not be grounded; and when the slow-acting relay 106 deenergizes, upon the cessation of the rotary movement, the following circuit will be completed: ground at G^3, working contact of armature 116 and the said armature, conductor 77, armature 123 and its resting contact, upper winding of switching relay 107, upper winding of frequency selecting relay 108, resting contact of armature 128 and the said armature, test wiper 161, test contact 172, conductor 215, center terminal of terminal set 111 on horizontal side of I. D. F., strand of jumper 205, center terminal of set marked 33^D of idler block group #1, resistance 220, center terminal of upper set of idler block group #1, strand of jumper 204, center teminal of the set assigned to pair #1 on the vertical side of the I. D. F., conductor 216, conductor 217, winding of switching relay 13′ of line switch C′ and the winding of the stepping magnet 15′ to battery. By the closure of the above circuit relays 107 and 108 of the connector are connected in series over the third conductor of the called branch with the switching relay 13′ of the line switch C′, and

the latter relay is energized, being operated only about half way, however, due to the fact that the line relay 14′ is not energized. As a result, the conductors 218 and 219 are disconnected from the line relay 14′ and from ground, respectively. At the connector, relay 108 is not energized because of the fact that resistance 220 is included in the circuit. Relay 107, however, is energized and establishes a locking circuit for itself at armature 134, opens the rotary magnet circuit at its armature 135, connects direct ground to the test wiper 161 at armature 133, prepares a circuit for the ring cut-off relay 104 at armature 132, and at armature 136 completes the ringing circuit for signalling the called station. The complete ringing circuit over which alternating current from the 33 cycle generator flows out over the lower side of the line circuit and by way of line conductor 201 and the ringers at stations A′ and A² to ground, whence the circuit is completed by ground return to the other side of the grounded generator, is not difficult and will not need to be traced out in detail. It is understood, of course, that the ringers at stations A′ and A² are tuned to 33 and 50 cycles, respectively, and that the ringer at station A² will not respond in the present case.

Before proceeding further, attention is called to the relay 221 which is associated with idler block group #1, Fig. 3, there being a similar relay for each of the other groups. This relay is energized in parallel with the switching relay 13′ of line switch C′ both on incoming and outgoing calls; and has the function of short-circuiting the resistance 220, which operation is necessary in order to make all four branches of the line test busy. Whenever the line is called by way of one of the 33 cycle branches it is essential that relay 221 should not operate before the switching relay 107 of the connector, as otherwise a false operation of the marginal relay 108 might occur, resulting from the short-circuiting of resistance 220 before relay 107 connects direct ground to the test wiper. Relay 221, therefore, is made slightly slow to pull up by means of a copper slug or sleeve. It is noted that the slow action is required only when the resistance 220 is included in the circuit, and at such times the presence of the resistance assists in producing the desired result.

When the called subscriber at substation A′ removes his receiver in response to the ringing of his bell, the ringing circuit to ground is broken by the hook switch and the two line conductors are closed through the receiver and transmitter. The return path for the ringing current is thereby completed over line conductor 202, the upper side of the line circuit in the exchange, the upper winding of the ring cut-off relay 104, and the exchange battery to ground. The ring cut-off relay is therefore energized by current from the exchange battery, in series with the 33 cycle generator or the battery B′ associated therewith, and upon attracting its armature 120, establishes a locking circuit through its lower winding. Relay 104 also disconnects its upper winding and the ringing current generator at armatures 119 and 121 and at the working contacts of the same armatures completes the talking circuit by connecting the conductors of the incoming line circuit with the line wipers 160 and 162. The transmitter at the called station is now supplied with current through the windings of the double wound back bridge relay 100 in the usual manner. Upon energizing, relay 100 reverses the direction of current flow in the calling line, as is the usual custom, for the purpose of operating a meter or supervisory mechanism, although no such devices are shown in the present system.

The desired connection has now been established and the subscribers may converse as desired. The complete talking circuit is shown in heavy lines, and being of the usual character, will not be traced in detail.

When the conversation is finished both subscribers will replace their receivers. When the receiver is replaced at substation A the line relay 101 of the connector is deenergized followed by the deenergization of the slow-acting release relay 102. Relay 102 closes the circuit of the release magnet 112, through the medium of which the connector E is restored to normal in the usual manner. Relay 102 also breaks the holding circuit extending back to the selector D and line switch C, and as a result relays 55 and 13 are deenergized, thereby restoring the selector and line switch to normal also. The selector is of course restored by the release magnet 57; while the wipers of the line switch remain where they are, and are simply disconnected by the deenergization of the switching relay 13.

A brief explanation will now be given of the operation of selectively signalling the other stations on the party line. Suppose that station A² is called, the ringer at this station being connected from the positive side of the line to ground, as is the ringer at station A′, but being tuned to the 50 cycle frequency. When connected as shown, the telephone number of station A² is #121. The operation of the switches is the same as has been described, except that since the number called is 121, the connector E will establish connection with the called line by way of bank contacts 174, 175 and 176, the terminal set on the horizontal side of the I. D. F. which is numbered 121, jumper 206, and the 50 cycle positive terminal set of idler

block group #1, this latter set being marked 50[P] in the drawing. At the end of the rotary movement of the switch, when the slow acting relay 106 deenergizes, a circuit is completed for the relays 107 and 108 of the connector in series with the relays 221 and 13′ (these last two being in parallel), which is the same circuit as was described in the case where station A′ was called except that it does not include resistance 220. It follows that since the resistance 220 is not included in the circuit, the marginal relay 108 at the connector will be energized at the same time that relay 107 is energized. Relay 108 establishes a locking circuit through its lower winding at armature 144, and at its armature 146 changes the ringing circuit over to the 50 cycle generator. It will be evident, then, that during the signalling operation 50 cycle ringing current will be transmitted over conductor 201 of the called line to operate the 50 cycle ringer at station A[2].

The ringers at stations A[3] and A[4] are also tuned to the 33 and 50 cycle frequencies, respectively, but are connected from conductor 202, or the negative side of the line, to ground. Referring to Fig. 3, it will be observed that there is a reversal in the line connections between the positive and negative terminal sets of the idler block group shown. It follows that if either telephone number 131 or 141 is called, the ringing current will be projected out over line conductor 202 and through the ringers at stations A[3] and A[4] to ground. Whether 50 cycle ringing current or 33 cycle ringing current is used will depend on whether the marginal relay 108 is or is not energized, and the operation of this relay depends on whether the resistance 220 is or is not included in its circuit, as was previously explained.

From the foregoing considerations it will be clear that I have devised a simple and effective party line system in which the selective ringing is controlled entirely by the connections of the called branches at the intermediate distributing frame. It will be evident that any telephone number may be caused to ring on either of the two frequencies to either side of the line simply by connecting the jumper to the proper terminal set of the idler block group in use. This makes it possible to change subscribers from one party line to another, and change the frequency and connections of the ringers, if necessary, without changing their telephone numbers.

For instance, and in further explanation of the process of changing a subscriber's telephone from one party line to another, if the subscriber at substation A′ should change his residence his telephone may be disconnected from the party line shown and connected to any party line in the new locality on which there is a vacancy. At the exchange the jumper 205 is transferred from the idler block terminal set where it is now connected to a vacant terminal set on the idler block group to which the new party line is connected, the 33[P] terminal set being used in case it is vacant. Assuming that this set is available and is made use of the telephone will now be connected for service in its new location without further change. In case, however, that the 33[P] terminal set on the new idler block group is in use the jumper may be connected to any other set of this group which is vacant and the frequency of the ringer, the connection of the ringer to the line, or both, may be changed in order to accommodate the telephone to the new ringing condition.

While I have described a certain specific embodiment of my invention, I am aware that changes and modifications may be made which under certain circumstances may be desirable. For instance, instead of the 33 and 50 cycle ringing current generators shown and described herein, generators may be used which deliver positive and negative pulsating currents, such machines being well known and in extended use. It will be obvious also that the principles upon which party lines are connected up and selectively signalled may be employed with advantage in two party systems. For a two party system the easiest method of procedure is to employ but one kind of ringing current and connect the two stations on each line from opposite sides of the line to ground. The marginal ringing circuit selecting relay at the connector would be omitted, as would also the resistance 220 and relay 221 at the idler block groups. The wiring of the idler block groups would be simplified, it being only necessary to provide for a reversal between the two terminal sets which take the jumpers coming from the horizontal side of the frame.

In view of the above I do not wish to be restricted to the precise form of the invention disclosed herein but desire to secure and have protected by Letters Patent all modifications of my invention which may thereafter 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, a called party line, an automatic connector switch, a plurality of branches of the called line accessible to said switch, each branch comprising two line conductors and a third conductor, means whereby a subscriber on the calling line can operate said switch to connect with any one of said branches, ringing current generators of different frequency, a circuit including said third conductor and excluding any line or talking

conductor involved in the connection, and mechanism in said connector selectively controlled over said circuit to select the proper generator to selectively signal a desired station on the called line.

2. In a telephone system, a calling line, a called party line, an automatic connector switch, a plurality of branches of the called line accessible to said switch, each branch comprising two line conductors and a third conductor, means whereby a subscriber on the calling line can operate said switch to connect with any one of said branches, ringing current generators of different electrical character, a circuit including said third conductor and excluding any line or talking conductor involved in the connection, and mechanism in said connector selectively controlled over said circuit to select the proper generator to selectively signal a desired station on the called line.

3. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising line and test conductors, a resistance included in the test conductor of one of said branches, means for operating said switch to connect with any one of said branches, selective ringing mechanism automatically controlled over the test conductor of the branch connected with, and means for short-circuiting said resistance thereafter to insure the proper functioning of said test conductor.

4. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising line and test conductors, a resistance included in the test conductors of a plurality of said branches, means for operating said switch to connect with any one of said branches, selective ringing mechanism automatically controlled over the test conductor of the branch connected with, and means for short-circuiting said resistance thereafter to insure the proper functioning of said test conductor.

5. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising two line conductors and a third conductor, a resistance included in the third conductor of one of said branches, means for operating said switch to connect with any one of said branches, selective ringing mechanism automatically controlled over the third conductor of the branch connected with, and means for short-circuiting said resistance after the control of said mechanism has been exercised.

6. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising two line conductors and a third conductor, a resistance included in the third conductors of a plurality of said branches, means for operating said switch to connect with any one of said branches, selective ringing mechanism automatically controlled over the third conductor of the branch connected with, and means for short-circuiting said resistance after the control of said mechanism has been exercised.

7. In a telephone system, a calling and a called party line, an automatic connector switch, a plurality of branches of the called line accessible to said switch, each branch comprising two line conductors and a third conductor, means whereby a subscriber on the calling line can operate said switch to connect with any one of said branches, a resistance included in the third conductors of a plurality of said branches, selective ringing mechanism automatically controlled over the third conductor of the branch connected with, and means for short-circuiting said resistance after the control of said mechanism has been exercised.

8. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising two line conductors and a third conductor, a resistance included in the third conductor of one of said branches, means for operating said connector to connect with any one of said branches, a marginal ringing current selecting relay in said connector controlled over a circuit including the third conductor of the branch connected with, and means for excluding the said relay and resistance from the circuit after the control of said relay has been exercised.

9. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising two line conductors and a third conductor, a resistance included in the third conductors of a plurality of said branches, means for operating said connector to connect with any one of said branches, a marginal ringing current selecting relay in said connector controlled over a circuit including the third conductor of the branch connected with, and means for excluding the said relay and resistance from the circuit after the control of said relay has been exercised.

10. In a telephone system. a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising two line-conductors and a third conductor, a resistance included in the third conductor of one of said branches, means for operating said connector to connect with any one of said branches, selective ringing mechanism automatically controlled over a circuit including the third conductor of the branch connected

with, and means for excluding the said mechanism and resistance from the circuit after the control of said mechanism has been exercised.

11. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising two line conductors and a third conductor, a resistance included in the third conductors of a plurality of said branches, means for operating said connector to connect with any one of said branches, selective ringing mechanism automatically controlled over a circuit including the third conductor of the branch connected with, and means for excluding the said mechanism and resistance from the circuit after the control of said mechanism has been exercised.

12. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each comprising two line conductors and a third conductor, a resistance included in the third conductor of one of said branches, a cut-off relay for said line, means for operating said connector to connect with any one of said branches, means in said connector for establishing a circuit for said cut-off relay over the third conductor of the branch connected with, a marginal ringing current selecting relay included in said circuit, and controlled thereover, and means for short circuiting said selecting relay by closing said circuit in the connector over a new path.

13. In a telephone system, a four party line, an automatic connector switch, as many branches of said line accessible to said switch as there are stations on the line, each branch comprising two line conductors and a third conductor, a resistance included in the third conductors of two of said branches, a cut-off relay for said line, means for operating said connector to connect with any one of said branches, means in said connector for establishing a circuit for said cut-off relay over the third conductor of the branch connected with, a marginal ringing current selecting relay included in said circuit and controlled thereover, a locking circuit for holding up the selecting relay in case the same is energized, another self locking relay initially energized in series with the cut off relay, and contacts on the second self locking relay for closing the cut off relay circuit over a path excluding the windings of both other relays.

14. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising two line conductors and a third conductor, a resistance included in the third conductor of one of said branches, a cut-off relay for said line, means for operating said connector to connect with any one of said branches, means in said connector for establishing a circuit for said cut-off relay over the third conductor of the branch connected with, a marginal ringing current selecting relay included in said circuit, a switching relay in said connector also included in said circuit, and contacts controlled by said switching relay for connecting the said third conductor direct to the grounded pole of the exchange battery.

15. In a telephone system, a four party line, an automatic connector switch, as many branches of said line accessible to said switch as there are stations on the line, each branch comprising two line conductors and a third conductor, a resistance included in the third conductors of two of said branches, a cut-off relay for said line, means for operating said connector to connect with any one of said branches, means in said connector for establishing a circuit for said cut-off relay over the third conductor of the branch connected with, a marginal ringing current selecting relay included in said circuit, a switching relay in said connector also included in said circuit, and contacts controlled by said switching relay for connecting the said third conductor direct to the grounded pole of the exchange battery.

16. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising two line conductors and a third conductor, a resistance included in the third conductor of one of said branches, a cut-off relay for said line, means for operating said connector to connect with any one of said branches, means in said connector for establishing a circuit for said cut-off relay over the third conductor of the branch connected with, a marginal ringing current selecting relay included in said circuit in said connector, a switching relay in said connector also included in said circuit, and contacts controlled by said switching relay for closing said circuit in the connector over a path excluding said selecting relay.

17. In a telephone system, a four party line, an automatic connector switch, as many branches of said line accessible to said switch as there are stations on the line, each branch comprising two line conductors and a third conductor, a resistance included in the third conductor of two of said branches, a cut-off relay for said line, means for operating said connector to connect with any one of said branches, means in said connector for establishing a circuit for said cut-off relay over the third conductor of the branch connected with, a marginal ringing current selecting relay included in said circuit, a switching relay in said connector also

included in said circuit, contacts controlled by said switching relay for closing said circuit in the connector over a path excluding said selecting relay and its own winding, and parallel locking circuits for maintaining the said selecting and switching relays energized until the connector is released.

18. In a telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each comprising two line conductors and a third conductor, a resistance included in the third conductor of one of said branches, a cut-off relay for said line, means for operating said connector to connect with any one of said branches, means in said connector for establishing a circuit for said cut-off relay over the third conductor of the branch connected with, a marginal ringing current selecting relay included in said circuit and controlled thereover, means for closing said circuit in the connector over a new path excluding said selecting relay, and a relay energized over said circuit in parallel with the said cut-off relay for short-circuiting said resistance.

19. In a telephone system, a four party line, an automatic connector switch, as many branches of said line accessible to said switch as there are stations on the line, each branch comprising two line conductors and a third conductor, a resistance included in the third conductors of two of said branches, a cut-off relay for said line, means for operating said connector to connect with any one of said branches, means in said connector for establishing a circuit for said cut-off relay over the third conductor of the branch connected with, a marginal ringing current selecting relay included in said circuit, and controlled thereover, means for closing said circuit in the connector over a new path excluding said selecting relay, and a relay energized over said circuit in parallel with the said cut-off relay for short-circuiting said resistance.

20. In telephone system, a party line, an automatic connector switch, a plurality of branches of said line accessible to said switch, each branch comprising two line conductors and a third conductor, a resistance included in the third conductor of one of said branches, a cut-off relay for said line, means for operating said connector to connect with any one of said branches, means in said connector for establishing a circuit for said cut-off relay over the third conductor of the branch connected with, a marginal ringing current selecting relay included in said circuit, a switching relay in said connector also included in said circuit, contacts controlled by said switching relay for closing said circuit in the connector over a path excluding said selecting relay, and a relay energized over said circuit in parallel with the said cut-off relay for short-circuiting said resistance.

21. In a telephone system, a four party line, an automatic connector switch, as many branches of said line accessible to said switch as there are stations on the line, each branch comprising two line conductors and a third conductor, a resistance included in the third conductors of two of said branches, a cut-off relay for said line, means for operating said connector to connect with any one of said branches, means in said connector for establishing a circuit for said cut-off relay over the third conductor of the branch connected with, a marginal ringing current selecting relay included in said circuit, a switching relay in said connector also included in said circuit, contacts controlled by said switching relay for closing said circuit in the connector over a path excluding said selecting relay, and a relay energized over said circuit in parallel with the said cut-off relay for short-circuiting said resistance.

22. In a telephone system, a four party line, ringers at the stations on said line of two kinds connected two from each side of the line, to ground, four called line branches for said line at the exchange, a third conductor in each branch, a connector switch operable to connect with any one of said branches, two grounded ringing current generators of different electrical character, selecting means in said connector controlled over the third conductor of any branch connected with to select one of said generators, a relay for thereafter connecting the ungrounded side of the selected generator to a line conductor of the connected branch, there being a reversal in the line connections between two of said branches and the line whereby the selected generator may be connected to either side of the party line depending on the branch connected with, a cut-off relay for said line connected from the third conductor to the ungrounded pole of the battery, and means in said switch for connecting the grounded pole of the battery direct to the third conductor of any connected branch after the proper generator has been selected.

23. In a telephone system, a subscriber's line, automatic switches for extending connections from or to said line, a set of normal conductors including a test conductor over which said line is reached when called, a resistance in said test conductor, and means for short circuiting said resistance when said line is busy either as a calling or as a called line.

24. In a telephone system, a subscriber's line, an individual switch for extending said line when calling, a cut off relay for said switch, a set of normal conductors over

which the said line is reached when called, said set including a test conductor, a resistance in said test conductor, means for energizing said cut off relay when said line is busy either as a calling or as a called line, and a second relay energized in parallel with said cut off relay for short circuiting said resistance.

Signed by me at Chicago, Cook County, Illinois, this 31st day of January, 1920.

RODNEY G. RICHARDSON.