

J. F. TOOMEY.

TESTING AND ADJUSTING APPARATUS FOR CORD CIRCUITS.

APPLICATION FILED MAR. 9, 1920.

1,428,667.

Patented Sept. 12, 1922.

2 SHEETS—SHEET 1.

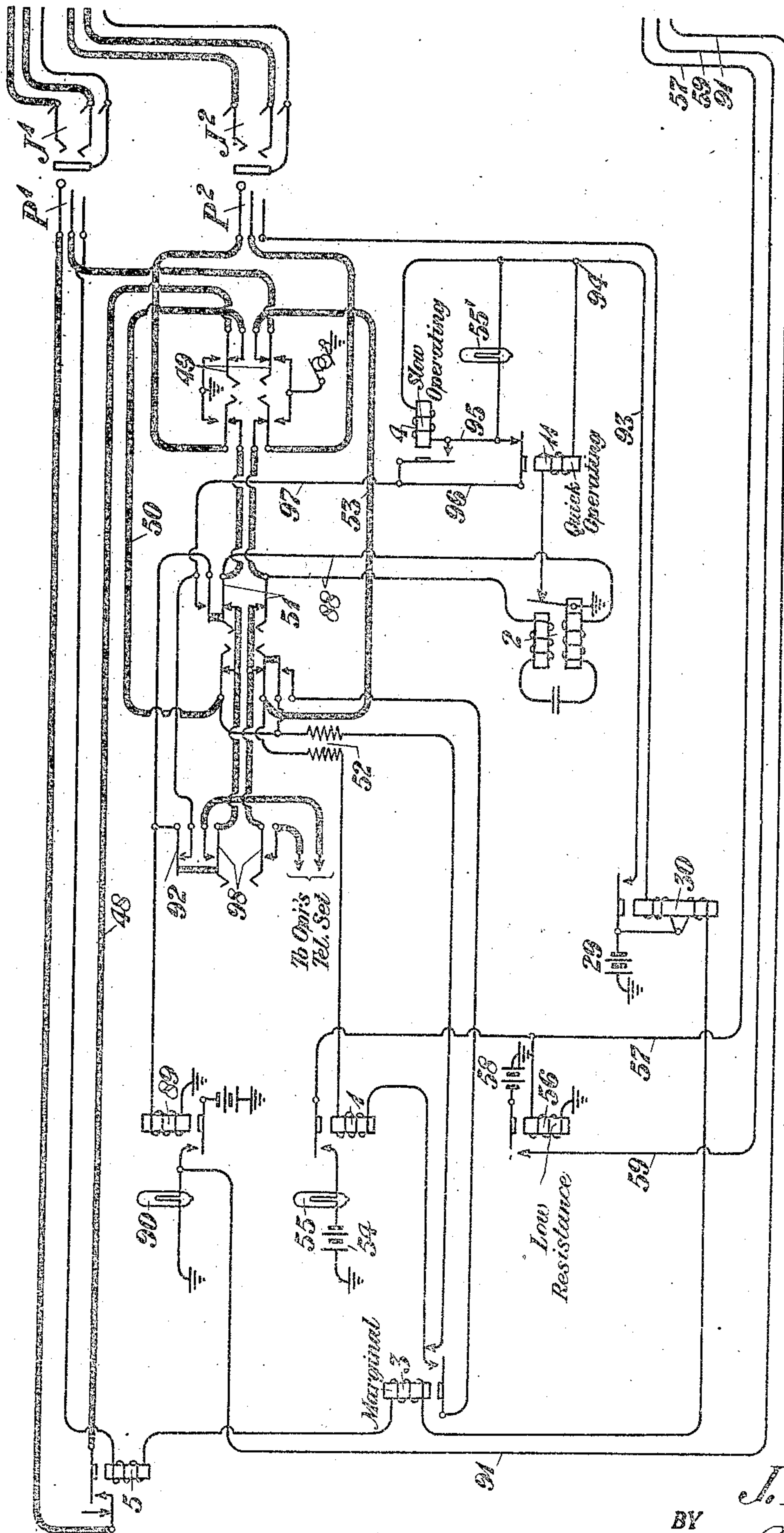


Fig. 1

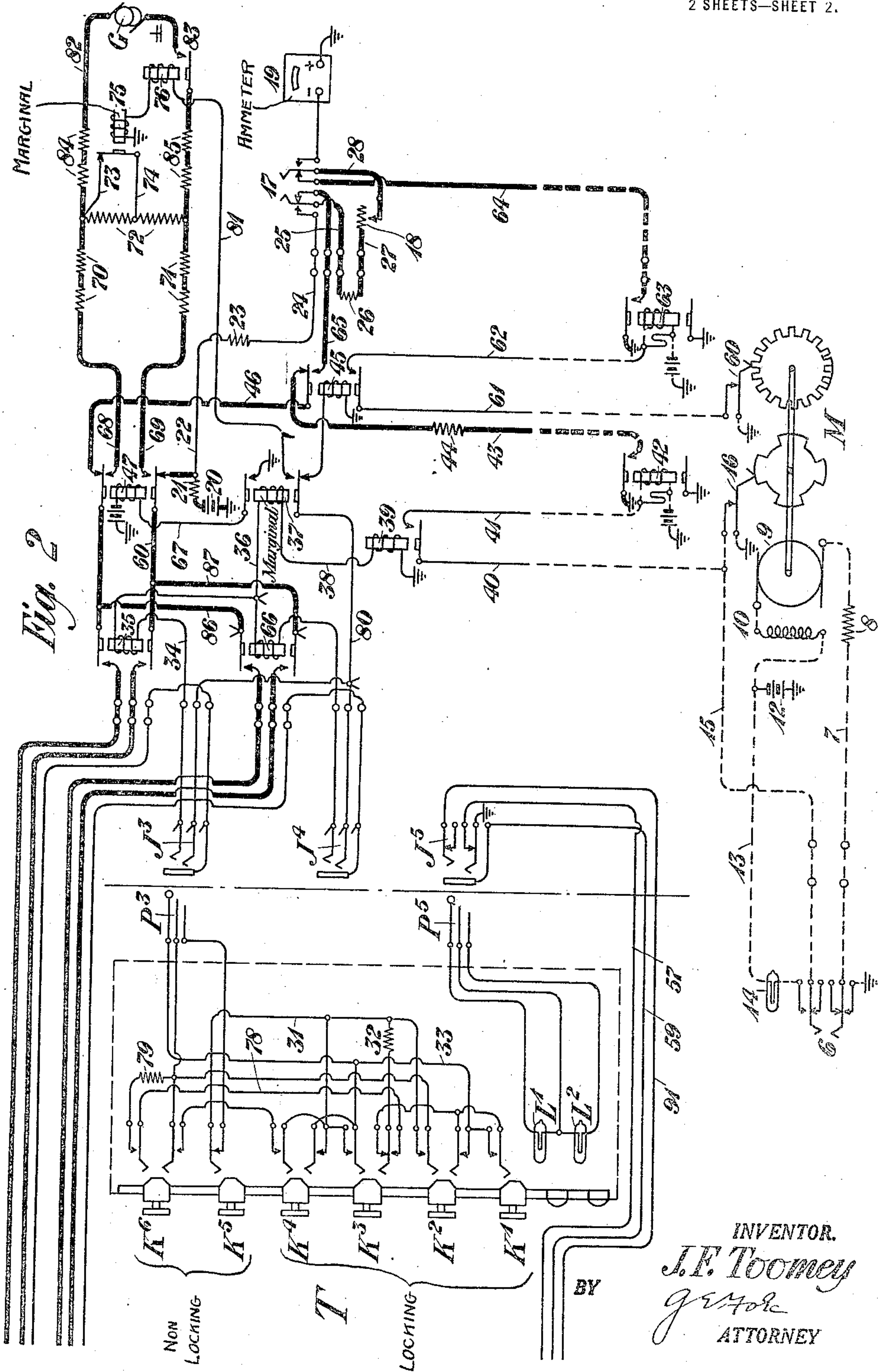
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UNITED STATES PATENT OFFICE.

JOHN F. TOOMEY, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TESTING AND ADJUSTING APPARATUS FOR CORD CIRCUITS.

Application filed March 9, 1920. Serial No. 364,397.

To all whom it may concern:

Be it known that I, JOHN F. TOOMEY, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Testing and Adjusting Apparatus for Cord Circuits, of which the following is a specification.

This invention relates to testing apparatus, and more particularly to equipment for testing and adjusting the various apparatus associated with a telephone cord circuit.

One of the principal objects of this invention consists in providing testing equipment which, when connected to a cord circuit, affords means to determine whether the supervisory relays associated with the cord circuit function properly under conditions which are either approximately the same or are more severe than those experienced in actual service.

Another object consists in providing adjusting equipment whereby the adjusting of the supervisory relays to meet the desired operating conditions may be done in an efficient manner.

Other and further objects of the invention will appear from the following description taken in connection with the accompanying drawings, Figures 1 and 2 of which, when arranged with Fig. 2 to the right of Fig. 1, embody a circuit diagram of the testing and adjusting features of the invention.

Fig. 1 illustrates a circuit diagram of a standard toll cord circuit terminating in the usual front and back plugs P^1 and P^2 , which are adapted for insertion into the usual line jacks (not shown) that are installed in a switchboard. A direct current supervisory relay 1, and an alternating current supervisory relay 2 are associated with said cord circuit, whereby the said cord circuit may be used to establish a supervised connection either between two long distance toll lines or between a long distance toll line and a toll switching trunk line or other similar trunks. If two long distance toll lines are connected by inserting plugs P^1 and P^2 into two line jacks (not shown) in which the said toll lines terminate at a switch-

board, the alternating current relay 2 may be energized by alternating current which may be transmitted over each or either of said toll lines. The circuit containing the direct current supervisory relay 1, which is normally bridged across the said cord circuit, is opened by the operation of marginal relay 3 when the cord circuit is used to establish a connection between two long distance toll lines, whereby the loss in transmission due to such bridged relay is prevented. If, however, a long distance toll line is connected by said cord circuit to a toll switching line, over which direct current is transmitted for supervisory purposes, the alternating current relay 2 may be energized by the alternating ringing current transmitted over the long distance toll line, and the direct current supervisory relay 1 may be energized by the direct current transmitted over the toll switching trunk line.

In addition to the usual line jacks special jacks J^1 and J^2 are multiplied at each switchboard section in order that the toll cord circuits located in each switchboard section may be connected with the testing or adjusting circuit shown in Fig. 2.

Jacks J^3 and J^4 , shown in Fig. 2 and hereinafter designated as control jacks, are connected to jacks J^1 and J^2 , and are preferably mounted in the rear of the switchboard sections wherein jacks J^1 and J^2 appear. In order that the testing or adjusting circuit may be controlled from the point at which the supervisory relays of the cord circuit to be tested are located, a portable test set T is provided, the plug P^3 of which may be inserted in the control jacks J^3 or J^4 , and the plug P^5 of which may be inserted into lamp jack J^5 of the auxiliary circuit which is associated with the cord circuit. In order to test the supervisory relays of the cord, either of the plugs of the toll cord with which said relays are associated may be inserted in either of the jacks J^1 and J^2 at the switchboard, and plug P^3 inserted in either of the control jacks J^3 and J^4 , respectively, and the plug P^5 inserted in jack J^5 . Then by manipulating the keys of the portable

test set T, the operation of the supervisory relays may be observed and suitable adjustments may be made if said relays are not functioning properly.

5 The portable test set T comprises keys K^1 , K^2 , K^3 , K^4 , K^5 and K^6 . Keys K^1 , K^2 , K^3 and K^4 are preferably of the locking type and the two first mentioned keys are adapted to control the adjustment of the direct current supervisory relays of a cord circuit. Keys K^5 and K^6 are preferably of the non-locking type and together with the keys K^3 and K^4 are adapted to control the alternating current supervisory relay of a cord circuit. Associated with the portable set T are the signals L^1 and L^2 which are used for indicating the action of the relays under adjustment.

20 Having described generally the circuits and apparatus shown in the drawings embodied in Figs. 1 and 2, the invention may now be made clear from the following description of its operation.

When it is desired to adjust the apparatus of the cord circuit shown in Fig. 1, the key 6 of Fig. 2 is operated, and completes the following circuit: from ground, lower contact of said key, conductor 7, resistance 8, through armature 9, field winding 10 of motor interrupter M to battery 12. The depression of key 6 also closes the following circuit: from battery 12, conductor 13, lamp 14, upper contact of key 6, conductor 15, spring 16 to ground. The closing of the first-mentioned circuit by the depression of key 6, causes the motor interrupter apparatus M to be set in motion, and the closing of the second mentioned circuit provides for the intermittent lighting of lamp 14 which indicates whether or not the interrupter is working properly, and serves as a guard signal in case said interrupter is left running when the circuit is not in use.

Key 17 is now depressed for the purpose of providing a circuit through rheostat 18, whereby the ammeter 19 may be adjusted to the proper current value of an actual line over the following circuit: from grounded battery 20, resistance 21, conductor 22, resistance 23, conductor 24, lefthand outer contact of key 17, conductor 25, resistance 26, conductor 27, rheostat 18, conductor 28, outer righthand contact of key 17, through ammeter 19 to ground. By now adjusting rheostat 18 the current flow over the above traced circuit, which will be indicated by ammeter 19, may be regulated as desired. The circuit is now in condition for testing the apparatus of a cord circuit.

60 *Testing direct current supervisory relay.*

Assuming that it is desired to make a test to determine whether the direct current supervisory relay 1 functions properly, the plug P^1 is inserted in the jack J^1 ; plug P^3

of portable test set T is inserted in the control jack J^3 and plug P^5 is inserted in jack J^5 . The key K^1 of said test set is now depressed, whereupon the following circuit is closed: from grounded battery 29 of the cord circuit, winding of relay 30, marginal relay 3 and relay 5, sleeve conductor of said cord, sleeve contacts of plug P^1 and jack J^1 , sleeve contacts of jack J^3 and plug P^3 , closed contact of key K^5 of test set T, conductor 31, resistance 32, closed contact of key K^3 , contact of key K^1 , conductor 33, tip contacts of plug P^3 and jack J^3 , conductor 34, winding of relay 35, conductor 36, winding of marginal relay 37, conductor 38, winding of relay 39 to ground. This circuit will cause the operation of relays 30, 5, 35 and 39. The operation of relay 30 closes a circuit from battery 29 over its armature and contact which will be described later. The operation of relay 39 will complete an intermittent circuit from ground through spring 16 of motor interrupter M, conductor 40, armature and contact of relay 39, conductor 41, winding of relay 42 to battery. The relay 42 will be operated intermittently by this circuit, and each time it operates will close a circuit from ground through its upper armature and contact over conductor 43, resistance 44, upper back contact and armature of relay 45, conductor 46, upper back contact of relay 47, closed armature and contact of relay 35, through tip contacts of jack J^1 and plug P^1 , closed contact and armature of relay 5, conductor 48, contact of key 49, conductor 50, through one side of coil 52, contact of marginal relay 3, winding of supervisory relay 1, out through the other side of coil 52, conductor 53, lower right hand contact of key 49, ring contacts of plug P^1 and jack J^1 , lower contact and armature of relay 35, conductor 60, lower armature and back contact of relay 47, resistance 21 to grounded battery 20. This circuit will provide for the intermittent energization of supervisory relay 1. This circuit is of relatively low resistance and the current flow thereover is sufficient to saturate relay 1. The operation of said relay will indicate that it is properly adjusted to meet this condition and that its armature will not stick up under any of the conditions that it is likely to undergo in service. The relay 1 will attract its armature intermittently, and close the following circuit: from grounded battery 54 in the cord circuit, filament of lamp 55, contact and armature of relay 1, winding of relay 56 to ground. Relay 56 is energized by this circuit and closes a circuit through its contact from battery 58, conductor 59, sleeve contacts of jack J^5 and plug P^5 , filament of lamp L^2 , ring contacts of plug P^5 and jack J^5 to ground. This circuit will cause lamp L^2 to light. Thus each time the supervisory re-

lay 1 operates and lights the supervisory lamp 55, the indicating lamp L^2 will also be lighted. The flashing of lamp L^2 at the proper intervals will indicate that the direct current relay 1 will operate properly under the condition described.

The plug P^1 is left inserted in the jack J^1 and key K^2 of the portable test set T may now be depressed to provide for the minimum current condition and the fast operation of direct supervisory relay 1. When the key K^2 is depressed a current path similar to that outlined in connection with the key K^1 will be provided, but instead of traversing the key K^1 , as previously described, it passes through the lower make contact of key K^2 and causes the apparatus contained in said circuit to function as described above. An additional current path is also provided, which is similar to the previously described path, to the resistance 32, from which it continues as follows: from conductor 31 of the test set T to the upper contact of key K^2 , ring contacts of plug P^3 and jack J^3 , conductor 80, lower armature and contact of relay 37, winding of relay 45, to ground. The second mentioned circuit will cause the relay 45 to operate, and thereby close a circuit from ground, through spring 60 of the interrupter M, conductor 61, lower contact and armature of relay 45, conductor 62, winding of relay 63 to grounded battery. An intermittent circuit will thus be provided by the interrupter, which opens and closes the armature of relay 63, and said armature upon opening and closing provides an intermittent current path from its upper grounded armature by way of conductor 64, right hand normal contact of key 17, conductor 28, rheostat 18, conductor 27, resistance 26, conductor 25, left hand normal contact of key 17, conductor 65, upper make contact and armature of relay 45, conductor 46, upper back contact and armature of relay 47, armature and closed contact of relay 35, through the tip contacts of jack J^1 and plug P^1 , and thence over the circuit through relay 1 previously described. As formerly pointed out, the rheostat 18 may be adjusted by operating key 17 so that the above described testing circuit may have characteristics similar to those of an actual line.

Thus it will be apparent from the above descriptions that current may be applied intermittently to the direct current relay over a circuit of relatively low resistance and the relay saturated in order that tests may be made to insure that the armature of said relay will not stick up. Current may also be intermittently applied to the direct current relay over a circuit of relatively higher resistance, such as the resistance of an actual line, and the relay may thus be tested with an operating current such as would be met

with under actual conditions. The intermittent application of current to these two testing circuits may be done at different speeds and the slow flash or fast flash of the signal lamp L^2 will thus indicate which test is being made. If the direct current supervisory relay operates satisfactorily under these two tests, it may be considered properly adjusted.

Adjustment of alternating current supervisory relay.

For the adjustment of the alternating current supervisory relay 2, plug P^2 may be connected with jack J^2 and plug P^3 associated with jack J^4 . The key K^3 is now operated so as to restore any of the keys which may have been locked down during the previous testing. The depression of key K^3 also closes a circuit from grounded battery 29, upper winding of relay 30, sleeve conductor of the toll cord and sleeve contacts of plug P^2 and jack J^2 , sleeve contacts of jack J^4 and plug P^3 , closed contact of key K^5 , conductor 31, upper contact of key K^3 , conductor 33, tip contacts of plug P^3 and jack J^4 , winding of relay 66, winding of marginal relay 37, conductor 38, winding of relay 39 to ground. This circuit will cause relays 30, 66, 37 and 39 to operate. Relay 37 upon operating will close a circuit from ground, over its upper contact and armature, conductor 67, winding of relay 47, to grounded battery; and the closing of this circuit will energize relay 47. The energization of relay 47 will close a circuit over its front contacts and armatures, over conductors 68 and 69, resistances 70, 71, 72, 84 and 85 including the back contact and armature of relay 75. It will be obvious from the foregoing description that the operation of relay 47 has resulted in the connection of the alternating current equipment of the adjusting circuit to the cord circuit instead of the direct current equipment previously described.

The key K^6 is now depressed and the following high resistance circuit closed: from battery 29, winding of relay 30, sleeve conductor of toll cord, sleeve contacts of plug P^2 and jack J^2 , sleeve conductors of jack J^4 and plug P^3 , closed contact of key K^5 , conductor 31, resistance 32, lower make contact of key K^3 , conductor 78, upper make contact of key K^6 , resistance 79, ring contacts of plug P^3 and jack J^4 , conductor 80, lower armature and front contact of marginal relay 37, which had been operated as previously outlined, conductor 81, through windings of relays 76 and 75, to ground. This circuit does not operate marginal relay 75, but relay 76 will operate at this time and attract its armatures. The energization of relay 76 will also provide a high resistance circuit for ringing current from source G, over conductors 82 and 83, resistances 84, 85,

70 and 71, conductors 68 and 69, front contacts and armatures of relay 47, conductors 86 and 87, contacts and armatures of relay 66, tip and ring contacts of jack J^2 and plug P^2 through contacts of key 49 of the toll cord and over conductors 88 to windings of the alternating current supervisory relay 2. The relay 2 should not be operated by this current, since part of the bridged resistance 72 in the ringing circuit is short circuited by the contact of relay 75, and relay 2 receives its non-operative current value. Should, however, the lamp L^1 of test set T light at this time, such indication will show that the relay 2 did operate, and is therefore not working properly. In that case the key K^5 of the test set should be depressed, and relay 2 should be adjusted, after which the operation previously described may be repeated until said relay functions properly.

The key K^4 should be depressed next and then K^6 should be operated. The depression of key K^4 releases key K^3 which was previously operated and completes a circuit through the windings of relays 66, 37 and 39 as formerly outlined, thus connecting alternating current generator G of the adjusting circuit to the toll cord. The depression of key K^6 will close a circuit from grounded battery 29 in the toll cord, winding of relay 30, sleeve contacts of plug P^2 and jack J^2 , sleeve contacts of jack J^4 and plug P^3 , contact of key K^5 , lower and upper contacts of key K^4 , lower contact of key K^6 , ring contacts of plug P^3 and jack J^4 , conductor 80, lower armature and make contact of relay 37, conductor 81, windings of relays 76 and 75 to ground. This circuit is of lower resistance than the previously traced circuit, as the resistances 32 and 79 are not included therein, and will accordingly provide sufficient current for the energization of relays 75 and 76. The operation of marginal relay 75 will cause its armature to be attracted, removing the shunt normally closed about the upper part of bridged impedance 72, thereby increasing the impedance bridged across conductors 82 and 83. The increased impedance bridged across conductors 82 and 83 will decrease the current drain through the bridged impedance 72, and therefore permit sufficient current to flow over the previously traced circuit from the generator G to relay 2, and the current now transmitted to said relay from generator G will be equal to the operating current used under actual conditions and said relay should be energized. If the relay 2 responds to this current it is properly adjusted, and upon operating will open the following circuit which had previously been closed by the operation of relay 30. From grounded battery 29, contact of relay 30, conductor 93 to point 94, winding of relay 11, contact of relay 2 to ground. Upon the breaking of

this circuit a new circuit is closed on the release of relay 11, from battery 29 contact 30 conductor 93, point 94, through lamp 55' and relay 4 in parallel to the contact and armature of relay 11, over conductor 96 to contact 92 of key 98, winding of relay 89, to ground. This circuit energizes relay 4 which locks up and shunts the contact of relay 11 and thus makes the circuit just traced independent of said contact. The relay 89 will also be energized by this circuit and will close a circuit through its contact from battery, filament of lamp 90 to ground, thereby lighting said lamp. The operation of relay 89 will also close a circuit from battery, through its armature and contact, conductor 91 tip conductors of jack J^5 and plug P^5 , filament of lamp L^1 , ring contacts of said plug and jack to ground and thereby provide for the lighting of lamp L^1 of test set T. Thus the operation of relay 89 will cause the lamps 90 and L^1 to act in unison with each other. The lighting of lamp L^1 of test set T under the above described tests will indicate that relay 2 is properly adjusted for actual service conditions. The operation of key K^5 at this time will cause the circuits previously traced to resume their normal condition.

It should be understood that the resistances used in the interrupter circuit and in the alternating circuit may be of such value or values that the current which flows through the circuit will be either the same as or somewhat less than the minimum, or somewhat greater than the maximum current that flows under actual service conditions.

It will now be clear that by this invention a simple, convenient and efficient arrangement of circuits has been devised whereby any toll cord may be plugged into a convenient adjusting jack and the functioning of the various apparatus associated with the said cord circuit may be determined by manipulating the keys associated with the test set. If any apparatus is found defective on such test, the cord with which the defective apparatus is associated may be controlled by the test set from a point adjacent to such apparatus and thereby the defective apparatus may be adjusted in a convenient and efficient manner.

While the invention has been disclosed as embodied in certain specific organizations and arrangements, it is to be understood that its embodiment may be varied without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. A testing system comprising an operator's cord circuit, electromechanisms included in said circuit operable by current of different characteristics, an auxiliary circuit associated with said electromechanisms, a test-

ing circuit adapted to be associated with said cord circuit, a portable test set adapted to be associated with said testing circuit and said auxiliary circuit, switching means in said set for controlling the application of current to said electromechanisms, and signaling means in said set operable when associated with said auxiliary circuit for indicating the action of said electromechanisms upon the application of current thereto.

2. A testing system comprising an operator's cord circuit having a direct current relay and an alternating current relay, an auxiliary circuit associated with said relays, a testing circuit adapted to be associated with said cord circuit, means simulating normal direct and alternating current operating conditions associated with said testing circuit, a portable test set adapted to be associated with said testing circuit and said auxiliary circuit, switching means in said portable testing set for selectively subjecting said relays to normal direct or alternating current operating conditions, and signaling means in said test set operable when associated with said auxiliary circuit for indicating the action of said relays when so subjected.

3. A testing system comprising an operator's cord circuit having a direct current relay and an alternating current relay, an auxiliary circuit associated with said relays, a testing circuit adapted to be associated with said cord circuit, means simulating normal direct and alternating current operating conditions associated with said testing circuit, a portable test set adapted to be associated with said testing circuit and said auxiliary circuit, switching means in said portable test set for selectively subjecting said relays to normal direct or alternating current operating conditions and signaling means in said test set operable when associated with said auxiliary circuit for indicating the operation of said relays when so subjected.

4. A testing system comprising a cord circuit having a direct current relay and an alternating current relay, an auxiliary circuit associated with said relays, a testing circuit adapted to be associated with the cord circuit, an interrupter in said testing circuit having a member of slow operating frequency and a member of relatively fast operating frequency, resistance elements simulating normal operating characteristics associated with the fast operating member adapted to be associated with the direct current relay, an artificial line simulating normal operating characteristics adapted to be associated with the alternating current relay, a test set, means for associating the test set with the testing circuit and auxiliary circuit, switching means in said test set for selec-

tively associating the direct current relay and alternating current relay with the direct current and alternating current equipment of the testing circuit, and signaling means in said test set for indicating the operations of said relays when so associated.

5. A testing system comprising a cord circuit having a direct current relay and an alternating current relay, an auxiliary circuit associated with said relays, a testing circuit adapted to be associated with the cord circuit, control jacks associated with the testing circuit, relays associated with the tip conductors of said control jacks for associating said direct current and alternating current relays with the testing circuit, a marginal relay connected in series with the first mentioned relay, a plurality of relays associated with said marginal relay for controlling the connection of the direct current equipment with the direct current relay, a relay controlled by said marginal relay for associating the alternating current equipment with the alternating current relay, a portable test set adapted to be associated with the control jacks of the testing circuit and said auxiliary circuit, switching means in said test set for selectively associating the direct current relay and alternating current relay with the direct current and alternating current equipment in the testing circuit, and signaling means in said test set for indicating the operation of the direct and alternating current relays.

6. A testing system comprising a cord circuit having a direct current relay and an alternating current relay, an auxiliary circuit associated with said relays, a testing circuit adapted to be associated with the cord circuit control jacks associated with the testing circuit, direct current equipment simulating actual service conditions associated with the testing circuit, an interrupter in said equipment having a member of slow operating frequency associated with a low resistance circuit and a member of relatively fast operating frequency associated with a high resistance circuit, alternating current equipment simulating actual service conditions associated with the testing circuit, a portable test set adapted to be associated with the control jacks of the testing circuit and said auxiliary circuit, switching means in said set, a pair of relays associated with the slow operating member operable by certain of said switching means for subjecting the direct current relay to a test simulating a low resistance circuit under actual service conditions, a second pair of relays associated with the fast operating member operable by other of said switching means for subjecting the direct current relay to a test simulating a relatively high resistance circuit under actual service conditions, a marginal relay in the testing circuit

associated with the tip conductor of said control jacks of said test set, means controlled by said marginal relay for subjecting the alternating current relay to test
5 simulating actual service operating conditions, and signaling means in said test set for indicating the operation of the direct

and alternating current relays when so subjected.

In testimony whereof, I have signed my name to this specification this 8th day of March, 1920.

JOHN F. TOOMEY.