

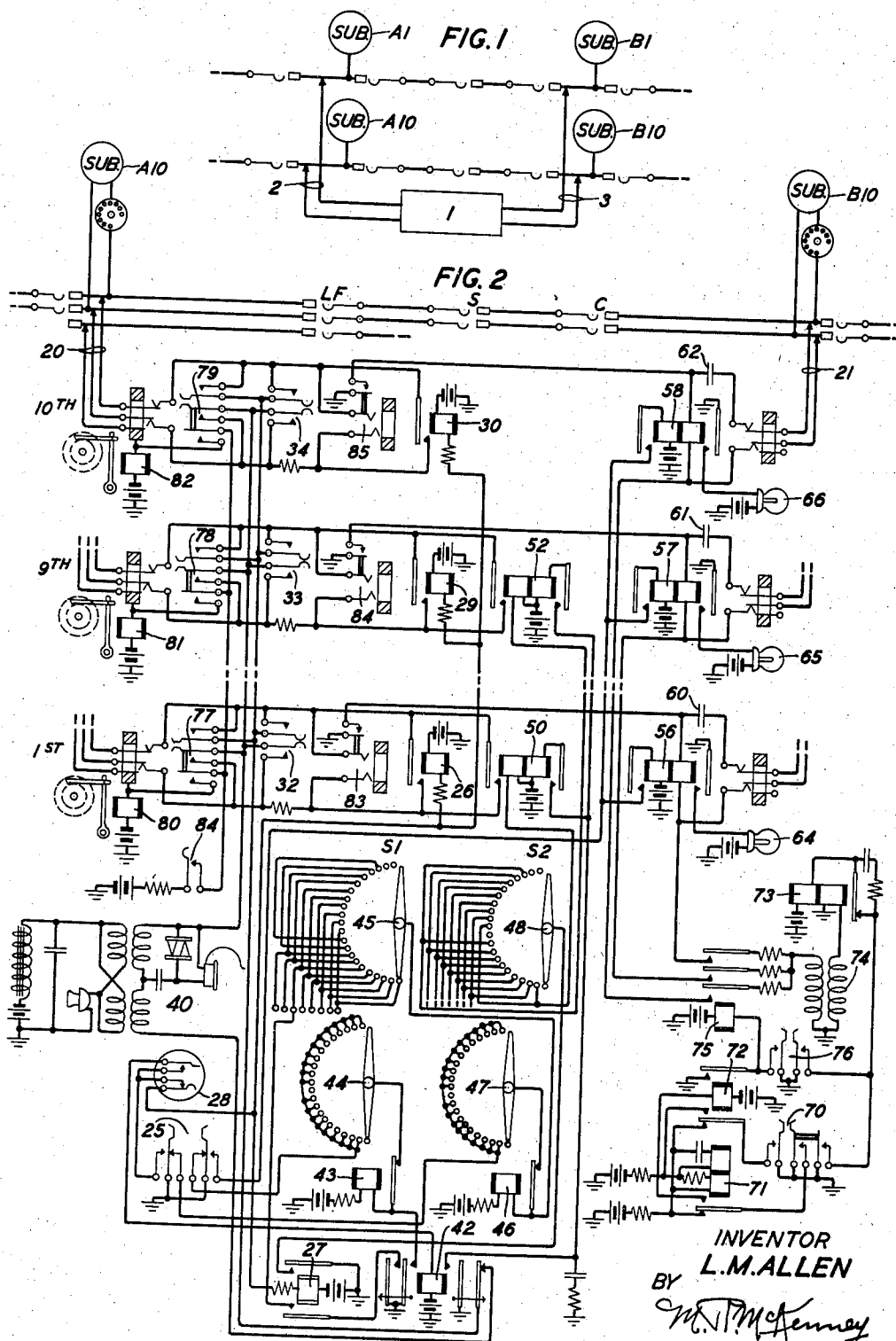
Jan. 24, 1939.

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2,144,866

TELEPHONE SYSTEM

Filed March 20, 1937



UNITED STATES PATENT OFFICE

2,144,866

TELEPHONE SYSTEM

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Application March 20, 1937, Serial No. 131,996

9 Claims. (Cl. 179-175.21)

This invention relates to telephone systems and particularly to testing arrangements for automatic telephone systems.

An object of the invention is to increase the accuracy and speed at which the testing operations may be performed in systems of this kind.

Heretofore systems have been provided for testing various parts of automatic systems such as arrangements for testing multiple connections of subscribers' lines terminating at line switches and at connectors. Automatic switches have been used which are operated by dialing of numbers to test such connections. Test sets have also been used for testing selectors and associated trunk circuits for dialing a number and testing trunks in succession.

A feature of the applicant's invention is a test set for testing automatic switching systems comprising means for enabling an operator to originate a number of simultaneous calls over an automatic telephone system while dialing a single number and to distribute these calls over a corresponding number of different lines terminating in the test set.

A special feature of the test set is an arrangement whereby any one of the digits in a dialed number may be arranged to send out a number of different digits, for example, one pulse on a first line, two pulses on a second line, etc., until, for example, ten pulses are sent out on a tenth line. A large quantity of test connections may therefore be rapidly set up and these connections may thereby be checked as to the ability of the automatic equipment to set up such connections and further checking may also be made relating to the dialing, ringing transmission and registration features of the automatic system.

The invention has been illustrated in the accompanying drawing in which:

Fig. 1 is a schematic view showing in general the application of the invention to an automatic telephone system; and

Fig. 2 shows the details of a test set applied to such a system.

Reference may now be made to the drawing and particularly to Fig. 1. There has been outlined in this figure two out of a group of, for example, ten automatically established connections between subscribers' lines over switches in an automatic telephone system. A test set has been symbolized at 1 with ten so-called originating lines 2, two of which have been shown as single lines and ten terminating lines 3, two of which have been shown by single lines. When this test set is to be used for testing, ten subscrib-

ers' lines A1 to A10 are chosen. Of these only A1 and A10 have been shown, and to these the individual lines of the originating lines 2 are connected at some convenient point such as a main distributing frame through which the conductors of these lines pass. Then ten other subscribers' lines B1 to B10 are chosen. Of these lines B1 and B10 have only been shown. To the conductors of these lines the terminating lines 3 are individually connected at convenient points such as a main distributing frame. For the convenience during testing, the subscribers' lines used may be temporarily vacant or lines unassigned to actual subscribers may be used. The subscribers' lines B1 to B10 may be numbered in consecutive order, and the operator in testing will establish connection to all ten subscribers' lines simultaneously over ten different paths while dialing the number of one of these subscribers' lines. The testing system is so arranged that by dialing this number a call will be originated on each one of the originating lines 2 by each selecting in the usual way a line-finder. Then when the various digits are dialed out over these ten originating lines individually selectors and connectors are operated in the system in the usual manner with this exception, that the impulses of one of the digits will be different. This may be the tens or unit digit, or any other as desired. At any rate, when the dialing of this digit occurs the first line of the originating lines 2 will receive one impulse, the second line will receive two impulses, etc. until the tenth line which will receive ten impulses. Thus, the selection which is done by this digit causes the selection of ten different subscribers' lines and therefore there will be connections established from ten different originating lines 2 through ten different set-ups to ten different terminating lines 3 back into the test set 1. Various tests may now be performed by the operator to test in general the connections established and other functional features of automatic systems, as will be described hereinafter.

In Fig. 2, the test set 1 has been shown with an originating line 20 and a corresponding terminating line 21 connected to a subscriber's line A10 and a subscriber's line B10 respectively in a typical step-by-step system in which the switches have been represented diagrammatically by a line-finder LF, a selector S and a connector C. It should be understood that any number of switches intermediate the line-finder LF and the connector C may be employed depending on the capacity of the system. The wiring in the test

set for the first, ninth and tenth originating and terminating lines has been shown in full except that only the tenth lines are connected up and the wiring for the intermediate lines has been omitted for the sake of clearness. For the purpose of description, it is assumed that the subscribers' lines to which connections will be made are reached by dialing an office code number comprising three digits and four numerical digits and that all impulses for these digits that are transmitted over the originating line correspond to the digits dialed except the tens digit which is used to distribute the calls to ten different terminating lines. For example, the number to be dialed may be 332—1806 and ten calls will be directed to the lines 332—1816, 332—1826 etc. to line 332—1806. That is, on all originating lines, all digits will be the same except the tens digit which in the case of the first line will comprise one impulse and on the succeeding lines one additional impulse each until the tenth line is reached when ten impulses will be transmitted over the originating line 20 for the tens digit. It should, however, be understood that any other digit in this number may be used for distribution of the calls to ten different lines.

Assuming then that all the originating and terminating lines have been connected in the proper manner, the test may be started by having the operator actuate the start key 25. This closes a circuit for relays 26 and 27 from battery through the winding of relay 26, contacts of the dial 28, contacts of key 25 to ground and from battery through the winding of relay 27, contacts of dial 28 and key 25 to ground. In addition to the operation of relay 26, relays 29 and 30 and all intermediate relays connected in parallel between the relays 26 and 29 of the other originating lines not shown will be operated from battery through the windings of these relays, contacts of dial 28 and key 25 to ground. These relays 26, 29 and 30 and intermediate relays in operating connect together the tip and ring conductors of the originating lines controlled thereby. This is equivalent to ten calling subscribers removing their receivers from the switchhook. Each originating line will therefore be connected through a linefinder LF to a selector S. The operator may at this time check for dial tone before she begins to dial by operating one at the time keys, such as 32, 33 or 34, or intermediate keys, which on being operated connect the tip and ring conductors of a corresponding originating line with her telephone set at 40. When the operator has heard dial tones and released the keys she may begin to dial the number 332—1806. As soon as the dial is operated off-normal for the first digit, a circuit is closed for the operation of relay 42 which is slow in releasing and remains operated during the return of the dial to normal. On the return of the dial to normal, three interruptions of the circuits for relays 26, 29 and 30 cause these relays and the intermediate relays of other lines to interrupt the tip and ring connections to control the selectors in the ten connections accordingly. As will be noted, the operation of relay 42 prepared a circuit for the stepping magnet 43 for the step-by-step switch S1 from battery, through the winding of this magnet and the contacts of relay 42 to ground. This caused the stepping magnet 43 to operate. Now on the return to normal of the dial 28, relay 42 releases and in turn causes the release of the magnet 43. The release of magnet 43 causes the advance of the

brushes of the banks 44, and 45 of switch S1 to the next terminal.

The succeeding digits are now dialed in the same manner operating relays 26, 29 and 30 to open and close the connections through the tip and ring conductors of the originating lines, advancing the switches in the automatic system of ten different connections in accordance with each digit and at the end of each digit relay 42 and the stepping magnet 43 release to advance the brushes of switch S1 an additional step. When the fifth digit has been dialed, these brushes are advanced to the sixth terminal. Therefore, when relay 42 operates as the dial 28 is operated for the succeeding or tens digit from the normal position, a circuit will be closed for the operation of the stepping magnet 46 for step-by-step switch S2 from battery, winding of magnet 46, brush 45 of switch S1 and the sixth terminal, contacts of relays 27 and 42 to ground. Relays 26, 29 and 30 and the intermediate relays operate and release as usual during the dialing of this digit. It should be noted, however, that when relay 27 releases the first time on the dialing of this digit, the magnet 46 releases and thereby causes the switch S2 to take one step with the brushes of its banks 47 and 48, hence when relay 27 is again operated after the first impulse, a circuit will be closed for the operation of relay 50 from battery, left-hand winding of this relay, the first terminal and brush of bank 48 of switch S2, contacts of relay 27 to ground. Relay 50 locks through its right-hand winding to relay 42. Consequently, any further operation of relay 26 will become ineffective as relay 50 has now short-circuited the tip and ring conductors of this line. The first originating line will therefore only receive a single impulse as the tens digit. On the second operation of relay 27 the circuit for the stepping magnet 41 will again be closed to cause the switch S2 to take another step when relay 27 releases. At this time the brush of bank 48 will rest on the second terminal and cause the operation of a relay corresponding to relay 50 for the second originating line and thus prevent more than two impulses from being transmitted over the second line. For each impulse transmitted by the dial 28 during this digit, therefore, a succeeding relay corresponding to relay 50 will be operated to prevent further impulses being transmitted over the corresponding originating line until the relay 52 of the ninth line is operated after which the tenth line will receive ten impulses. When the dial restores to normal at the end of the tens digit, stepping magnet 43 is operated on the release of relay 42 to cause the switch S1 to take another step and open the connections through the sixth terminal for magnet 46. Relay 42 in releasing also opens the holding circuits for relays 50 and 52 and intermediate relays causing these relays to release. The units digit may now be dialed in the usual manner. What has actually taken place, therefore, in the automatic step-by-step system is that ten different paths have been established through the switches of this system from the ten different originating lines to ten terminating lines. The tenth of these terminating lines, numbered 21, is shown connected to the automatic system. When the connectors C of these various paths establish connections with these ten terminating lines, ringing tone will be transmitted over these lines in the usual manner from the connectors and cause the operation of relays such as 56, for the first line, 57 for the ninth line, and 58 for the

tenth line, through the tip and ring conductors and condensers such as 60, 61, 62 and the right-hand windings of these relays, which will be operated and locked through their left-hand windings and left-hand armatures and front contacts to ground at the contacts of key 25. The operation of these relays 56, 57 and 58 and corresponding intermediate relays of the omitted line will close obvious circuits for the lighting of lamps 64, 65 and 66 and corresponding lamps of intermediate lines to indicate to the operator that the calls have been terminated in the test set where these lamps are located.

The operator may now test the connections through the automatic system by first operating the key 70. This key closes obvious circuits for the alternate operation and release of relays 71, 72 and 73. Relay 73 induces an interrupted current or tone through the repeating coil 74 and the alternate operation and release of relay 72 causes the alternate operation and release of relay 75. This relay in turn connects intermittently the ring sides of the terminating lines to ground through the left-hand winding of the repeating coil 74 which causes the ringing to be tripped in the ten connectors, and succeeding application of current through this coil causes ringing tone to be transmitted out over the ten connections back to the originating line. The operator may then listen to these tones at the originating ends of the ten line connections by operating individual keys such as 77, 78, or 79, or others of the intermediate lines which connect her telephone set 40 to these lines, to confirm that the calls were completed properly. In listening to the tones incoming over the lines, the operator will also observe the registers such as 80, 81 and 82 and other intermediate registers to see whether any of them should operate falsely which may be caused by the interruptions of the tone current pulses not being received in the system at the proper rate as determined by the alternate operation and release of relay 75. The circuits in the system for operating the registers may be so designed that they will not normally operate in response to impulses of a duration below a certain interval, in this case determined by relay 75. The operator may then, if she so desires, operate key 76 which maintains relay 75 operated to test the proper operation of the registers. To facilitate this latter test, the operator may set all the registers to show the same readings before the test starts by operating keys such as 32, 33 and 34 and other intermediate keys and key 84. Jacks 83, 84 and 85 and intermediate jacks are provided to enable the operator to hold any connection when necessary to investigate for trouble by plugging in a short-circuited plug in these jacks.

When the tests are completed, the start key 25 is restored to normal and this closes circuits for returning the switches S1 and S2 to normal. The circuit for stepping magnet 43 may be traced from battery, winding of this magnet and its self-interrupting contact, brush of bank 44, the ninth terminal and the multiple connections of the terminals from one to nine to ground at contacts of key 25. The circuit for the stepping magnet 48 may be traced from battery through the winding of this magnet and its self-interrupting contacts, brush of bank 47 at the ninth terminal, contacts of key 25 to ground. These magnets 43 and 46 are thereby stepped until the brushes of these switches are returned to normal position. It should be noted that in case of switch

S1, two steps are required and in the case of switch S2, one step only is required to return these switches to a normal position which occurs every quarter of a turn of the brushes. The relays 26, 27, 29 and 30 are now also released which causes the ten connections through the automatic system to be released in the usual manner corresponding to the subscribers of these lines replacing their receivers on the switchhooks. Relays 56, 57 and 58 that were held operated by key 25 are now also released. It should be understood, of course, that any connection held, by a short-circuited plug connected to a jack, such as 83, 84 or 85, will not be affected by the release of the corresponding relay 26, 29 or 30 but will be held for investigation of further trouble on the line.

In case the operator should dial an incorrect number and wishes to correct this fault before completing dialing or should desire to abandon the call for any reason before dialing is completed, she may restore the start key 25 which releases the operated relays and restores the selectors S1 and S2 as described.

The automatic release of a connection over an automatic system due to the delay of the calling subscriber to disconnect after a called subscriber has disconnected may be checked by this arrangement by waiting a period of over four minutes, for example, after release of the key 76 at the end of a test call before the key 25 is restored. At the end of this delay period, key, such as 32, 33 or 34 of the originating line should be operated and dial tone should be noted if disconnection has taken place. If no dial tone is heard, the key 70 may be operated to transmit the tone over the subscriber's connection to indicate that it has not been released.

What is claimed is:

1. In an automatic telephone system, means 40 for dialing telephone numbers, and means responsive to the dialing of a single number for transmitting a plurality of different numbers simultaneously for the establishing of corresponding separate independent telephone connections. 45

2. In an automatic telephone system, a test set comprising means for dialing telephone numbers, and means responsive to the dialing of a single telephone number for transmitting simultaneously over a plurality of connections the same number of impulses in all but one of the digits of said single number and for transmitting for the remaining digit a different number of impulses over each connection for the establishing of corresponding different telephone connections through said system. 55

3. In combination, a test set comprising means for dialing telephone numbers, and means responsive to the dialing of any one of a plurality of telephone numbers for transmitting simultaneously over a plurality of connections the same number of impulses in all but one of the digits of the dialed number and for transmitting for the remaining digits a different number of impulses over each connection for the establishing of corresponding different telephone connections to said system. 65

4. In an automatic telephone system, a test set, a plurality of line connections between said automatic telephone system and said test set, means in said test set for dialing telephone numbers consisting of series of digits, and means responsive to the dialing of a single telephone number for transmitting simultaneously over said line connections the same number except 75

for one digit therein which is translated to transmit a different digit over each of said line connections to set up in said telephone system a corresponding plurality of different telephone

5 connections.

5. In combination, a test set, a plurality of line connections between said automatic telephone system and said test set, means in said test set for dialing telephone numbers consisting of series of digits, means responsive to the dialing of a single number for transmitting simultaneously over said line connections the same number except for one digit therein which is translated to transmit a different digit over each

15 of said line connections to set up in said telephone system a corresponding plurality of different telephone connections, and means for altering the choice of digit in said single number to be translated.

20 6. In combination, a test set, a plurality of individual line connections between said test set and said automatic telephone system, said test set comprising means for dialing telephone numbers consisting of a plurality of digits, means responsive to the dialing of a particular telephone number for transmitting simultaneously over said line connections the digits of said number with the exception of one of the digits therein which is translated to cause the transmission of a different digit over each line connection for actuating said automatic telephone system to set up a corresponding plurality of different telephone connections, means responsive on the completion of said telephone connection for separately signaling the completion of each telephone connection, means for simultaneously tripping the ringing over all of said telephone connections when completed and for transmitting a tone over each telephone connection and the associated line connection to said test set, and means for listening to said tone over each telephone connection separately.

7. In combination, a test set, a plurality of individual line connections between said test set and said automatic telephone system, said test set comprising means for dialing telephone numbers consisting of a plurality of digits, means responsive to the dialing of a particular telephone number for transmitting simultaneously over said line connections the digits of said number with the exception of one of said digits which is translated to cause the transmission of a different digit over each line connection for actuating said automatic telephone system to set up a corresponding plurality of different telephone connections, means responsive on the completion of said telephone connections for separately signaling the completion of each telephone connection, means for simultaneously tripping the ringing over all of said telephone connections when completed and for transmitting a tone over each telephone connection and associated line connection to said test set, means for listening to said tone over each telephone connection separately, and means for holding any of said telephone connections and for releasing the remaining connections.

8. In an automatic telephone system, step-by-step switches, means for dialing a single number, and means responsive to the dialing of this number for simultaneously operating a plurality of groups of switches with each group of said switches operating a different number of steps.

9. In an automatic telephone system, step-by-step switches, means for dialing a single number, and means responsive to the dialing of this number for simultaneously operating a plurality of groups of switches with one switch in each group operating a different number of steps from the corresponding switch in any other group.

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