J. F. TOOMEY.

TESTING AND ADJUSTING APPARATUS FOR CORD CIRCUITS.

APPLICATION FILED SEPT. 1, 1917.

1,360,331.

Patented Nov. 30, 1920.

2 SHEETS—SHEET 1.

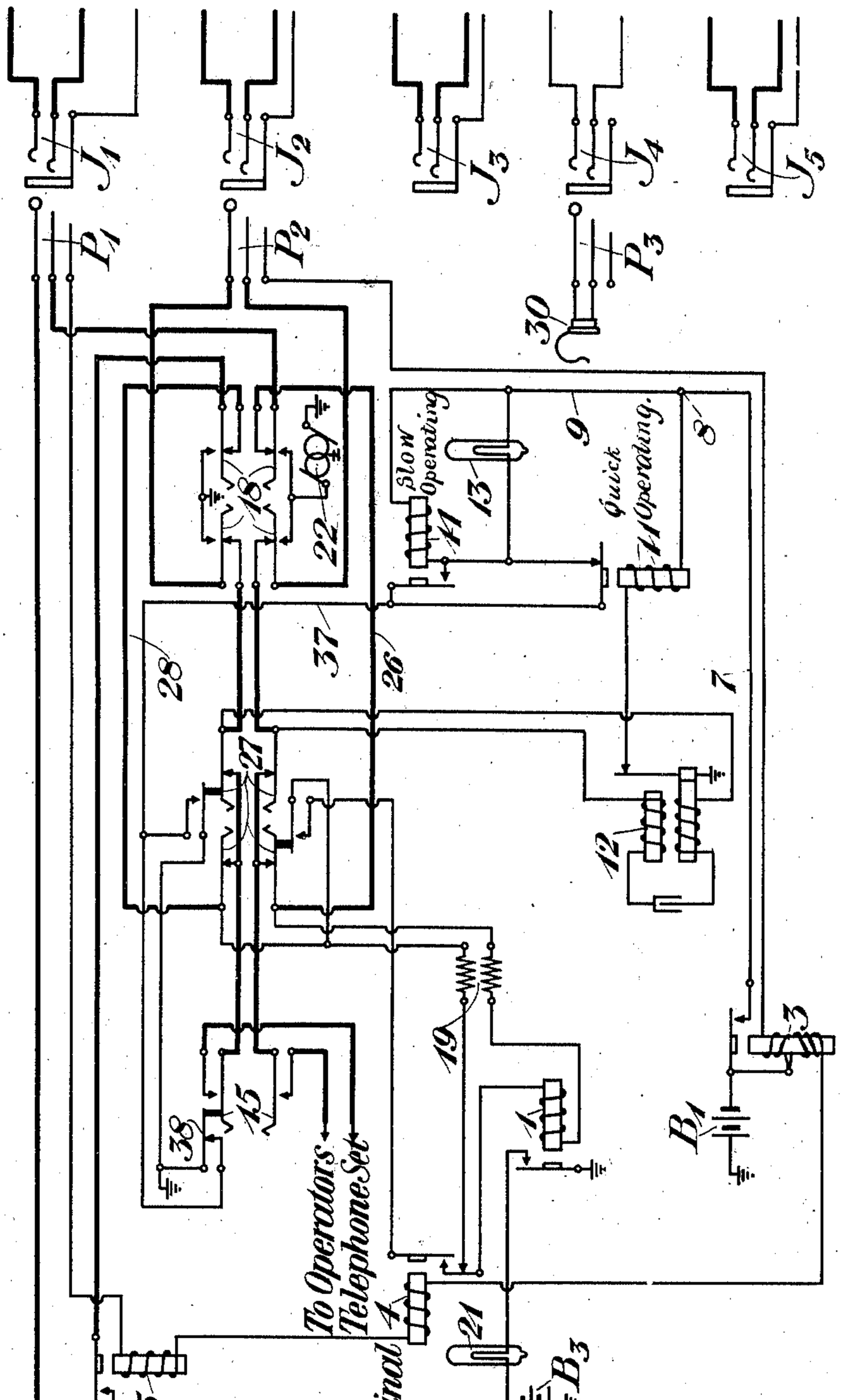

Fig. 1

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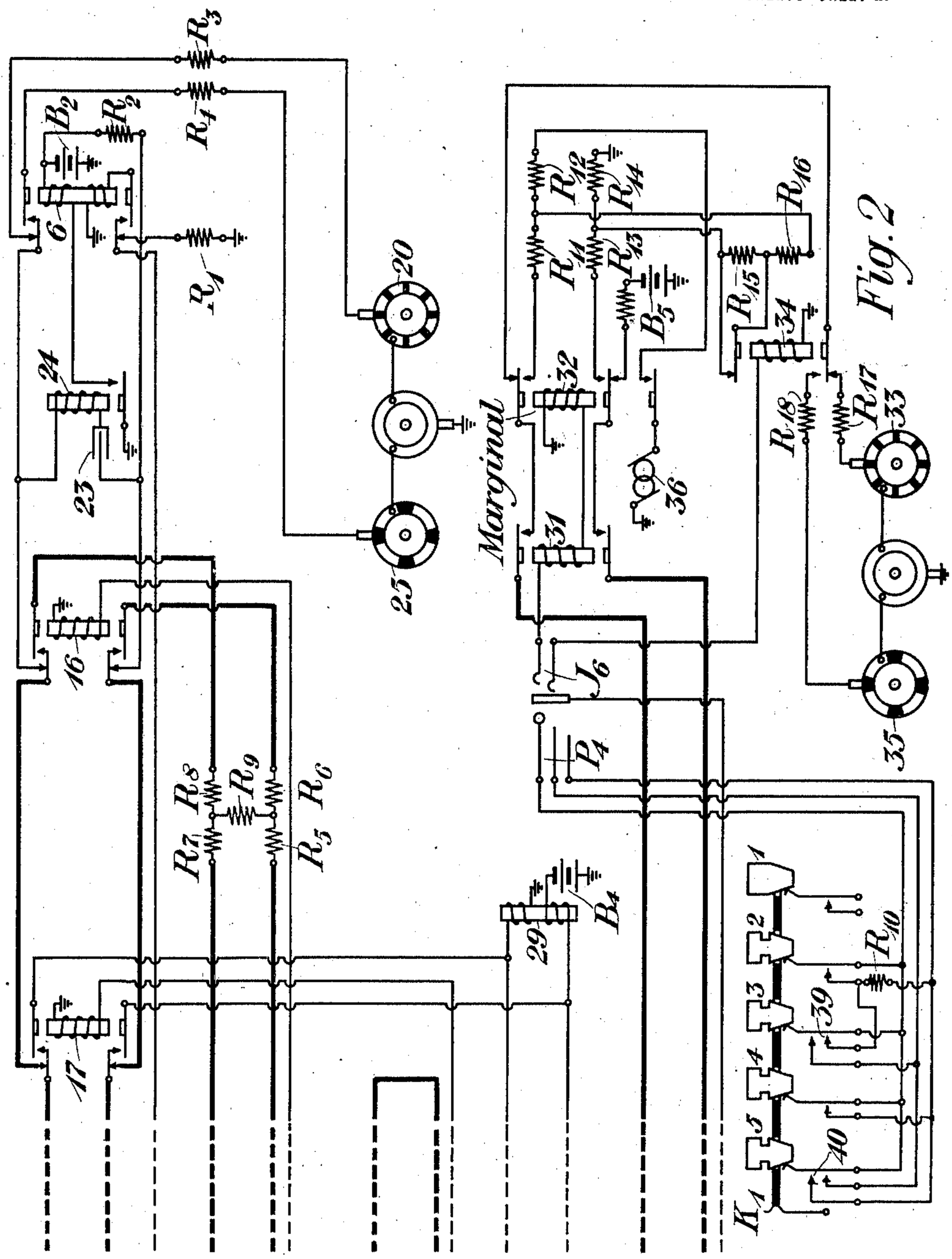

Fig. 2

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UNITED STATES PATENT OFFICE.

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TESTING AND ADJUSTING APPARATUS FOR CORD-CIRCUITS.

1,360,331. Specification of Letters Patent. Patented Nov. 30, 1920.

Application filed September 1, 1917. Serial No. 189,332.

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 cord circuit.

The principal objects of this invention are:

To provide testing equipment which, when connected to a cord circuit, affords means to determine whether the supervisory relays associated with said cord circuit function properly under conditions which are either approximately the same as or are more severe than those experienced in actual service; also, to determine whether the ringing key associated with the said cord circuit operates properly.

To provide adjusting equipment whereby the adjusting of the supervisory relays to meet the desired operating conditions may be done in an efficient manner.

To provide testing equipment by means of which any circuit troubles such as an open circuit or a short circuit in the conductors in the cords may be detected.

Other and further objects of the invention will appear from the following description taken in connection with the accompanying drawing, 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 this invention.

Fig. 1 illustrates a circuit diagram of a standard toll cord circuit, terminating in the usual back and front plugs, P_1 and P_2, respectively, which are adapted for insertion into the usual line jacks (not shown) that are installed in a switch-board. A direct current supervisory relay 1, and an alternating current supervisory relay 12 are associated with the said cord circuit, whereby the said 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. 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 switchboard, the alternating current relay 12 may be energized by the alternating ringing current which may be transmitted over each 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 4 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 trunk line, over which direct current is transmitted for supervisory purposes, the alternating current relay 12 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, J_2 and J_3 are multipled at each switchboard section, in order that the toll cord circuits located in each switchboard section may be variously connected with the testing circuit shown at the top of Fig. 2. An additional jack J_4 is also multipled at each switchboard section for the purpose of connecting with the testing circuit a suitable indicating instrument 30.

Jack J_5 is also multipled at each section of the switchboard for the purpose of connecting to the adjusting circuit shown at the bottom of Fig. 2, any cord circuit, such as that shown on Fig. 1, the supervisory relays of which need adjustment. Jack J_6, shown on Fig. 2 and hereinafter designated the control jack, is located at some point convenient to the supervisory relays associated with the said cord circuit, it being understood that in practice the said relays may be located at some point distant from the switchboard. In order that the adjusting circuit may be controlled from the point at which the said relays are located, a key set K_1 is provided, the plug P_4 of which may be inserted in the control jack J_6 which is located near the supervisory relays. If a supervisory relay proves defective on test.

the plug of the toll cord with which said relay is associated may be inserted in jack J_5 at the switchboard, and plug P_4 inserted in control jack J_6. Then, by manipulating the keys of key set K_1, the operation of the defective supervisory relay may be observed and suitable adjustments may be made so that the said relay will function properly.

Key set K_1 comprises five keys, 1, 2, 3, 4 and 5, key 1 being non-locking, and keys 2, 3, 4 and 5 being of a well-known locking type whereby any key when fully depressed becomes locked and restores to its non-operative position any key that has been previously locked. Key 1 controls no circuits, its sole function being to restore to its non-operative position any key that may be locked, whereas the other keys control contacts whereby the various circuits of the testing and adjusting apparatus are controlled.

Having described generally the circuits and the apparatus shown on the drawing embodied in Figs. 1 and 2, the invention may be made clear by describing the operation of the said circuits and apparatus.

Testing direct current supervisory relay.

Assuming that it is desired to make a test in order to determine whether the direct current supervisory relay 1 functions properly, which is one of the principal objects of this invention, plug P_1 is inserted in jack J_1 whereby a circuit is closed from ground through battery B_1, relay 3, marginal relay 4, relay 5, sleeve contacts of plug P_1 and jack J_1, lower back contact of relay 6, through resistance R_1 to ground. Relay 3 and relay 5 are thereby energized. Relay 3 closes a circuit from ground, through battery B_1, upper front contact of relay 3, conductor 7 to point 8 where the circuit divides, part of the current flowing through relay 11, right hand back contact of relay 12 to ground; the remainder of the current flowing through conductor 9, thence through lamp 13 and winding of relay 14 in parallel, through upper back contact of relay 11, conductor 37, contact 38 of key 15 to ground until relay 11 is sufficiently energized to open the latter circuit through its upper contact. Due to the fact that relay 11 is of a quick-operating type, and relay 14 is of a slow operating type, sufficient current does not flow through lamp 13 and the winding of relay 14, prior to the opening of the circuit containing them at the contact of relay 11, to light the lamp 13 or to energize and lock up relay 14.

Relay 5 at its upper front contact closes a circuit from ground, battery B_2, resistance R_2, lower back contacts in series of relays 16 and 17, ring contacts of jack J_1 and plug P_1, right hand lower back contact of key 18, conductor 26, lower winding of retardation coil 19, relay 1, back contact of marginal relay 4, upper winding of retardation coil 19, conductor 28, right hand upper back contact of key 18, upper front contact of relay 5, tip contacts of plug P_1 and jack J_1, upper back contacts in series of relays 17 and 16, upper back contact of relay 6, resistance R_3, through interrupter 20 to ground. Relay 1 will be energized, and if properly adjusted, it will close a circuit from ground through battery B_3, lamp 21, contact of relay 1 to ground, causing the lamp 21 to glow. When said interrupter opens the circuit, relay 1 is deënergized, which results in the opening of the circuit through its contact, and the lamp 21 is extinguished. The resistance R_3 is of such value and the interrupter 20 is so designed as to permit the flow of the minimum current through relay 1, and the maximum rate of flashing of the lamp 21 that will occur under actual operating conditions. If lamp 21 flashes properly, relay 1 may be considered satisfactorily adjusted for the conditions described.

In order to test the operation of the direct current supervisory relay 1 under the condition of maximum current and minimum rate of flashing of the lamp 21, plug P_1 is left inserted in jack J_1 and the key 18 is operated so as to apply ringing current over the right hand springs to the testing circuit, whereby a circuit is closed from ground, ringing generator 22, right hand lower front contact of key 18, ring contact of plug P_1 and jack J_1, lower back contacts in series of relays 17 and 16, through condenser 23, relay 24, upper back contacts in series of relays 16 and 17, tip contacts of jack J_1 and plug P_1, upper front contact of relay 5, right hand upper front contact of key 18 to ground, which will energize relay 24, thereby closing a circuit from ground, contact of relay 24, upper winding of relay 6, battery B_2 to ground. After applying ringing current as described above, key 18 is restored to its normal position. Relay 6 is energized, closing through its lower front contact a locking circuit from ground, battery B_1, lower winding of relay 3, relay 4, relay 5, sleeve contacts of plug P_1 and jack J_1, lower front contact of relay 6, lower winding of relay 6 to ground, which locks relay 6. Through the upper front contact of relay 6, a circuit is closed from ground, interrupter 25, resistance R_4, upper front contact of relay 6, upper back contacts in series of relays 16 and 17, tip contacts of jack J_1 and plug P_1, front contact of relay 5, right hand upper back contact of key 18, conductor 28, upper winding of retardation coil 19, back contact of relay 4, winding of relay 1, lower winding of retardation coil 19, conductor 26, right hand lower back contact of key 18, ring contacts of plug P_1 and

jack J_1, lower back contacts in series of relays 17 and 16, resistance R_2, battery B_2 to ground. If the relay 1 is properly adjusted, it will close a circuit from ground, battery B_3, lamp 21, contact of relay 1 to ground, causing the lamp to glow. When the interrupter 25 opens said circuit, relay 1 should be de-energized, thereby opening the circuit through its contact, so that lamp 21 is extinguished. Resistance R_4 is of such value and interrupter 25 is so designed as to permit the maximum current to flow through relay 1, for the maximum length of time that will occur under actual operating conditions, so that if there is a tendency for the relay to remain operated, the trouble will be readily noted by the action of lamp 21. Furthermore, the difference in the flashing rate indicates to the testing operator that the testing circuit is operating properly. If the direct current supervisory relay 1 operates satisfactorily under these two tests, it may be considered properly adjusted.

Test of alternating current supervisory relay.

To determine whether the alternating current supervisory relay 12 is properly adjusted the following test is made. Plug P_1 is left inserted in jack J_1 and plug P_2 is inserted in jack J_2 which closes a circuit from ground, battery B_1, upper winding of relay 3, sleeve contacts of plug P_2 and jack J_2, winding of relay 16 to ground. Relay 16 is energized, closing a circuit from lower front contact of relay 16, lower back contact of relay 17, ring contacts of jack J_1 and plug P_1, right hand lower back contact of key 18, conductor 26, lower back contacts of key 27, left hand lower back contact of key 18, ring contacts of plug P_2 and jack J_2, resistances R_5 and R_6 to the lower front contact of relay 16, thus forming a circuit through ring side of both cords. Also, by the energization of relay 16, a circuit is closed from upper front contact of relay 16, upper back contact of relay 17, tip contacts of jack J_1 and plug P_1, front contact of relay 5, right hand upper back contact of key 18, conductor 28, upper contacts of key 27, left hand upper back contacts of key 18, tip contacts of plug P_2 and jack J_2, resistances R_7 and R_8 to the upper front contact of relay 16, thus forming a circuit through the tip side of both cords. The alternating current supervisory relay 12 is bridged across the ring side and the tip side of the above-mentioned circuits at a point between splitting key 27 and ringing key 18.

Resistances R_7 and R_8 in series in the tip side of the line and R_5 and R_6 in series in the ring side of the line, together with resistance R_9 bridged across the line, represent an artificial line, one end of which terminates in jack J_1 and the other end in jack J_2. Relay 3 was energized when plug P_1 was inserted in jack J_1, and the results of its operation have already been described under "Testing direct current supervisory relay".

In order to test the alternating current supervisory relay 12, key 18 is thrown to the right so as to apply ringing current to the cord terminating in Plug P_1. A circuit is closed from ground, right hand upper front contact of key 18, front contact of relay 5, tip contacts of plug P_1 and jack J_1, upper back contact of relay 17, upper front contact of relay 16, resistances R_8 and R_7, tip contacts of jack J_2 and plug P_2 left hand upper back contact of key 18, through relay 12, left hand lower back contact of key 18, the ring contacts of plug P_2 and jack J_2, resistances R_5 and R_6, lower front contact of relay 16, lower back contact of relay 17, ring contacts of jack J_1 and plug P_1, to right hand lower front contact of key 18 through ringing generator 22 to ground. Relay 12 is energized, and, if properly adjusted, opens the circuit through relay 11 which closes a circuit from ground, battery B_1, front contact of relay 3, conductors 7 and 9, through lamp 13 and winding of relay 14 in parallel, back contact of relay 11, conductor 37, contact 38 of key 15 to ground, energizing relay 14 and causing lamp 13 to glow. Relay 14 operates and locks up through a circuit from ground, battery B_1, front contact of relay 3, conductors 7 and 9, through lamp 13 and winding of relay 14 in parallel, front contact of relay 14, conductor 37, contact 38 of key 15 to ground. Lamp 13 will continue to glow until contact 38 is opened, which, in actual service, occurs when an operator throws key 15 to the right so as to bridge her telephone set across the line, in response to the signal given by the lighting of lamp 13.

If key 18 is thrown to the left so as to apply ringing current to plug P_2, a circuit is closed from ground, through left hand upper front contact of key 18, tip contacts of plug P_2 and jack J_2, resistances R_7 and R_8, upper front contact of relay 16 and upper back contact of relay 17, tip contacts of jack J_1 and plug P_1, front contact of relay 5, right hand upper back contact of key 18, conductor 28, through upper contacts of key 27, relay 12, lower contacts of key 27, conductor 26, right hand lower back contact of key 18, ring contacts of plug P_1 and jack J_1, lower back contact of relay 17, lower front contact of relay 16, resistances R_6 and R_5, ring contacts of jack J_2 and plug P_2, left hand lower front contact of key 18, through ringing generator 22 to ground. Relay 12 if properly adjusted is energized, and the lamp is caused to glow as before described. By means of these two tests not only is the operation of relay 12 observed, but also the condition of the contacts of keys 27 and 18, since a defective

key contact will prevent the closing of the circuit through relay 12, thereby rendering the said relay inoperative.

Cord tests.

It sometimes happens that the stranded conductors in a cord become opened or crossed. If the conductors of the cord circuit are entirely opened or crossed, the trouble will be detected in the test for the adjustment of the relays previously described. If the trouble consists in broken strands in the conductors, which increases the resistance of the cord and impairs the transmission, it may be detected by the following test: Plug P_1 is left inserted in jack J_1 and plug P_2 is inserted in jack J_3, of which the tip and the ring contacts are short circuited. When plug P_2 is inserted in jack J_3 a circuit is closed from ground through battery B_1, upper winding of relay 3, sleeve contacts of plug P_2 and jack J_3, winding of relay 17 to ground, whereby relay 17 is energized, closing a circuit from ground through battery B_4, lower winding of retardation coil 29, lower front contact of relay 17, ring contacts of jack J_1 and plug P_1, right hand lower back contact of key 18, conductor 26, lower contacts of key 27, left hand lower back contact of key 18, ring contacts of plug P_2 and jack J_3, through shortcircuiting strap to tip contacts of jack J_3 and plug P_2, left hand upper back contact of key 18, upper contacts of key 27, conductor 28, right hand upper back contact of key 18, front contact of relay 5, tip contacts of plug P_1 and jack J_1, upper front contact of relay 17, through upper winding of retardation coil 29 to ground. Plug P_3, to which is connected receiver 30 or other suitable indicating instrument, is inserted in jack J_4, the tip and ring contacts of which are bridged across the tip and ring sides respectively of the circuit just described. When the cord circuit and the receiver and source of current are associated as described, it will be seen that the conductors of the cord are connected in parallel with the receiver and that both the conductors and the receiver are bridged across the ends of the windings of the retardation coil and battery. The voltage across the receiver and the conductors of the cord depends upon the drop in potential across the retardation coil and this voltage can be varied only by changing the current through the said coil. Since the resistance of the receiver is constant, such change in the current through the retardation coil can be effected only by changing the resistance of the cord circuit. Hence if all or part of the strands of the cord are broken and if the cord remains in a fixed position, no variation in current will occur and consequently no indication will be given by the receiver. If the cord be forcibly shaken, the resistance of the conductors will vary greatly, thereby causing a corresponding rapid change in the voltage across the receiver which produces a "sputtering" noise in the receiver. In this manner breaks in the strands of the conductors may be readily detected.

Adjustment of direct current supervisory relay.

If the tests previously made show that the supervisory relays need adjusting in order to obtain satisfactory operation, the following procedure is pursued: Plug P_1 is inserted in jack J_5 and plug P_4 is inserted in jack J_6. Plug P_4 is associated with a portable key set K_1, comprising keys 1, 2, 3, 4 and 5, key 1 being non-locking, keys 2, 3, 4 and 5 being of the well-known locking type.

In order to adjust the direct current supervisory relay 1, with the plugs inserted as stated above, key 2 may be depressed whereby current will flow through the sleeve contacts of plug P_1 and jack J_5, sleeve contacts of jack J_6 and plug P_4, resistance R_{16}, contact of key 2, tip contacts of plug P_4 and jack J_6, relays 31 and 32 to ground. Relay 32 is marginal and does not operate because resistance R_{16} is of such value as to limit the current flowing through relay 32 to an amount that is less than the normal operating current for this relay. Relay 31 operates, closing a circuit from ground through interrupter 33, resistance R_{17}, lower back contact of relay 34, upper back contact of relay 32, upper front contact of relay 31, tip contacts of jack J_5 and plug P_1, upper front contact of relay 5, right hand upper back contact of key 18, upper winding of retardation coil 19, back contact of relay 4, relay 1, lower winding of retardation coil 19, right hand lower back contact of key 18, ring contacts of plug P_1 and jack J_5, lower front contact of relay 31, through middle back contact of relay 32 and battery B_5 to ground. Resistance R_{17} is usually of such value as to limit the flow of current to the minimum found in practice, and the interrupter 33 is so designed as to create the maximum number of interruptions of the current that may be experienced under actual service conditions. When relay 1 has been adjusted so that it will operate satisfactorily under the above-mentioned conditions, key 3 is depressed, restoring key 2 and closing a circuit from battery, sleeve contacts of jack J_6 and plug P_4, resistance R_{16}, to contact 39 where the circuit divides, part of current flowing through ring contacts of plug P_4 and jack J_6, winding of relay 34 to ground, and the remainder of the current flowing through the tip contacts of plug P_4 and jack J_6, and relays 31 and 32 to ground, thereby operating relay 31, but not relay 32, which is marginal. Relay 34 is operated,

thereby disconnecting interrupter 33 from the adjusting circuit just described, and connecting interrupter 35 through resistance R_{18} to the said adjusting circuit. Resistance R_{18} is usually of such value, and interrupter 35 is so designed as to permit the flow of the maximum current with the minimum number of interruptions that may be experienced under actual service conditions. After relay 1 has been adjusted so that it will operate satisfactorily under this condition, key 2 may be depressed, thereby restoring key 3 to its normal position, and again energizing relay 1 by the current through interrupter 33 and resistance R_{17}, in order to determine whether relay 1 still responds properly to the minimum current. If relay 1 operates properly under both of the conditions just described which will be indicated by the action of the lamp 21, its adjustment may be considered satisfactory.

Adjustment of alternating current supervisory relay.

With the plugs left inserted as in the previous test, restoring key 1 is operated so as to restore any of the locking keys which may have been locked down during the previous test, and key 4 is then depressed, closing a circuit from grounded battery, sleeve contacts of jack J_6 and plug P_4, contact of key 4, tip contacts of plug P_4 and jack J_6, relay 31 and relay 32 to ground, thereby operating both relays 31 and 32. Relay 32 closes a circuit from ground through ringing generator 36, lower front contact of relay 32, resistances R_{12} and R_{11}, upper front contact of relay 32, upper front contact of relay 31, tip contacts of jack J_5 and plug P_1, upper front contact of relay 5, right hand upper back contact of key 18, conductor 28, upper back contacts of key 27, through relay 12, lower back contacts of key 27, conductor 26, right hand lower back contact of key 18, ring contacts of plug P_1 and jack J_5, lower front contact of relay 31, middle front contact of relay 32, through resistances R_{13} and R_{14} to ground. Resistances R_{11}, R_{12}, R_{13} and R_{14} which are in series with the circuit just described, together with resistances R_{15} and R_{16} which in series are bridged across said circuit constitute two artificial lines which may be of such values as to permit the flow through relay 12 of the maximum and minimum current that might occur under actual service conditions. As may be seen, resistance R_{15} is normally shortcircuited through the upper back contact of relay 34, so that normally resistance R_{16} alone is effectively bridged across the two sides of the line.

With key 4 depressed, relay 34 being nonenergized, the minimum ringing current will flow through relay 12 over the circuit previously described, and the relay may be properly adjusted so as to operate under this condition, which represents the condition met with over the longest line with which the relay will be associated. Then, if key 5 is depressed, key 4 is restored to its normal position, and a circuit is closed from grounded battery, through sleeve contacts of jack J_6 and plug P_4 to contact 40 where the circuit divides, part of current flowing through the tip contacts of plug P_4 and jack J_6, and relays 31 and 32 to ground, operating relays 31 and 32, and the remainder of the current flowing through the ring contacts of plug P_4 and jack J_6, and relay 34 to ground, operating relay 34 and opening the short circuit around resistance R_{15} which effectively connects resistance R_{15} in series with R_{16} across the line. Supervisory relay 12 may then be adjusted, if necessary, to operate under this condition which corresponds with the condition that exists when the cord circuit is connected with the shortest trunk line that is met with in practice. If the relay meets the requirements of this test, key 4 may be depressed, restoring key 5 to its normal position, and the relay may again be tested to determine whether it will respond to the minimum ringing current. If the relay responds properly under both conditions, its adjustment may be considered satisfactory.

It should be understood that the resistances used in the interrupter circuit, and in the alternating current circuit may be of such value or values that the current that flows through the circuit will be either the same as or somewhat less than the minimum, or somewhat greater than the maximum current which 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 testing jack and the fun tioning of the various apparatus associated with the said cord circuit may be determined either directly or by manipulating the keys associated with the cord circuit. If any apparatus is found defective on such test, the cord with which the defective apparatus is associated may be plugged into a jack leading to an adjusting circuit, whereby the defective apparatus may be controlled by a key 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 if embodied in certain specific organizations and arrangements, it is to be understood that this embodiment may be widely varied without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A testing system comprising a telephone cord circuit having direct current supervisory relays, alternating current supervisory relays and ringing keys associated therewith, a testing circuit, means to associate said cord circuit with said testing circuit, means associated with said testing circuit whereby the direct current relays may be energized, and also means whereby the alternating current relays may be energized by ringing current applied through the ringing keys of said cord circuit.

2. A testing system comprising a telephone cord circuit having direct current and alternating current relays associated therewith, a testing circuit having sources of current associated therewith, means to associate said cord circuit with said testing circuit, and means associated with said testing circuit whereby the flow of current through each of said relays may be controlled.

3. A testing system comprising a telephone cord circuit located at a switchboard and having direct current and alternating current relays associated with said cord circuit, a testing circuit, means to connect said cord circuit to said testing circuit, and means associated with said testing circuit whereby the flow of current may be controlled by an operator from said switchboard.

4. A testing system comprising a telephone cord circuit, a testing circuit, means whereby both ends of the said cord circuit may be connected to the said testing circuit, and means associated with said testing circuit whereby a combination of resistances simulating an actual telephone line is bridged across the two ends of said cord circuit.

5. A testing system comprising a telephone cord circuit, a testing circuit having a source of current in series with a retardation coil bridged across one end thereof, an indicating instrument bridged across said testing circuit in parallel with said source and coil, means to connect one end of said cord circuit to said testing circuit and means to short circuit the other end of said cord circuit whereby defects in said cord circuit may be determined when the cords of said cord circuit are forcibly shaken.

6. A testing system comprising a telephone cord circuit having direct current and alternating current relays associated therewith, a testing circuit having a plurality of sources of current associated therewith, means to connect said cord circuit to said testing circuit, and means associated with said testing circuit whereby the flow of current through said relays may be controlled from a point adjacent to said relays.

7. A testing system comprising a telephone cord circuit at a switchboard having relays associated therewith, a testing circuit having a source of current and a plurality of interrupters associated therewith, means to connect said cord circuit with said testing circuit, and means located at said switchboard to connect any one of said interrupters in series with said source of current and said relays whereby said relays may be intermittently energized.

8. A testing system comprising a telephone cord circuit having relays associated therewith, a testing circuit having a source of current and a plurality of interrupters associated therewith, means for connecting said cord circuit with said testing circuit whereby said interrupted current may flow through said relays, and means whereby the value of said interrupted current, flowing through said relays, may be limited.

9. A testing system comprising a telephone cord circuit having direct current and alternating current relays associated therewith, a testing circuit having sources of interrupted direct current and alternating current, a circuit controlling set, means to connect said cord circuit with said testing circuit, means to connect said circuit controlling set with said testing circuit, and means responsive to the operation of said circuit controlling set whereby either a direct current or an alternating current relay may be caused to respond.

10. A testing system comprising a plurality of telephone cord circuits located at a switchboard and having direct and alternating current relays associated therewith, a testing circuit having a plurality of switching means associated therewith and located at said switchboard to connect any of said cord circuits with said testing circuit, sources of direct current and alternating current associated with said testing circuit and located at a point remote from said switchboard, and switching means associated with said testing circuit and adjacent to said relays to connect a circuit controlling set with said testing circuit whereby any of said relays associated with any of said cord circuits may be controlled from a point adjacent to said relays.

In testimony whereof, I have signed my name to this specification this twenty-eighth day of August, 1917.

JOHN F. TOOMEY.