July 24, 1923.

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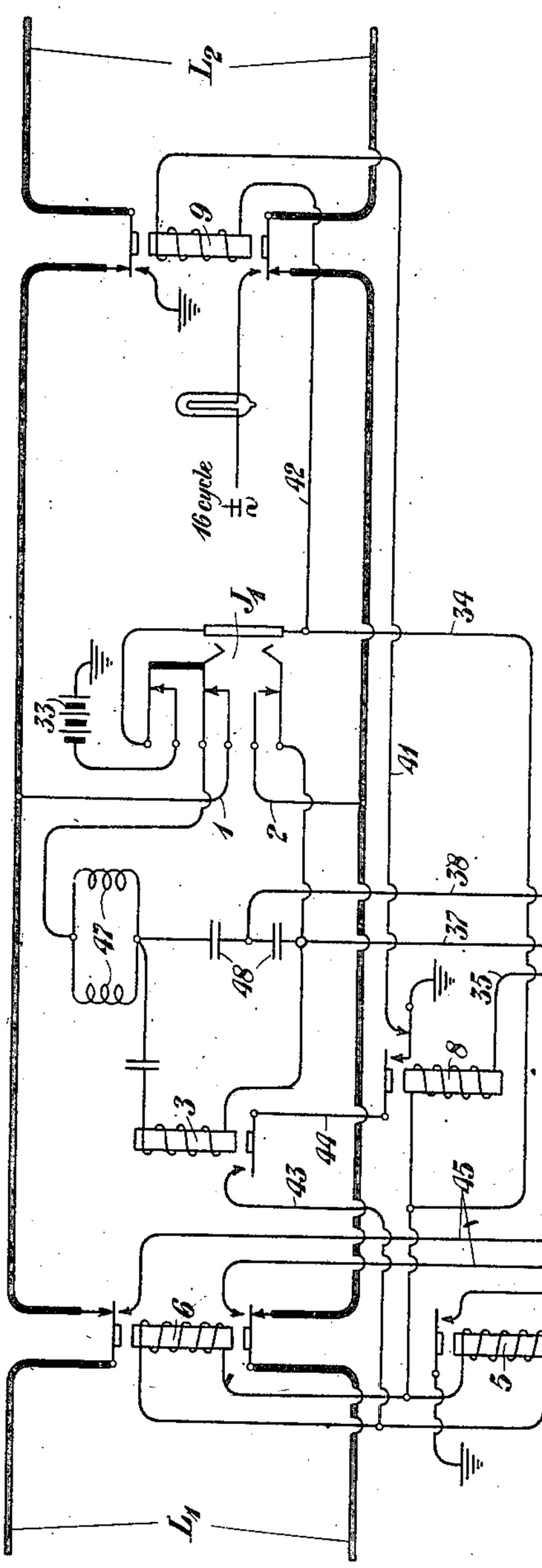
J. F. TOOMEY ET AL

COMPOSITE RINGER SET

Filed Dec. 31, 1920

2 Sheets-Sheet 1



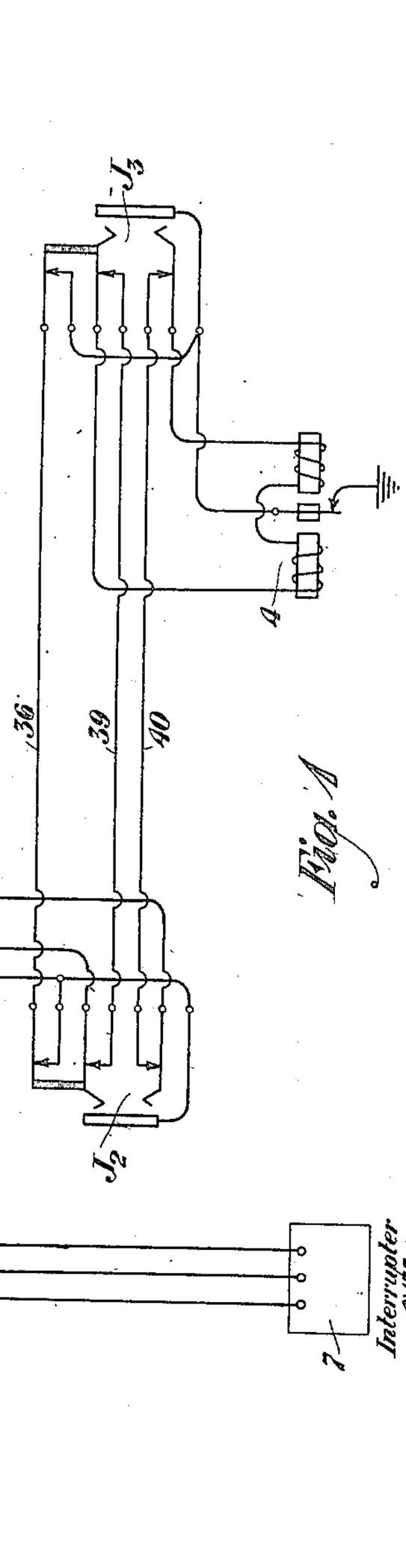


Fig. 1.

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2 Sheets-Sheet 2

Fig. 2.

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Patented July 24, 1923. 1,462,526

UNITED STATES PATENT OFFICE.

JOHN F. TOOMEY, OF NEW YORK, AND WILLIAM H. HARRISON, OF HOLLIS, NEW YORK, ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

COMPOSITE RINGER SET.

Application filed December 31, 1920. Serial No. 434,279.

To all whom it may concern:

Be it known that we, JOHN F. TOOMEY and WILLIAM H. HARRISON, residing at New York and Hollis, in the counties of New York and Queens and State of New York, respectively, have invented certain Improvements in Composite Ringer Sets, of which the following is a specification.

This invention relates to transmission lines, which include composite ringer devices, and also to arrangements for testing and adjusting the apparatus of such devices.

It is sometimes the practice, when a transmission line is associated with switchboard apparatus, to associate with the line a device known as a composite ringer, the purpose of such a device being to translate the type of signaling current suitable for use over the line and not suitable for use at the switchboard into the type of signaling current suitable for use at the switchboard and vice versa. For purposes of illustration the type of signaling current suitable for use over the transmission line may be assumed to be of a frequency in the neighborhood of 135 cycles and that suitable for use at the switchboard to be of a frequency in the neighborhood of 16 cycles. The operation of the composite ringer is controlled primarily by an alternating current relay which responds to the 16 cycle current transmitted from the switchboard and which when operated serves to apply 135 cycle signaling current to the transmission line and an alternating current relay which responds to the 135 cycle current coming in from the transmission line and which when operated serves to apply 16 cycle signaling current to the conductors leading to the switchboard.

In general it is the object of the invention to provide an improved type of composite ringer and to provide improved arrangements for subjecting the relay arrangements of the composite ringer to tests for observation and adjustment.

It is one of the cardinal features of the composite ringer of this invention that all of the jacks, which in former arrangements were included directly in the transmission circuit, are eliminated from the transmission circuit so that the arrangement affords less opportunity for interference with the transmission and gives an improvement in the quality of the transmission. Another feature of the invention consists in so wiring through jacks the relay, which responds to the 135 cycle signaling current, that it is possible to patch it from one circuit to another and to pick it up separately for adjustments. A further feature is that the receiving bridge of the composite ringer set is wired through a jack in such a manner that the composite ringer may be picked up for tests and adjustments or may be cut off entirely from the transmission circuit whenever the ringer is not required. The testing and adjusting circuit of the invention includes arrangements whereby the alternating current relays of the composite ringer may be given both operate and non-operate tests and whereby these relays may be subjected to these tests under actual service conditions and also under what may be termed adjustment conditions. Furthermore means are provided for testing the action of the direct current relays of the composite ringer. A further feature is that the testing and adjusting circuit is controlled by means of a portable control circuit used in connection with control jacks located near the relays of the composite ringer set. This arrangement makes it possible to control the action of the relays during tests from a position from which they may be observed. In the testing and adjusting circuit there is provided an automatic timing arrangement whereby the impulses of testing current to which the composite ringer relays are subjected may be controlled so as to be of a definite duration. Other features and objects of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing, in the Figures 1 and 2 of which are illustrated a preferred arrangement of the invention. In Fig. 1 is illustrated a circuit diagram of the composite ringer set, while in Fig. 2 is shown the testing and adjusting circuits associated therewith.

In Fig. 1 is illustrated a section of a transmission line including composite ringer apparatus. Section L_2 of the line leads to switchboard apparatus, while Section L_1 of the line constitutes the transmission line itself. Across the talking strands of the transmission line is the bridge comprising conductors 1 and 2. This bridge includes the contacts of jack J_1 and includes the

windings of the relays 3 and 4. The relay 4 is responsive to ringing current of the type suitable for use over the transmission line, which for purposes of illustration will be hereinafter referred to as 135 cycle ringing current. The relay 3 is responsive to ringing current of the type suitable for operating ringing apparatus at the switchboard, which for purposes of illustration will hereinafter be referred to as 16 cycle ringing current. The 135 cycle ringing current coming in over the transmission line operates relay 4, which in turn causes 16 cycle ringing current to be applied to section L_2 of the line and thence to the switchboard apparatus. The 16 cycle ringing current originating at the switchboard actuates the relay 3, which in turn controls other relay mechanism to apply 135 cycle ringing current to section L_1 of the transmission line. The operation of the arrangements of the composite ringer is as follows: Normally, the following circuit is closed; from ground and battery 33, contact of jack J_1, conductor 34, winding of relay 8, conductor 35, contact of jack J_2, conductor 36, contact of jack J_3, armature and contact of relay 4 to ground. Accordingly under normal conditions the relay 8 will be maintained in an energized condition by the above traced circuit. Ringing current of the order of 135 cycles coming in over section L_1 of the line will be transmitted over the bridge, including conductors 1 and 2, and thence over conductors 37 and 38, contacts of jack J_2, conductors 39 and 40, contacts of jack J_3 and the windings of relay 4. This will operate the relay 4, which will attract its armature and thereby open the previously traced circuit through the winding of relay 8, thereby deenergizing the relay 8. The deenergization of relay 8 will allow the following circuit to be completed; from ground, break contact of relay 8, conductor 41, winding of relay 9, conductor 42, contact of jack J_1 to battery 33 and ground, thereby operating the relay 9. The operation of relay 9 will cause it to pull up its armatures and apply to the talking strands of section L_2 of the line a source of 16 cycle ringing current suitable for operating the signaling arrangements at the switchboard. The ringing current originating at the switchboard is transmitted from section L_2 of the line through the bridge, including conductors 1 and 2 and the winding of relay 3. As the relay 3 is adjusted to operate with 16 cycle ringing current it will pull up its armature and thereby allow the following circuit to be completed: from ground and battery 33, contact of jack J_1, conductor 34 through the windings in parallel of relays 5 and 6, conductor 43, contact and armature of relay 3, conductor 44, armature and make contact of relay 8 to ground. The closing of this circuit will operate the relays 5 and 6. The operation of relay 6 will connect section L_1 of the transmission line to the conductors 45, which lead to an interrupter apparatus 7, whereby signaling current suitable for use out over the line, such as 135 cycle ringing current, may be generated. The operation of relay 5 by the attraction of its upper armature will close a circuit which will start the interrupter apparatus 7 into operation, and by the attraction of its lower armature will close a locking circuit over conductor 46 for the relay 8 to prevent said relay from being released, should the relay 4 be accidentally operated at this time. It is pointed out that in the bridge including conductors 1 and 2 across the transmission line, there is also included an arrangement 47 of inductances and condensers, such as 48, so that the transmission characteristics of the line will not be materially disturbed by the composite ringer apparatus and for the purpose of guiding the different signaling currents to their respective relays. Associated with the bridge including conductors 1 and 2 is the jack J_1 whereby testing apparatus may be associated with the composite ringer set. It is furthermore pointed out that by inserting a dummy plug or a short circuit plug in this jack that the composite ringer apparatus may be entirely disconnected from the transmission circuit. The jack J_3 associated with the relay 4 and also the jack J_2 are provided for patching purposes, so that other relays might be substituted in the circuit should the relay 4 fail to operate properly.

In Fig. 2 are illustrated arrangements for testing and adjusting the relays of the composite ringer circuit illustrated in Fig. 1. With the arrangements of Fig. 2 either of the alternating current relays such as 3 or 4 may be given the ordinary routine tests to see whether they operate or do not operate correctly. These relays may furthermore be given tests under what are known as adjustment conditions, or in other words, to test their operation under conditions more severe than would be encountered in actual service. Furthermore, the direct current relays of the composite ringer set may also be tested with the arrangements of Fig. 2, to see if they are functioning with the proper amount of current. The arrangements of Fig. 2 may best be understood from the following description of the various testing operations.

To test the relay 3 which as has been pointed out, is adjusted to operate with the 16 cycle signaling current transmitted from the switchboard, the plug P_1 should be inserted in the jack J_1 and the plugs P_4 and P_5 should be inserted in the jacks J_4 and J_5 respectively. When the plug P_1 is inserted in the jack J_1 the battery 33 which for-

merly supplied current for the direct current relays such as 5, 6, 8, and 9, is disconnected therefrom, and current is now supplied for these relays from the testing apparatus of Fig. 2 in the following manner: A circuit is closed from ground, sleeve contacts of jack J_4 and plug P_4, contact of key K_7, sleeve contacts of plug P_5 and jack J_5, winding of relay 25 to battery and ground. This will operate relay 25 and battery will then be applied to the following circuit: from ground and battery, armature and contact of relay 25, conductor 50, contact of key K_8, through the potentiometer 26, contact of key K_9 through the ammeter 27, conductor 51, sleeve contacts of plug P_1 and jack J_1 to conductor 34 and thence to the direct current relays in the same manner as previously pointed out. The key K_1 will now be operated and the following circuit will be closed: from ground, sleeve contacts of jack J_4 and plug P_4, resistance 29, contact of key K_1, tip contacts of plug P_4 and jack J_4, tip conductor of jack J_4, through the windings of relays 14 and 13, to battery and ground. The closing of this circuit will operate the relay 14 but as the circuit includes the resistance element 29, the relay 13, which is marginal, will not be operated. When the plugs P_4 and P_5 are inserted in the jacks J_4 and J_5, the relay 24 will be operated over the following circuit: from ground to battery, winding of relay 24, ring contacts of jack J_5 and plug P_5, contact of key K_5, sleeve contacts of jack J_4 and plug P_4 to ground. Accordingly when the plugs P_4 and P_5 are inserted in jacks J_4 and J_5 and the key K_1 is thrown the relays 24 and 25 and 14 will be operated. The relay 24 will pull up its armature and apply ground to conductor 52 to the junction point 30 for purposes which will now be pointed out. The relay 14 will now be locked up as follows: from ground and battery, winding of relays 13 and 14, upper make contact and armature of relay 14, resistance 29′, conductor 59, to junction point 30, and ground, It is pointed out that this locking circuit will not operate marginal relay 13 as it includes a resistance 29′, similar to the aforementioned resistance 29. The operation of relay 14 will close the following circuit: from ground and battery, winding of relay 17, conductor 53, make contact and armature of relay 14, conductor 54, contact and armature of relay 19 to the junction point 30 and thence to ground. This will operate relay 17 which will connect to the tip and ring conductors of the testing circuit a source of 16 cycle ringing current which will then be applied over the contacts of jack J_1 to the bridge, including the relay 3. It is pointed out that in the tip and ring conductors of the testing circuit are included resistance elements such as R in series with said conductors and resistance elements such as R_1 in bridge across said conductors. These resistance elements are so adjusted and arranged that under the above described relay operation the 16 cycle ringing current transmitted to the relay 3 of the composite ringer will be of the correct value under which said relay should operate. Accordingly, the test man, by operating the key K_1, may observe whether the relay 3 is operating when current of the correct value is transmitted thereto. The arrangements of the testing circuit include means whereby the ringing impulse thus sent out to the composite ringer may be regulated to be of a definite duration. These arrangements are as follows. Upon the aforementioned operation of relay 14 the following circuit will be closed: from ground and battery, winding of the stepping magnet 20, conductor 55, armature and contact of relay 19, lower contact and armature of relay 14, conductor 56, interrupter 23 to ground. The closing of this circuit will start the stepping magnet 20 in operation. The stepping magnet 20 controls the rotary switches 21 and 22, and will commence to step these switches ahead in a sequential order. When the switch 21 is started in operation, the circuit for the stepping magnet 20 will now be completed as follows: from ground and battery, winding of magnet 20, through the switch arm and the contacts of switch 21, and over conductor 57 and through the interrupter 23, to ground. When the switch arm of switch 22 reaches an arbitrarily chosen one of its contact points such as the contact point connected to conductor 31, the following circuit will be closed: from ground and battery winding of relay 19, conductor 58, through the switch arm 22, conductor 31, upper make contact and armature of relay 14, resistance 29′, break contact of relay 13, conductor 59 to the junction point 30, and thence to ground. The closing of this circuit will operate the relay 19, which will pull up its armatures and open at its right hand armature and contact the previously traced circuit for the relay 17, thereby deenergizing relay 17, and thus discontinuing the application of 16 cycle ringing current to the composite set. The relay 19, by pulling up its left hand armature will open a previously traced circuit for starting the stepping magnet 20 so that the switch arms 21 and 22 after having been returned to their original positions will not be started in a second cycle of operation. It will be seen that with the rotary switch arrangements above described, that the duration of the application of ringing current to the composite set may be controlled by arbitrarily connecting conductor 31 to different ones of the contacts of the rotary switch. Should the test man desire to rering over the line, this may be ac-

complished by simply operating the key K_5. This will open the previously traced circuit through the relay 24 and deenergize said relay. The deenergization of said relay will remove ground from the conductor leading to junction point 30, and thus open the circuits for all of the relays whose energization depended upon the operation of relay 4. By now closing the key K_5 the relay 24 may again be operated and the sequence of the ringing operation may be repeated.

To give the relay 3 a non-operate test, or in other words, to test said relay to see if it is operating on current of less than the proper value, the key K_2 should be operated. The following circuit is then completed through the relays 13 and 14; from ground, sleeve contacts of jack J_4 and plug P_4, contact of key K_2, tip contacts of plug P_4 and jack J_4, tip conductor of jack J_4 through the windings of relays 14 and 13 to battery and ground. It will be noted that this last mentioned circuit does not include the resistance element 29. Accordingly when the key K_2 is operated the current is of a sufficient value to operate the marginal relay 13 as well as relay 14. The relay 14 will function in the same manner as has previously been pointed out to operate the relay 17, which will apply under the control of the rotary switching apparatus 16 cycle ringing current to the composite ringer. The relay 13, by pulling up its right hand armature and contact will close a short circuit about certain of the resistance elements such as R_1, which are in bridge of the tip and ring conductors of the testing circuit. This decrease in the impedance bridged across the tip and ring conductors will allow less current to be transmitted to the composite ringer. Accordingly, if the relay 3 now operates it will be operated on current of less than the proper value and will need adjustment.

To give the relay 4, which, as has been pointed out, is adjusted to operate with 135 cycle current, an operate test, or in other words, to ascertain if said relay is functioning with the proper amount of current, the key K_3 should be operated. This will close the following circuit: from ground and battery, winding of relay 11, conductor 59, winding of relay 15, ring conductor of jack J_4, ring contacts of jack J_4 and plug P_4, contact of key K_3, resistance 29, sleeve contacts of plug P_4 and jack J_4, to ground. The closing of this circuit will operate relay 15 but as the circuit includes the resistance element 29, relay 11, which is marginal, will not operate at this time. The operation of relay 15 will close the following circuit: from ground and battery, winding of relay 18, conductor 60, contact and armature of relay 15, conductor 54, contact and armature of relay 19, to junction point 30 and thence to ground. This will operate the relay 18 which will connect the tip and ring conductors of the testing circuit to interrupter device 28, whereby 135 cycle ringing current may be applied to the testing circuit and the composite ringer apparatus. The operation of relay 18 through its lower armature and contact will start the interrupter device 28 in operation. The relay 15 will be locked up over its upper armature and contact and over conductor 61, resistance 29″, break contact of relay 11, conductor 62, conductor 59′ to junction point 30 and ground. It is pointed out that this locking circuit includes a resistance element 29″ similar to resistance element 29, so that the marginal relay 11 will not be operated upon the closing of this locking circuit. In a manner similar to the relay 14 the relay 15 will close a circuit over its lower armature and contact to start the rotary switching device into operation. The ringing current will then be applied to the line until the rotary switch 22 reaches the contact point to which the conductor 32 is connected. At this point a circuit will be closed for the relay 19, which, in a manner similar to that already pointed out, will cause the application of ringing current to the composite ringer apparatus to be discontinued. It is pointed out that in the above operations which take place when the key K_3 is operated that the 135 cycle ringing current is applied to the line through the resistance elements R and R_1, and that none of the latter resistance elements are short circuited as relay 11 is not operated. This ringing current is of the proper value to operate the relay 4 of the composite ringer and the test man may now make observations to see if this relay is functioning with the proper amount of current.

To give the relay 4 a non-operate test the key K_4 should be thrown. The operation of key K_4 will close a circuit through relays 11 and 15, which circuit will not include the resistance element 29 and accordingly both the marginal relay 11 and the relay 15 will be operated. The relay 15 will in the same manner as previously pointed out, cause 135 cycle ringing current to be applied to the line for a certain duration. However, the relay 11 will close a short circuit about certain of the resistance elements R_1 in bridge across the tip and ring conductors of the testing circuit. Accordingly this will reduce the impedance in bridge across said conductors and a smaller amount of current will be transmitted to the relay 4 than would normally be transmitted thereto under actual operating conditions. If the relay 4 now operates it will be operating on less than the proper current and will need adjustment.

To subject the relays 3 and 4 to operate and

non-operate tests under what are known as adjustment conditions, which are more severe than the conditions existing under the regular routine test the key K_3 should first be operated. When the key K_6 is operated the following circuit is completed: from ground and battery winding of relay 12, tip conductor of jack J_5, tip contacts of jack J_5 and plug P_5, contact of key K_3, sleeve contacts of plug P_4 and jack J_4, to ground. The closing of this circuit will operate the relay 12. The operation of the relay 12 will close short circuits about a greater number of the resistance elements R_1, thereby materially reducing the impedance bridged across the testing circuit and accordingly the amount of ringing current transmitted to the relays of the composite set will be materially reduced. After the key K_6 has been thus operated, the relays may be tested in the same manner as previously pointed out, by the operation of the keys K_1, K_2, K_3 and K_4.

It is pointed out in all of the above mentioned tests that by operating the key K_7 the relay 25 may be deenergized and the direct current supply for the direct current relays in the composite ringer set my be removed therefrom, so that the alternating current relays may be subjected to tests while entirely dissociated from the direct current relays. Furthermore, by adjusting the potentiometer 26, the ammeter 27 may be utilized to test the operation of the direct current relays in the composite set. By operating key K_9 the current supply through the ammeter 27 to the direct current relays may be varied by the potentiometer 26. In this manner the direct current relays may be subjected to both operate and non-operate tests.

While the invention has been disclosed in certain specific arrangements which have been deemed desirable it is understood that it is capable of embodiment in many other and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A transmission line, a bridge across said line including switching means, composite ringer apparatus including ringing responsive relays associated with said bridge over the contacts of said switching means, a testing apparatus adapted to be associated with said switching means, said testing apparatus comprising a testing circuit including a source of ringing current, a plurality of relays and a variable resistance network, and a control circuit including a plurality of keys and adapted to be associated with said testing circuit, said keys controlling said relay means in said testing circuit and said relay means controlling said variable resistance network and the application of ringing current from said source to said testing circuit whereby the amount of ringing current applied from said testing circuit to said composite ringer apparatus may be varied.

2. A transmission line, a bridge across said line including switching means, composite ringer apparatus including ringing responsive relays associated with said bridge over the contacts of said switching means, a testing apparatus adapted to be associated with said switching means, said testing apparatus comprising a testing circuit including a source of ringing current, a plurality of relays and a variable resistance network, and a control circuit including a plurality of keys and adapted to be associated with said testing circuit, said keys controlling said relay means in said testing circuit and said relay means controlling said variable resistance network and the application of ringing current from said source to said testing circuit whereby the amount of ringing current applied from said testing circuit to said composite ringer apparatus may be varied, and automatically operating means in said testing circuit for controlling the duration of said application of ringing current from said source to said testing circuit.

3. A transmission line, a bridge across said line including switching means, composite ringer apparatus including ringing responsive relays associated with said bridge over the contacts of said switching means, a testing apparatus adapted to be associated with said switching means, said testing apparatus comprising a testing circuit including a source of ringing current, a plurality of relays and a variable resistance network, and a control circuit including a plurality of keys and adapted to be associated with said testing circuit, said keys controlling said relay means in said testing circuit and said relay means controlling said variable resistance network and the application of ringing current from said source to said testing circuit whereby the amount of ringing current applied from said testing circuit to said composite ringer apparatus may be varied, automatically operating means in said testing circuit controlling the duration of said application of ringing current to said testing circuit, and means in said testing circuit controlled by an additional key in said control circuit for restoring the apparatus of said testing circuit to normal.

4. A transmission line, a bridge across said line including switching means, composite ringer apparatus including ringing responsive relays associated with said bridge over the contacts of said switching means, and testing apparatus adapted to be associated with said switching means,

said testing apparatus comprising a testing circuit including a plurality of sources of ringing current, a plurality of relays, and a variable resistance network, and a control circuit including a plurality of keys and adapted to be associated with said testing circuit, said keys controlling said relay means in said testing circuit and said relay means controlling said variable resistance network and the application of ringing current from said sources to said testing circuit whereby the amounts of ringing current applied from said testing circuit to said composite ringer apparatus may be varied.

5. A transmission line, a bridge across said line including switching means, composite ringer apparatus including alternating ringing responsive relays and direct current relays associated with said bridge over the contacts of said switching means, a testing apparatus adapted to be associated with said switching means, said testing apparatus comprising a testing circuit including a source of alternating ringing current, a plurality of relays and a variable resistance network, and a control circuit including a plurality of keys and adapted to be associated with said testing circuit, said keys controlling said relay means in said testing circuit and said relay means controlling said variable resistance network and the application of alternating ringing current from said source to said testing circuit whereby the current applied from said testing circuit to said alternating ringing responsive relays in said composite apparatus may be varied, and a source of direct current and a second variable resistance element in said testing apparatus for testing the operation of said direct current relays in said composite ringer apparatus.

In testimony whereof we have signed our names to this specification this 30th day of December, 1920.

JOHN F. TOOMEY.
WILLIAM H. HARRISON.