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W. T. POWELL

AUTOMATIC TELEPHONE SYSTEM

Filed Jan. 18, 1922

FIG. 1

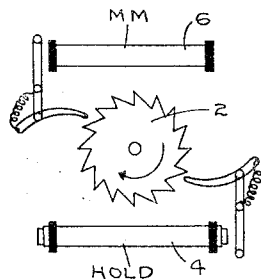
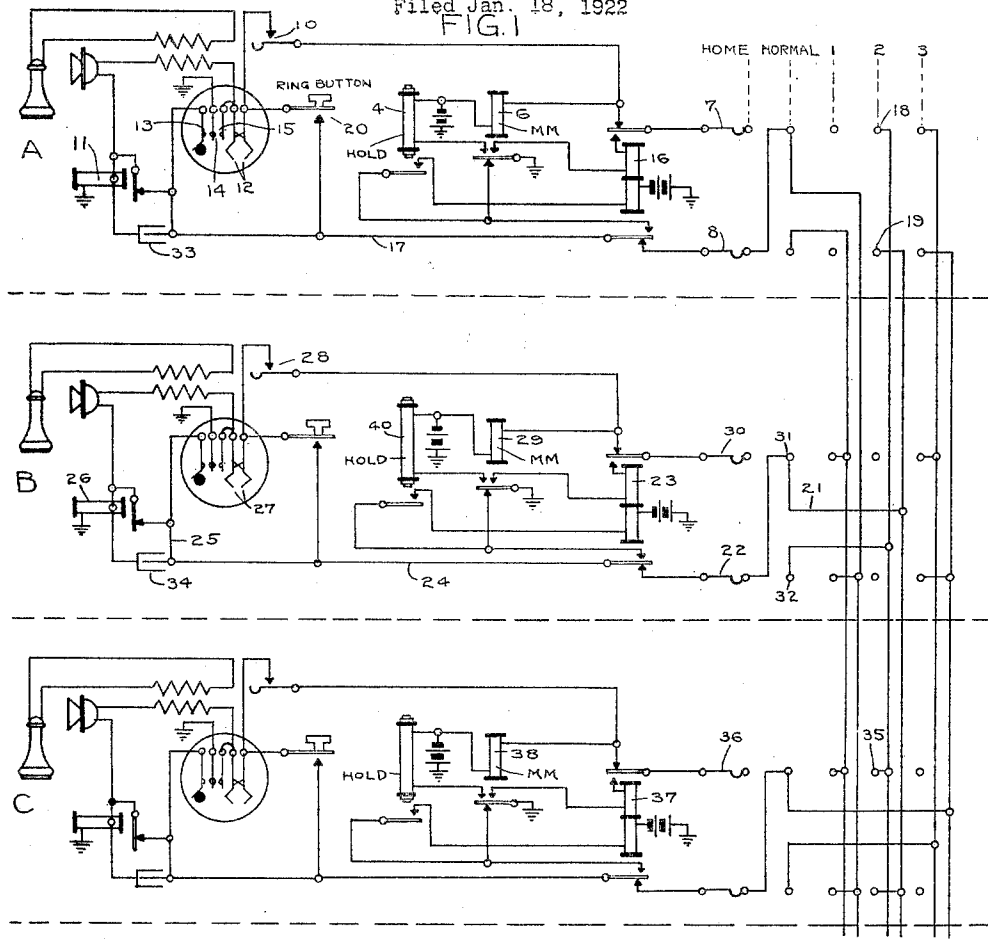
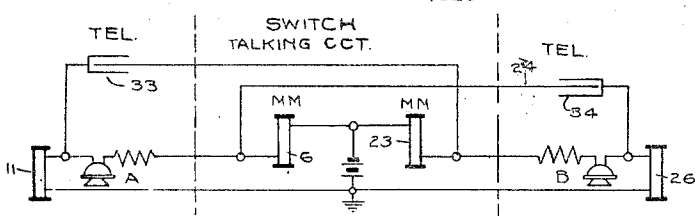


FIG. 2

FIG. 3



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WINFRED T. POWELL, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

AUTOMATIC TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, WINFRED T. POWELL, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems and more particularly to telephone systems in which automatic switches are employed in completing some portion of telephone connections.

The purpose of the present invention is to provide a telephone system of relatively small capacity, the circuits of which are relatively inexpensive to install and are simple to maintain in operation.

The various features of the invention will appear from the detailed description and appended claims.

In the drawings Fig. 1 diagrammatically represents the circuits and equipment necessary for three telephone lines. The equipment for each line is separated from that of the other telephone lines by dotted lines and the confines of the drawing. Fig. 2 shows a detail of the mechanical structure of the automatic switch which is provided for each telephone line. Fig. 3 is a schematic showing of the talking circuit completed between two telephone lines.

In this system each telephone line is provided with an individual numerical switch through the terminals of which any other telephone line of the system may be reached. The structure of this switch may be substantially similar to that disclosed in the patent to Bullard #1,106,922, patented August 11, 1914, except that the armatures and pawls of the retaining magnet 4 and the stepping magnet 6 are not interlocking, but are of the arrangement substantially similar to that disclosed in Fig. 2 of the present disclosure. By reference to the patent to Bullard it will be noted that the stepping magnet such as 6 advances the pair of switch wipers herein designated 7 and 8 over their respective sets of bank terminals. The stepping magnet 6 normally retains its stepping pawl out of engagement with the ratchet wheel 2 of the

switch and the retaining or holding magnet 4 likewise normally holds its pawl out of engagement with the ratchet wheel 2 and as will appear in the course of this description the operating pawls engage the ratchet wheel only during the time that its switch is in use.

The substation circuits of this system are of the type now well known in the art and are usually referred to as the "local secondary type," since the receiver is in a circuit local to the substation and serially includes a secondary winding of an induction coil, the primary winding of which is in series with the central source of energy and also with the transmitter.

In this system an impulse sender is employed which may be of any well known structure and in which a set of impulse springs is intermittently operated to cause a series of line interruptions commonly known in this art as impulses. The structure of this impulse sender, if the system is of relatively small size, (that is not over ten lines) or if the individual switch is directly operated in response to several series of impulses, may be of the structure substantially similar to the impulse sender or dial such as is shown in the patent to Keith #1,279,352, issued September 17, 1918. If, however, the system is arranged for more than ten subscribers' lines and it is still desired to directly set the subscriber's individual switch in response to one adjustment of the impulse sender then it will be desirable to employ an impulse sender of the type disclosed in the patent to Lattig #1,030,412, issued June 25, 1912. The impulse sender previously referred to is diagrammatically represented by a series of contact springs shown within the circle associated with each substation circuit. The purpose of these various sets of springs will appear in the course of the present description.

The ringer or signal provided at each substation is commonly known in the art as a direct current ringer such as is normally employed in certain intercommunicating telephone systems or may be similar to the ordinary door bell ringer.

With this description of the apparatus

and certain of the circuits associated therewith, it is believed that the operation of the system will best be understood by describing the method of establishing a telephone connection from the subscriber's substation designated A to a subscriber's line the substation circuits of which are herein designated B. When the subscriber at A removes his receiver from its switch hook, the contacts 10 are closed, thereby completing a circuit from ground, winding of the ringer magnet 11, through the transmitter and primary winding of the induction coil, impulse springs 12 of the impulse sender, contacts 10, winding of the stepping magnet 6 to grounded battery. Under the control of this circuit the stepping magnet advances its brushes 7 and 8 from their "home position," to the next set of terminals herein referred to as a "normal position" of the switch. As soon as the stepping magnet 6 is energized it closes an operating circuit for the slow releasing holding magnet 4 extending from grounded battery winding of this magnet, front contact and armature of magnet 6 to ground. The subscriber's individual switch is now in condition to receive a directive series of impulses from the impulse sender. Since it has been assumed that the connection is to be made to the line of the subscriber at B, it is necessary to transmit a series of two impulses from the impulse sender at substation A. This impulse sender is thereby adjusted to send two impulses and this adjustment, as is well known, results in the closure of the sets of contacts 13, 14 and 15 and subsequently in the intermittent closure of the set of impulse springs 12. The closure of the contacts 14 and 15 serves to short circuit the ringer magnet 11 and to connect ground to the impulse springs 12. This completes a substitute circuit for the stepping magnet 6 extending from grounded battery winding of this magnet, contact springs 10, impulse springs 12 and springs 14 and 15 to ground. When in the course of the operation of the impulse sender it opens its springs 12, the stepping magnet 6 will retract its armature, but the holding magnet 4 will maintain the switch in the position to which it has been advanced. Almost immediately after the opening of the impulse springs 12, they will again be closed to complete the operating circuit of the stepping magnet 6 with the result that the brushes 7 and 8 are advanced from the so-called "normal position" into position 1. In response to the next impulse from the impulse sender, the stepping magnet 6 will be deenergized as described but a circuit will soon after be completed by the closure of the impulse springs 12 so that the stepping magnet 6 will advance the brushes 7 and 8 into engagement with the

#2 set of line terminals. The impulse sender has now completed the transmission of the series of impulses and its sets of contact springs 12, 13, 14 and 15 will be in their normal condition, that is the condition in which they appear in Fig. 1.

It will be noted that as soon as the stepping magnet 6 deenergizes after the holding magnet 4 has been operated, an actuating circuit is closed for the cut-off relay 16, extending from grounded battery, lower winding of this relay, front contact and armature of magnet 4, back contact and armature of stepping magnet 6 to ground. The cut-off relay 16 is energized in this circuit and is locked operated as long as the impulse sender springs 13 and 14 are closed. This locking circuit may be traced from ground, springs 13 and 14, conductor 17, lower armature and front contact of relay 16, armature and contact of magnet 4, lower winding of cut-off relay 16 to grounded battery. At the close of the series of impulses, the sender springs 13 and 14 are opened to permit the release of relay 16.

The previously described operation of the automatic switch individual to the calling line has advanced the brushes 7 and 8 into engagement with the terminals 18 and 19 of the wanted subscriber's line. It will first be assumed that this line is idle so that when the subscriber at A signals the subscriber at B by depressing the ringing button 20, a ringing circuit is closed from grounded battery, winding of the stepping magnet 6, switch hook springs 10, ringing button 20, conductor 17, lower armature and back contact of cut-off relay 16 switch brush 8, which is now in engagement with the multiple terminal 19, conductor 21, brush 22 of the wanted subscriber's switch, lowermost contact and armature of the cut-off relay 23, conductors 24 and 25, back contact, armature and winding of the ringer magnet 26 to ground. It will thus be seen that a self-interrupting circuit is closed for the ringer magnet 26, which causes it to vibrate its armature and actuate the bell at the wanted subscriber's station. At this time condenser 34 serves to quench the spark at the contacts of ringer magnet 26. The alternating current generated by the operation of the ringer magnet 26 causes a tone to be heard in the receiver at the substation at A so that the subscriber thereat can tell that the wanted subscriber is being signaled. When the wanted subscriber at B answers by removing his receiver from its switch hook the ringing of his bell is immediately stopped since the ringer magnet 26 is now temporarily energized in a circuit extending from ground, winding of this magnet, through the called transmitter, primary winding of the induction coil, impulse springs 27, switch hook springs 28,

winding of the stepping magnet 29 to grounded battery. The stepping magnet 29 is also energized in this circuit and advances the brushes 30 and 22 of the wanted subscriber's switch to the so called "normal position" that is in engagement with the terminals 31 and 32. The subscriber's switch is therefore advanced from its "home position" so that his telephone line cannot be seized by some other subscriber's switch.

The telephone connection is now complete between the substations at A and B and the talking battery for the calling subscriber is supplied over a circuit from grounded battery, through the winding of the stepping magnet 6, switch hook springs 10, impulse springs 12, primary winding of the induction coil, through the transmitter, winding of the ringer magnet 11 to ground. Talking battery for the called subscriber is supplied from grounded battery winding of the stepping magnet 29, switch hook springs 28, impulse springs 27, primary winding of the induction coil, through the called subscriber's transmitter and winding of the ringer magnet 26 to ground. It will be noted that ringer magnets 11 and 26 are operated at this time to remove the short circuit from condensers 33 and 34. It will thus be seen that the ringer magnets 11 and 26 also function as impedance coils for the talking circuit. It will further be understood that the condensers such as 33 and 34 serve to inductively connect and conductively separate the conversational circuit extending between the calling and wanted subscribers.

Let it now be assumed that the wanted line terminating at substation B is already engaged in conversation and that this line is busy as a called line. Its set of brushes 22 and 30 will therefore be in engagement with the terminals 31 and 32 as already described so that the ringing circuit previously described as including conductors 24 and 25 will not be completed and consequently no ringing tone will be heard in the calling subscriber's receiver. The failure to hear this tone after the extension of the connection, is a signal to the calling party that the wanted line is busy. This is in the nature of a negative signal but one which is effective when the subscribers are instructed as to the operation of the system.

It will be recalled that the cut-off relay 16 of the calling line is locked energized during the adjustment of the calling subscriber's switch and if the called line is busy due to the fact that it has been previously seized by another line such as that terminating at substation C, this relay will be locked operated until the calling subscriber disconnects. The circuit for this relay now extends from ground, armature and front contact of magnet 6, upper winding, upper front contact and armature of relay 16, switch brush 7,

terminal 18, multiple terminal 35, brush 36 of the subscriber's line terminating at C, upper armature and back contact of cut-off relay 37, winding of the stepping magnet 38 associated with the C subscriber's individual switch, to grounded battery. Under the control of this circuit the cut-off relay 16 is locked operated and prevents the completion of the ringing circuit over conductor 17 and this insures that the connection now established between substations B and C will not be disturbed.

If the line terminating at B substation is busy due to the fact that this line has originated a call, the brushes 22 and 30 of its associated switch will be advanced beyond their so called "home" and "normal positions" so that the ringing circuit for the substation A will not be completed with the result that the A subscriber can hear no ringing tone and will know that the wanted line cannot be reached.

At the close of the conversation the calling subscriber at A restores his portion of the established connection by simply replacing his receiver on its switch hook thereby opening the switch hook springs 10 with the result that the stepping magnet 6 deenergizes and shortly after the slow releasing magnet 4 deenergizes. This permits the retractive spring of its associated switch to restore the brushes 7 and 8 of this switch to their "home position". Similarly when the called subscriber at substation B replaces his receiver on its switch hook, springs 28 are opened to permit the stepping magnet 29 to deenergize and shortly afterwards the slow releasing holding magnet 40 of this switch deenergizes so that the retractive spring of the called subscriber's switch restores the brushes 22 and 30 of this switch to their normal position.

While the subscriber's individual switches have not been described in detail as operating on the cumulative principle, it is to be understood that these switches may be so operated without any change in the operating circuits. Automatic switches operated on cumulative principle are also referred to as adding type switches and may be described as advancing a number of steps equal to the sum of the impulses in several series of impulses, instead of being advanced in the well known group and line selecting movements.

It will thus be seen that a simple automatic telephone system is provided in which a minimum amount of equipment is used and in which relatively simple operative circuits are employed.

I claim—

1. In an automatic telephone system, a plurality of telephone lines, a substation for each telephone line, a telephone transmitter, a telephone receiver and a ringer magnet at each substation, a plurality of automatic

switches, each automatic switch having passive contacts and active contacts arranged to be progressively advanced over said passive contacts, a motor magnet for advancing the active contacts of each switch, each telephone line terminating in the active contacts of one automatic switch, certain of the passive contacts of said automatic switches being multiplied together, means associated with the calling substation for directly controlling the operation of its associated automatic switch for extending said calling telephone line to a wanted telephone line, a common source of current, and means including circuits having therein the impedance of the motor magnets and ringers associated with the calling and called telephone lines for connecting said source of current to the telephone transmitters of these lines.

2. In an automatic telephone system, a plurality of telephone lines, a substation for each telephone line, a telephone transmitter, a telephone receiver, a ringer magnet and a ringing key at each substation, a plurality of automatic switches, each automatic switch having passive contacts and active contacts arranged to be progressively advanced over said passive contacts, electromagnetic means for advancing the active contacts of each switch, each telephone line terminating in the active contacts of one automatic switch, certain of the passive contacts of the said automatic switches being multiply connected together, means associated with the calling substation for controlling the operation of the electromagnetic means of its automatic switch for extending said calling substation to a wanted substation, a ringing circuit including the ringer magnet at the wanted substation, means including the ringing key at the calling substation, for controlling said circuit, a common source of current, and means including a circuit having therein the impedance of said electromagnetic means and the ringer magnets associated with the calling and called telephone lines for connecting said source of current to said transmitters.

3. In an automatic telephone system, a plurality of telephone lines, a substation for each telephone line, each substation having a telephone receiver, a telephone transmitter and a ringer magnet, a plurality of automatic switches, each automatic switch having passive contacts and active contacts arranged to be progressively advanced over said passive contacts, electromagnetic means for advancing the active contacts of each switch, each telephone line terminating in the active contacts of one automatic switch, certain of said passive contacts being multiply connected together, means associated with a calling substation directly controlling the operation of the electromagnetic

means of its associated switch for extending said calling substation to a wanted substation, a common source of current, means including circuits having therein the impedance of the electromagnetic means and the ringer magnets associated with the calling and called telephone lines for connecting said source of current to their transmitters, and means including a condenser at each substation of a completed connection for conductively separating said transmitter circuits from each other.

4. In an automatic telephone system, a plurality of telephone lines, each telephone line being provided with a transmitter and a receiver, means including an automatic switch individual to a telephone line for extending said telephone line to any of the other telephone lines, a common source of current, means including portions of the calling and called telephone lines for supplying current to the transmitters associated with said telephone lines, and means including condensers located at the calling and called substations for inductively connecting but conductively separating the telephone transmitters of an established connection.

5. In an automatic telephone system, a plurality of telephone lines, a substation associated with each telephone line, each substation being provided with a telephone receiver, a telephone transmitter and a call signal, an automatic switch individual to each telephone line for extending said telephone line to any of the other telephone lines, electromagnetic means arranged to be directly controlled from a calling substation for directly operating the automatic switch of a calling telephone line to extend said line to any wanted telephone line, means including a circuit extending over said calling and called telephone lines through said automatic switch for establishing a telephonic connection between the telephone receivers and transmitters at the calling and called substations, and a second circuit including a portion of said first circuit for actuating the call signal at the wanted substation, said circuit serially including the electromagnetic means of said last mentioned switch.

6. In an automatic telephone system, a plurality of telephone lines, a substation for each telephone line having a telephone receiver, a telephone transmitter and a call signal, an automatic switch individual to each telephone line for extending said telephone line to any of the other telephone lines, electromagnetic means associated with said switch, said electromagnetic means being directly controlled over a calling telephone line, a common source of current, means including said source of current for actuating the call signal at the wanted substation, means operated simultaneously with said

called signal for causing a tone in the receiver at the calling substation, and means for connecting said source of current to the telephone transmitters of the established connection.

7. In an automatic telephone system, a plurality of telephone lines, a substation having a transmitter for each telephone line, an automatic switch individual to each telephone line for extending said telephone line to any of the other lines, means for directing each automatic switch, a common source of current, and circuits for connecting said source of current to the transmitters of a completed telephone connection, said circuits each including a current feed coil and a winding of an induction coil at each of the substations of the telephone connection.

8. In an automatic telephone system, a plurality of telephone lines, a substation for each telephone line having a telephone transmitter, a telephone receiver and a call signal, an automatic switch for each telephone line, means for directing each automatic switch for connecting said telephone line to any other telephone line, a common source of current for said telephone transmitters and call signals, means including a portion of the calling and called telephone lines for causing said source of current to actuate the called signal and interrupt its own circuit at the wanted substation, a telephone circuit interconnecting the calling and called telephone line, said circuit including the transmitters of said telephone lines, a condenser at each of the substations of the associated connections for conductively dividing said telephone circuit into two parts, one part including each transmitter, means for bridging said source of current to each transmitter, and means including the mentioned condenser associated with the called substation for quenching the spark at the intermittently operating called signal.

9. In an automatic telephone system, a plurality of telephone lines, a telephone transmitter, a telephone receiver and a call signal for each telephone line, an automatic switch individual to each telephone line for connecting said telephone line with any of the other telephone lines, directly controlled means for operating each individual switch for causing it to seize any wanted telephone line, a call signal at each substation, electromagnetic means including a self-interrupting circuit for actuating the call signal at a wanted substation, manual means at the calling substation for controlling said circuit, a condenser at each substation normally bridged about the contacts of said electromagnetic means, and means for continuously energizing the electromagnetic means at the calling and called substations

during the maintenance of a telephone connection.

10. In an automatic telephone system, a plurality of telephone lines, a substation for each telephone line, a telephone transmitter, a receiver and a ringer magnet in each substation, a plurality of automatic switches for interconnecting said telephone lines, a motor magnet for advancing each automatic switch, means including one of said switches and its motor magnet for extending one of said telephone lines when calling to a wanted telephone line, a common source of current, and means including a circuit having therein the impedance of said last mentioned motor magnet and the ringer magnet of the calling telephone line for connecting said source of current to the telephone transmitter of said calling telephone line.

11. In an automatic telephone system, a plurality of telephone lines, each telephone line being provided with a transmitter and a receiver, means including an automatic switch for extending a calling telephone line to any of the other telephone lines, a common source of current, means including portions of the calling and called telephone lines for supplying current to the transmitters associated with said telephone lines, and means including condensers located at the called and calling substations for inductively connecting and conductively separating the telephone transmitters of an established telephone connection.

12. In an automatic telephone system, a plurality of telephone lines, a substation for each telephone line having a telephone receiver, a telephone transmitter and a call signal, an automatic switch for extending a telephone line when calling to any of the other telephone lines, electromagnetic means associated with said switch, said electromagnetic means being directly controlled by a calling telephone line, a source of current, ringing means including said source of current for actuating said call signal at the wanted substation, means operated simultaneously with said called signal for causing a tone in the receiver at the calling substation, and means including a portion of said ringing means for connecting said source of current to the telephone transmitters of the established connection.

13. In an automatic telephone system, a plurality of telephone lines, a telephone transmitter, a telephone receiver, and a call signal for each telephone line, means including an automatic switch for connecting a telephone line when calling to any other telephone line, directly controlled means for operating said automatic switch for causing it to seize a wanted telephone line, electromagnetic means including a self-interrupting circuit for actuating the call signal at a wanted substation, manual means at the call-

ing substation for controlling said circuit, during the maintenance of the telephone
condensers at each substation normally connection.
bridged about the contacts of said electro- In witness whereof, I hereunto subscribe ¹⁰
magnetic means, and means including a por- my name this 17th day of January A. D.
5 tion of said self-interrupted circuit for con- 1922.
tinuously energizing the electromagnetic
means at the calling and called substation

WINFRED T. POWELL.