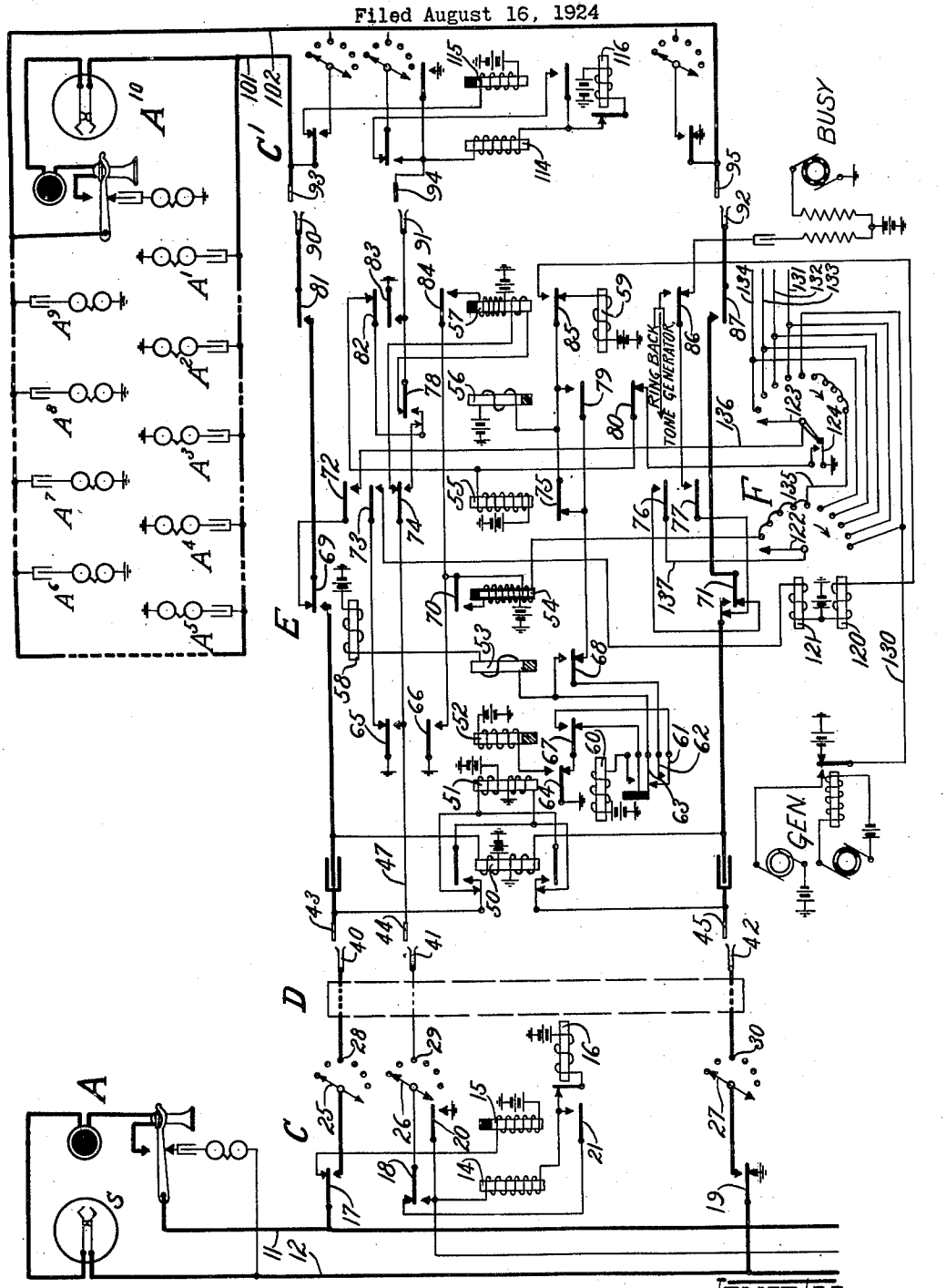
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AUTOMATIC TELEPHONE SYSTEM

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AUTOMATIC TELEPHONE SYSTEM.

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This invention relates in general to automatic telephone systems in which connections are established through the medium of subscriber controlled automatic switches, but is more particularly concerned with such automatic systems as include party lines and selective ringing equipment at the exchange.

In the patent to Ray and Obergfell, No. 1,469,809, there is described a system for selectively signalling twice the number of stations on a party line as there are different kinds of ringing current at the exchange, by means of a frequency selector individual to a connector, and a line reversing relay in said connector. The calling subscriber, by manipulating his dial in accordance with the frequency selecting digit, operates the frequency selecting switch at the exchange to select the frequency of ringing current which corresponds to the called substation, and to close a circuit for the reversing relay in case the substation is on the side of the line opposite that normally connected for ringing.

The principal object of the present invention is to provide a selective signalling system of the general type described above which is adapted to signal twice the number of stations on a party line as there are different kinds of ringing current at the exchange, without, however, requiring the line reversing relay, but by utilizing both wipers of the frequency selecting switch for the selection of the proper ringing currents.

Another feature of the invention is the elimination of a relay which in the Ray and Obergfell system is used to complete the ringing circuit after the frequency selecting switch has operated. By suitably rearranging the circuits it has been found possible to make the usual busy test relay complete the ringing circuit at the proper time and accordingly the relay heretofore used for this purpose has been done away with.

The means by which the foregoing objects, together with others not specifically mentioned at this time, are accomplished will be fully set forth hereinafter, reference being had to the accompanying drawing, in which is shown sufficient of the apparatus in an automatic telephone system to enable the invention to be explained and understood. The reference character A indicates an automatic substation of the usual type, which has the usual talking instrumentalities and the calling device S for controlling the central office switches.

Substation A is connected with the central exchange by line conductors 11 and 12 which terminate in the individual line or trunk selecting switch C. The line switch C is a switch of the well known rotary type whose wipers have no normal position and move in a forward direction only. As is well known, the function of the individual line switch is to extend its associated line to an idle selector switch when the receiver is raised at the substation to initiate a call.

One of the first selector switches, to which the line switch C has access in common with other similar line switches, is indicated in the drawing by the rectangle D. Inasmuch as selector switches are well known in the art, it has not been considered necessary to show the circuits in detail. It may be stated briefly that the selector D is a Strowger vertical and rotary switch of well known mechanical construction, and operable according to the two-wire system of control. When used in setting up a connection the selector responds to the first digit in the called number in order to select a desired group of connector switches, after which the selector automatically rotates to select and connect with a trunk line extending to an idle connector in the selected group. The above is, of course, true only of a one thousand line system; if the capacity of the system is greater than this, second or third selectors will be interposed between the first selectors and connectors in the well understood manner. This is the usual percentage trunking system, however, and need not be discussed in detail.

One of the trunk lines which the selector D has access to is shown in the drawing as extending to the connector E, which is also a Strowger vertical and rotary switch having a capacity of one hundred subscribers' lines. The connector E is operable according to the two-wire system of control, like the selector D, and it responds to the next two digits in a called number to complete the connection to the called line.

One of the lines to which the connector E has access is shown at the upper right hand corner of the drawing and comprises line conductors 101 and 102. This line is a party line, and substations A^1–A^{10}, inclusive,

only one of which is shown completely, are connected in bridge of the line in the usual manner. The line switch C^1 is associated with the party line at the exchange, and is similar to the line switch C.

Just below the connector E is shown an auxiliary switch which is indicated by reference character F. This is the switch referred to in the foregoing, and when used in the present situation is generally called a frequency selecting switch. It comprises, briefly, the wipers 122 and 123, associated sets of bank contacts, the stepping magnet 120, and the release magnet 121. The frequency selector F is individual to the connector E. The improved circuit arrangement whereby the two switches can operate in selectively signalling any one of the ten stations on the party line shown, or another similar party line, is the principal subject matter of the invention and will now be described.

For this purpose it will be assumed that the subscriber at substation A desires to establish connection with a subscriber at station A^{10}. When the receiver is removed at the calling station a circuit is completed over the conductors 11 and 12 for the slow acting line relay 15. Upon energizing, relay 15 closes a circuit at its armature 20, which includes the winding of the switching relay 14 and the stepping magnet 16 in series; and at its armature 21 connects the test wiper 26 to the above circuit at a point midway between the said switching relay and the magnet. The operation now depends upon whether the trunk line with which the line switch wipers are associated is busy or is not busy. If the trunk line is busy, there will be a ground potential upon the test contact with which the test wiper 26 is in engagement, the switching relay 14 will be short circuited, and the stepping magnet 16, which interrupts its own circuit, will be operated in the manner of a buzzer to advance the switch wipers in search of an idle trunk line. We may assume, in the present case, that when the call is initiated the wipers are advanced to the idle trunk terminating in bank contacts 28–30, inclusive. When the wipers arrive at this set of contacts the short circuit is removed from the switching relay 14 and the operation of the stepping magnet 16 will cease because of the high resistance of the said switching relay. The latter relay, however, is energized and grounds the test wiper 26 at its armature 18, and at its armatures 17 and 19 disconnects the line conductors 11 and 12 from the winding of the line relay 15 and from ground, respectively, and extends them by way of wipers 25 and 27, and bank contacts 28 and 30 to the line relay (not shown) of the first selector D. The line and release relays of the selector D are now energized in the usual manner and the latter relay grounds the release trunk conductor of the trunk line in order to establish a holding circuit for the switching relay 14 of the line switch C. This operation is well understood and need not be explained further.

The calling subscriber may now operate his calling device in accordance with the first digit in the desired number. In response to the interruptions in the line thus produced, the vertical magnet of the selector D is operated under control of the line relay to raise the wipers 40–42, inclusive, to the particular level in which are terminated the trunk lines extending to the desired group of connector switches. Thereafter the rotary or trunk selecting movement is initiated automatically in the usual manner, and the wipers are rotated in search of an idle trunk line. Assuming that the trunk line shown in the drawing is the first idle trunk line, then when the wipers arrive at bank contacts 43–45, inclusive, the test wiper 41 will find no ground potential upon the test contact 44, and the rotation of the switch will cease. When this occurs, the incoming line conductors are extended in the usual manner by way of the switch wipers 40 and 42, bank contacts 43 and 45, and contact springs controlled by the reversing relay 50 to the windings of the double wound line relay 51 of the connector E.

When the line is extended as above described, the line relay 51 is energized over the line circuit to close a circuit for the slow to release "release" relay 52. Upon energizing, relay 52 prepares a circuit for the vertical magnet 58 at its armature 67, and at its armature 65 connects ground to the release trunk conductor 47, thereby completing a holding circuit for the selector D and the line switch C in the well known manner. The calling subscriber may now operate his calling device in accordance with the next digit in the desired number. As a result, the line relay 51 is deenergized a plurality of times, and at the first deenergization transmits a current impulse to the vertical magnet 58 over the following circuit: grounded armature 64 and its resting contact, armature 67 and its working contact, off normal springs 61 and 63, winding of the slow to release series relay 53, and the winding of the vertical magnet 58 to battery. By the operation of the vertical magnet, the wipers 90–92, inclusive, are raised step by step until they stand opposite the level in which is terminated the line including substation A^{10}. The slow to release series relay 53 is energized in series with the vertical magnet and by means of its armature 68 maintains the circuit of the vertical magnet intact after the off normal springs have been shifted, which occurs on the first vertical step. At the end

of the vertical movement of the switch, relay 53 is deenergized and transfers the operating circuit to the rotary magnet 59.

The subscriber will now operate his calling device in accordance with the next digit of the desired number, which is the last digit which has to do with the line selection. When the calling device is operated, the line relay 51 responds as before and sends impulses to the rotary magnet 59 over the following circuit: grounded armature 64 and its resting contact, armature 67 and its working contact, off normal springs 61 and 62, armature 68 and its resting contact, resting contact and armature 75, armature 85 and its resting contact, and the winding of the rotary magnet 59 to battery. By the operation of the rotary magnet, the wipers 90–92, inclusive, are rotated step by step and are finally brought to rest in engagement with the bank contacts in which the line including substation A^{10} is terminated, these bank contacts being indicated in the drawing by the reference characters 93, 94 and 95. The slow to release relay 56 is energized in multiple with the rotary magnet and retains its armature attracted throughout the rotary movement of the switch. At its armature 78, relay 56 connects the test wiper 91 with the test relay 55, and at its armature 79 the said relay 56 closes a shunt around the contact at armature 75 of the test relay. The latter operation is to prevent the test relay from opening the rotary magnet circuit while the test wiper is passing over busy test contacts.

It will be assumed first that the called line is busy. Such being the case, when the test wiper 91 arrives at test contact 94, it will find a ground potential thereon, the test relay 55 will be energized, and when the slow to release relay 56 deenergizes at the end of the rotary movement of the switch, the test relay 55 establishes a locking circuit for itself at its armature 74. Relay 55 also opens the rotary magnet circuit at its armature 75, thus rendering the impulse circuit ineffective at this time in case the calling subscriber dials the last or frequency selecting digit. Relay 55 also at its armature 77, connects a lead from the busy signalling machine to the lower heavy talking conductor. By this latter operation, an audible signal is transmitted to the calling subscriber, and, being advised thereby that the called line is inaccessible for the time being, he will hang up his receiver.

Having explained the operation which takes place when the called line is busy, it will now be assumed that the line is idle when called. Under these circumstances, when the test wiper 91 arrives at test contact 94, it will find no ground potential and the test relay 55 will not be energized. Then when the slow to release relay 56 deenergizes at the end of the rotary movement of the switch, a circuit is completed for the slow acting switching relay 57 as follows: from the grounded release trunk conductor 47 by way of armature 74 and its resting contact, lower winding of the switching relay 57, resting contact and armature 78, test wiper 91, test contact 94, winding of the switching relay 114, and the winding of the stepping magnet 116 to battery. Relays 57 and 114 are energized in series over the above circuit, and the latter relay is operated to clear the called line of its normal battery and ground connections in the line switch C^1. It should be noted that the relay 114 is not fully operated at this time, due to a mechanical interlocking arrangement between the armature of this relay and the armature of the slow acting line relay 115, and the wipers of the line switch C^1 are not connected up. In the connector E, when the switching relay 57 is energized, it establishes a locking circuit for itself at its armature 84, grounds the test wiper 91 at armature 83, transfers the impulsing circuit from magnet 59 to the stepping magnet 120 of the frequency selecting switch F at its armature 85, and prepares a circuit at its armature 86 which provides for transmitting a tone signal to the calling subscriber during the ringing operation.

The calling subscriber may now operate his calling device in accordance with the final digit in the number, which is the digit which selects the proper frequency of ringing current for signalling the particular station wanted. The substations A^1–A^{10}, inclusive, have been numbered for convenience in accordance with the digits to which they correspond, and since the substation A^{10} is the wanted substation in the present case, the final digit to be called will be the digit 0. When the calling device is operated for this digit, the line relay 51 transmits ten impulses of current to the stepping magnet 120 of the frequency selector F over the following circuit: from grounded armature 64 and its resting contact, armature 67 and its working contact, off normal springs 61 and 62, armature 68 and its resting contact, resting contact and armature 75, armature 85 and its working contact, and the winding of the stepping magnet 120 to battery. By the operation of magnet 120, wipers 122 and 123 are given a step by step movement and are finally brought to rest in engagement with the tenth contact in their respective banks. The slow to release relay 56 is energized in multiple with the magnet 120 and now serves to prevent the energization of relay 55 by holding open its energizing circuit at armature 80, which circuit will be explained hereinafter. At the end of the series of impulses transmitted to the magnet 120, relay 56 is deenergized and a circuit is completed for relay 55 as follows: grounded spring 124 and

its working contact, which close on the first rotary step of the frequency selector, resting contact and armature 80, and the winding of busy relay 55, now acting as a frequency switch control relay, to battery. Relay 55, upon energizing, closes the usual busy signalling circuit at armature 77, but this is of no effect because the circuit has already been opened at armature 86 of switching relay 57. In addition, relay 55 breaks the circuit of the stepping magnet 120 at armature 75, prepares a circuit for the release magnet 121 at armature 73, closes a circuit for the ring back tone at armature 77, and at armature 76 completes the signalling circuit as follows: from the grounded generator Gen, through the contacts of the ringing interrupter, conductor 130, tenth contact in the bank associated with wiper 122, wiper 122, conductor 137, armature 76 and its working contact, resting contact and armature 71, working contact and armature 87, wiper 92, bank contact 95, conductor 102, the normally closed switch-hook contact at substation A^{10}, and the ringer at the said substation to ground. The above circuit is intermittently opened and closed by the operation of the ringing interrupter and the ringer at substation A^{10} is thus operated at intervals to signal the called subscriber. It is understood, of course, that the ringing current also flows through the ringers at substations A^6–A^9, inclusive, to ground at the same time, but the ringers at these other substations are tuned so that they will not respond to the frequency of ringing current which is now in use. This is according to the well known practice of harmonic signalling, and it follows that the ringer at substation A^{10} is the only one which is operated. When the called subscriber at substation A^{10} removes his receiver to answer the call, the ringer thereat is disconnected and the ringing circuit is completed over a metallic circuit including the other line conductor 101 and the lower winding of the ring cut-off relay 54 at the connector E, which may be traced as follows: grounded armature 66 and its working contact, lower winding of ring cut-off relay 54, contacts 1–5, inclusive, of left hand bank of switch F, conductor 135, contact 10 of right hand bank, wiper 123, conductor 136, working contact and armature 72, resting contact and armature 69, working contact and armature 81, wiper 90, bank contact 93, line conductor 101, substation equipment, line conductor 102, bank contact 95, wiper 92, armature 87 and its working contact, armature 71 and its resting contact, working contact and armature 76, wiper 122, contact 10 of left hand bank, conductor 130, and through the contact of the ringing interrupter to direct battery or to battery by way of generator Gen. The ring cut-off relay 54 is now energized and establishes a locking circuit for itself at armature 70, opens the ringing circuit at its armatures 69 and 71, opens the ring back tone circuit at the latter armature, and at the working contacts of these same armatures finally completes the talking circuit.

The required connection has now been established and the calling and called subscribers may converse as desired. Current for the transmitter at substation A is supplied through the windings of the double wound line relay 51, while current for the transmitter at substation A^{10} is supplied through the windings of the back bridge or reversing relay 50. The latter relay is of course energized and reverses the direction of current flow in the calling line during conversation. Although this operation is of no utility in connection with the apparatus shown, it is a standard operation for use in controlling measured service equipment and is therefore included. When the conversation is finished, both subscribers will hang up their receivers. When the receiver is replaced at substation A the line and release relays 51 and 52 are deenergized and the latter relay closes a circuit for the release magnet 60, which operates to restore the connector E to normal position in the usual manner. Relay 52 also disconnects ground from the release trunk conductor 47, thereby breaking the holding circuits of the selector D and line switch C, and these two switches are accordingly restored to normal also. At the same time that relay 52 closes the circuit of release magnet 60, the said relay closes a circuit at armature 65 by way of armature 73 of relay 55 which includes the release magnet 121 of the frequency selecting switch F. By the operation of the release magnet 121, the wipers are restored to normal position. Thus all the apparatus in use has been freed and made ready for use in another connection.

A brief explanation will now be given of the manner in which the other stations of the line are signalled. Substations A^6, A^7, A^8, and A^9, may be reached by calling digits 6, 7, 8, and 9, respectively, as the final digits, and the operations are exactly the same as when substation A^{10} is called, except that a different frequency of ringing current is selected. It will be understood in this connection that conductors 130–134, inclusive, all extend to separate ringing current generators, and these generators are all of different frequencies. Although only one of these generators is shown on the drawing, it is believed that this explanation will make the arrangement perfectly clear. The ringers at the five substations just referred to are all connected from the line conductor 102 to ground. In order to operate the ringers at the remaining substations A^1–A^5, inclusive,

which are connected from the line conductor 101 to ground, digits 1, 2, 3, 4, and 5, respectively, must be called as the final digits. Suppose, for example, that it is desired to call the substation A^5, the ringer at which station is tuned to the same frequency as the ringer at substation A^{10}. The final digit to be called in this case is the digit 5, and the wipers of the frequency selector F are advanced five steps into engagement with the fifth contact in their respective banks. When the wiper 123 comes to rest on the fifth contact, the ringing generator shown on the drawing is selected, as the first five contacts in the bank associated with wiper 123 are connected in multiple with the last five contacts in the bank associated with the wiper 122. When relay 56 deenergizes at the end of the operation of the frequency selecting switch, a circuit is closed for the relay 55 the same as before, and when relay 55 energizes, a ringing circuit is completed substantially the same as previously described except that in the present case, the ringing current is applied to the line by way of wiper 123 of frequency selecting switch F and connector wiper 90 instead of by way of the frequency selecting switch wiper 122 and connector wiper 92, and hence flows over the line conductor 101 and through the ringers at substations A^1–A^5, inclusive, to ground. The ringer at substation A^5 is accordingly operated. Substations A^1 to A^4, inclusive, may be called in the same manner by using the final digits which correspond to these substations.

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 is claimed is:

1. In a selective ringing telephone system, a party line, a connector switch for extending a connection to said line, a frequency selector for selecting the proper ringing current to be applied to said line, a relay in said connector for closing the ringing circuit at one point, a second relay energized while the frequency selector is being operated and deenergized thereafter, off normal springs on said frequency selector, a circuit for said first relay jointly controlled by said second relay and said off normal springs, and an automatic interrupter for intermittently closing said ringing circuit at another point.

2. In a telephone system, a party line, substation ringers connected from opposite sides of said line to ground, an automatic switch for extending a connection to said line, said switch including a pair of line wipers, a plurality of sources of ringing current of different character there being half as many of said sources as there are stations on said line, and a device associated with said switch for selecting one of said sources and for simultaneously preparing a circuit for the selected source which determines to which of said wipers the selected source is to be connected.

3. In a telephone system, different sources of ringing current at the exchange, a party line, substation ringers equal in number to the number of said sources connected from one side of said line to ground, a like number of ringers connected from the other side of said line to ground, means including an automatic connector switch for extending a connection to said line, two devices associated with said connector for selecting any one of said sources, and means for connecting the selected source to either side of said line to signal any desired station thereon, the side to which the selected source is connected depending on which of said devices is in use.

4. In a telephone system, a party line, a plurality of stations and ringers thereat connected from opposite sides of said line to ground, a plurality of different ringing current sources at the exchange less in number than the number of said stations, an automatic connector switch at which said line terminates in a single set of bank contacts, means for operating said connector to connect with said contacts, a frequency selector having two sets of bank contacts, a portion of one bank being connected to said current sources and multipled with a non-corresponding portion of the other bank, two wipers for then selecting one of said current sources via either bank, and a connecting device operable for connecting the selected source to either side of said line to signal either one of two of said stations, the station signalled depending upon which of the said banks is used.

5. In a telephone system, a party line, a plurality of stations and ringers thereat connected from opposite sides of said line to ground, a plurality of different frequency ringing current sources at the exchange less in number than the number of said stations, an automatic connector switch at which said line terminates in a single set of bank contacts, means for operating said connector to connect with said contacts, a frequency selecting switch associated with said connector at which said current sources terminate in a portion of one set of bank contacts and are multipled with a non-corresponding portion of a second set of bank contacts, means for operating said frequency selecting switch to select a ringing current source via either set of bank contacts, and means to signal a station on either side of said line depending upon which of said banks is used.

6. In a telephone system, a connector switch, a line accessible thereto, a plurality of sources of ringing current, a ring cut-

off relay in said connector switch, a frequency selecting switch associated with said connector switch having two wipers and two sets of bank contacts, the first half of one set of contacts being multipled with the second half of the other set and connected to said sources of ringing current, the remaining contacts being connected in multiple and extended to said ring cut-off relay, means for impressing said ringing current sources on one side of said line when said wipers are brought to rest on the first half of said contacts, and for impressing said ringing current sources on the other side of said line when said wipers are brought to rest on the second half of said contacts, and means responsive to said wipers being brought to rest on either half of said contacts for preparing a circuit for said ring cut-off relay.

7. In combination, an automatic connector switch and an associated frequency selector for connecting with and ringing on either side of a line, said switch including a combination busy test and control relay for performing the usual busy test relay functions when the switch connects with a busy line and for preparing the ringing circuit, the frequency selector release circuit, and closing the ring-back tone circuit when the switch connects with an idle line.

8. In a connector switch, a combination busy test and ringing circuit control relay, contacts on said relay for closing a busy signalling circuit when the connector connects with a busy line, contacts on said relay for closing the ringing circuit when said connector connects with an idle line, and means for energizing said relay to close said last mentioned contacts a predetermined time after any connection to an idle line is established.

9. In a telephone system, different sources of ringing current, a party line, substation ringers equal in number to the number of said sources connected from one side of said line to ground, a like number of ringers connected from the other side of said line to ground, means including an automatic connector switch for extending a connection to said line, a device associated with said connector having two wipers used alternatively for selecting any one of said sources, and means for connecting the selected source to either side of said line to signal any desired station thereon, the side to which the selected source is connected depending on which of said wipers is used to select the source.

10. In a telephone system, a party line, different sources of signalling current, means for extending a connection to said line, and a device comprising two wipers used alternatively for selecting any one of said sources to signal any desired station thereon, the wiper used to select the source depending on the extent of operation of said device.

In witness whereof, I hereunto subscribe my name this 13th day of August, A. D. 1924.

ARTHUR J. RAY.