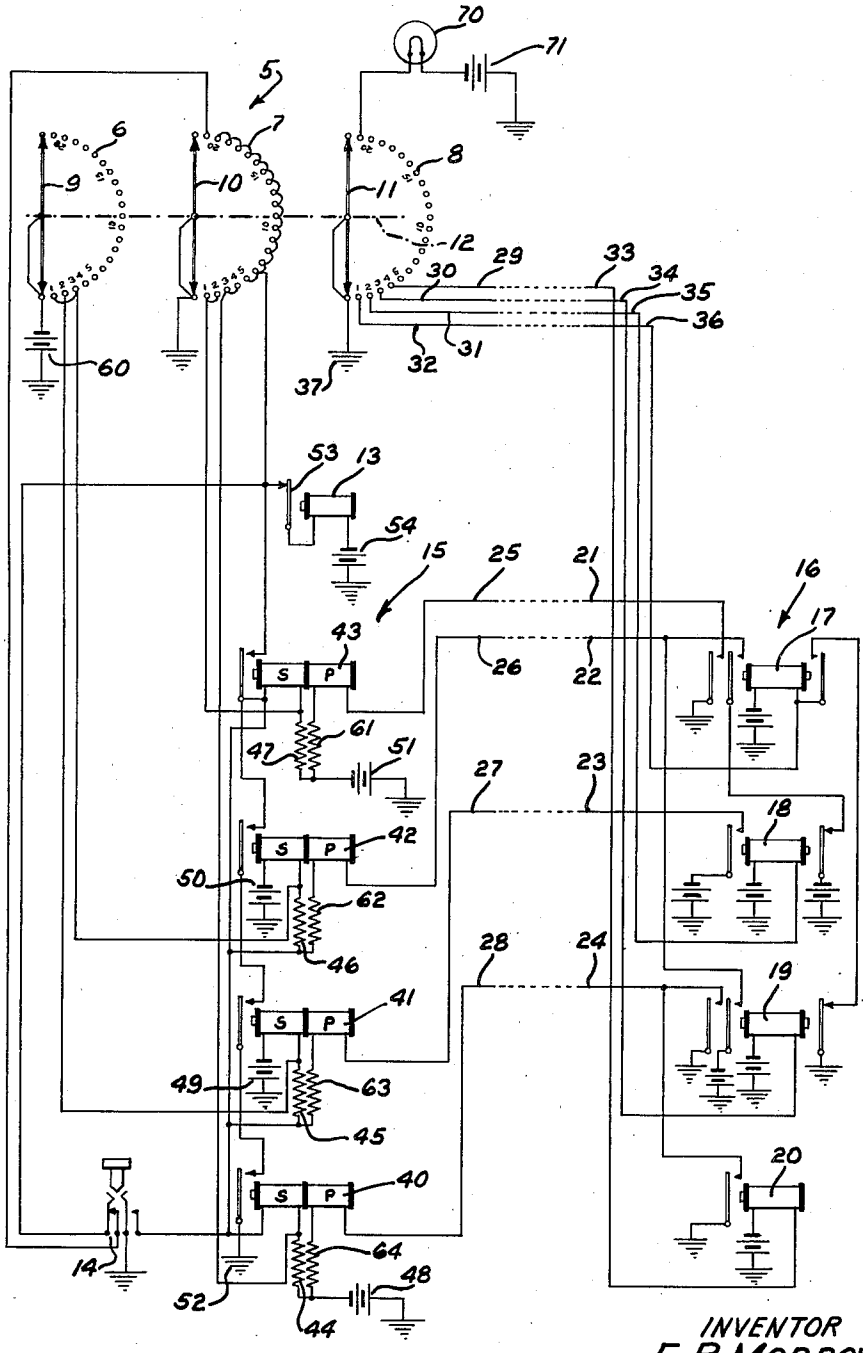
March 11, 1941. E. B. MORROW 2,234,272

TESTING CIRCUIT

Filed July 12, 1939



INVENTOR
E. B. MORROW
BY Emery Robinson.
ATTORNEY

Patented Mar. 11, 1941

2,234,272

UNITED STATES PATENT OFFICE

2,234,272

TESTING CIRCUIT

Edward B. Morrow, Chicago, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application July 12, 1939, Serial No. 283,953

9 Claims. (Cl. 179—175.2)

This invention relates to testing circuits and more particularly to circuits for testing telephone switching units.

It is an object of the present invention to provide a simple and efficient testing circuit for testing telephone exchange equipment.

In accordance with one embodiment of the invention as applied to private exchange link and trunk units, which, in their operation in connection with the completing of telephone calls, automatically place potential on some leads of the circuit in the units and operate relays therein in predetermined sequences, a circuit is provided for checking simultaneously for the presence of potential on certain leads in the telephone exchange unit and the absence of potential on all other leads in the unit. The circuit includes a series of differential relays arranged so that a stepper switch which controls the operations of the relays of the unit under test will automatically make one test after another of the unit as long as the unit under test operates correctly, but which will interrupt the automatic testing operation when any of the circuits in the unit under test have potential on leads therein which should not be present at that stage of the test or when they have no potential on them at a time during the test when they should have potential on them.

A better understanding of the invention will be had by reference to the accompanying drawing, wherein the single figure shows schematically a testing apparatus for checking for the presence or absence and polarity of potential on leads in an automatic telephone switching unit.

Referring to the drawing, wherein like reference characters designate similar parts throughout the several views, a selector switch, designated generally by the numeral 5, comprises a plurality of arcuate banks of contacts 6, 7 and 8 having brushes 9, 10 and 11 associated therewith, respectively. The brushes 9, 10 and 11 are mounted upon a common shaft, indicated by dot and dash lines at 12, and are actuated by a stepper magnet 13.

A start switch 14 is provided for initiating testing operations in the testing circuit shown at the left hand side of the drawing and designated generally by the numeral 15. Upon operation of the start switch 14, the testing apparatus 15 will test the operation of a telephone switching unit, a portion of which is shown, designated generally 16. The telephone switching unit has been shown diagrammatically and as so shown comprises a series of relays 17, 18, 19 and 20, which, when connected to other telephone equipment, will operate to automatically complete a telephone connection. The details of the automatic switching unit are not necessary to an understanding of the present invention, it being understood that the leads 21, 22, 23 and 24, extending from the switching unit 16, are those leads which would either be connected to the subscriber's telephone equipment or other parts of telephone exchange equipment. Prior to the start of the testing operations, these leads may be connected by any suitable means, not shown, but illustrated by the dotted lines, to leads 25, 26, 27 and 28 in the testing apparatus 15.

The right hand bank of contacts 8 of the stepper switch 5 have a series of leads extending therefrom, designated by the numerals 29, 30, 31 and 32. These leads may be connected to leads 33, 34, 35 and 36 in the switching unit to be tested, and upon step by step operation of the brush 11 under control of the stepper magnet 13, the brush 11 will connect ground at 37 to one side of the winding of the relays 17, 18, 19 and 20 in automatic succession. The other side of the windings of the relays 17, 18, 19 and 20 are connected to grounded battery and the relays should therefore operate in succession.

Since it is a function of the relay 17, in its intended operation in the switching unit 16, to, upon operation, place ground on lead 21 and grounded battery on lead 22 over the break contact of relay 18, the arrangement of the testing apparatus is such that it will, in the first operative position of the selector switch, test lead 21 for ground potential and lead 22 for a grounded battery connection. Since relays 18, 19 and 20 are at this stage of the operation not supposed to be energized, it will check lead 23 and lead 24 for the absence of either grounded battery or ground, respectively, on those leads. In like manner, operation of relay 18, which occurs at the second operative position of selector switch 5, should break the circuit to lead 22 through its break contact and place grounded battery on lead 23, and the relays 19 and 20 are not supposed to be operated. Therefore, lead 22 should have no potential on it, the lead 23 should be connected to grounded battery, the lead 24 should have no potential on it and lead 21 should have ground on it since relay 17 should remain locked up over break contact of relay 19 and its own locking contact. In position 3 of the selector switch, the desired condition is to have grounded battery on lead 22, no potential on lead 21, ground on lead 24, and no potential on lead 23, and while relay

19 is operated and relays 17, 18 and 20 are not operated, the testing apparatus 15 will check for this condition. In like manner, relay 20 is adapted to place a ground potential on lead 24 and no potential on any of the other leads 21, 22, or 23. The testing apparatus 15 will, in the fourth position of the selector switches, test for this condition.

The description of the testing apparatus per se will be included in a description of the operation of the apparatus since it is believed that it will be more clearly understood if the general description of the apparatus and the description of the operation thereof are combined. After the switching unit 16 to be tested has been connected to the testing apparatus 15, as indicated by the dotted lines, the start key 14 may be closed to place ground on the secondary winding S of four differential relays 40, 41, 42 and 43. The other side of the secondary windings of each of these relays is connected to grounded battery, as indicated at 48, 49, 50 and 51, respectively, resistances 44 and 47 being connected between the grounded batteries 48 and 51 and their respective secondary windings and resistances 45 and 46 being connected between the secondary windings S of relays 41 and 42 and ground at the key 14. The closure of key 14 therefore will initiate the testing operation by operating relays 40, 41, 42 and 43, the operation of these relays then connecting ground at 52 through the make contacts of the relays 40, 41, 42 and 43 and an interrupter contact 53 associated with the stepping electromagnet 13, through the winding of the electromagnet 13 to grounded battery at 54. The electromagnet 13 will cause the brushes 9, 10 and 11 to step out of their normal position, as shown, into position 1.

When the selector switch brushes 9, 10 and 11 step to their first position, the brush 9 will complete a circuit from grounded battery at 60, thereby short circuiting the secondary winding of the relay 42; brush 10, in its first position, will place ground on one side of the secondary winding of the relay 43 so that in position 1 of the selector switch, the secondary windings of the relays 43 and 42 will be deenergized. However, if the relay 17 in the unit under test has operated as it should, ground at relay 17 will be connected over leads 21 and 25 through the primary winding P of relay 43 and a resistance 61 to grounded battery at 51 and grounded battery associated with the break contact of relay 18 will be connected over a make contact of relay 17, leads 22 and 26, through the primary winding P of relay 42 and resistance 62 to ground at key 14.

In position 1 of the test, relays 18, 19 and 20 should not be operated and therefore the grounded battery at relay 18 should not be connected to the primary winding of relay 41 to oppose the secondary winding of this relay and in like manner ground at the make contacts of relays 19 and 20 should not be connected to the primary winding of relay 40 to energize that winding so that it would oppose the secondary winding. Therefore, if the unit under test operates satisfactorily in position 1, the test will proceed due to the completion of a circuit from ground at 52 through the make contacts of relays 40, 41, 42 and 43, interrupter contact 53, winding of electromagnet 13 to grounded battery at 54, thereby to step the brushes 9, 10 and 11 into position 2. It should be noted that relay 17 when energized will lock up to ground at relay 19 until relay 19 is operated.

In position 2, brush 9 supplies grounded battery to the secondary winding of relay 41 to short circuit that winding and brush 10 supplies ground to the secondary winding of relay 43 to short circuit that winding. However, relay 43 will not fall back since it will remain energized over its primary winding P from ground at relay 17 due to the fact that relay 17 is locked up over the circuit from grounded battery at relay 17, the right hand make contact of relay 17 to ground at the break contact of relay 19. Therefore, in position 2, relay 43 will be held energized unless relay 19 operates, relay 42 will be held energized over its secondary winding, relay 41 will be held energized over its primary winding from grounded battery at make contact of relay 18, leads 23 and 27 through primary winding of relay 41 and a resistance 63 to ground at the start key 14. Relay 40 will be held energized in position 2 because relay 19 and relay 20 did not operate to place either of the grounds at their make contacts on one side of the primary winding of relay 40. If, in position 2, of the test, relay 17 remains energized over its locking path and relay 18 is the only relay energized by brush 11 connecting ground to its winding, the double wound relays 40, 41, 42 and 43 will all be energized and the circuit to the electromagnet 13 will again be completed to step the brushes 9, 10 and 11 and selector switch 5 into position 3.

When the brushes 9, 10 and 11 arrive in position 3, brush 9 will place grounded battery on the secondary winding of relay 42 to again short circuit that winding, brush 10 will place ground on the secondary winding of relay 40 to short circuit that winding, and brush 11 will place ground over lead 34 to the winding of relay 19 to energize it. The energization of relay 19 breaks the locking ground which held relay 17 energized, thereby removing ground from the primary winding of relay 43, places ground on one side of the primary winding of relay 40, the other side of the winding of which is connected through the resistance 64 to grounded battery at 48. Therefore, relay 40 will be operated by the operation of relay 19 over the primary winding of relay 40 and relay 42 will be operated by the operation of relay 19 through energization of the primary winding of relay 42 from grounded battery at relay 19 over leads 22 and 26 through resistance 62 to ground at the start key 14. Relays 43 and 41 should at this time, be energized over their secondary windings if relays 17, 18 and 20 are not energized since no short circuit will be initiated and the windings of these relays will not buck one another.

Since all of the relays 40, 41, 42 and 43 will be pulled up if the unit under test is operating correctly, electromagnet 13 will again be energized to step its brushes to position 4, in which position brush 9 is ineffective. Brush 10 will connect ground to one side of the secondary winding of relay 40 to short circuit the secondary winding of relay 40 and brush 11 will connect ground to operate relay 20. Relay 20 operated will place ground on the primary winding of relay 40 to energize it. If relays 17, 18 and 19 are not operated at this time, the secondary windings of relays 41, 42 and 43 will operate these relays and the brushes 9, 10 and 11 will therefore step to their 5th position.

The contacts of the bank 7 associated with the brush 10 in positions 5 to 20, inclusive, are strapped together and accordingly when the brush 10, which is connected to ground, engages

the first of these contacts, ground will be connected to the interrupter contact 53 associated with the electromagnet 13 to cause the electromagnet to buzz or step its associated brushes 9, 10 and 11 forward to position 21 without affecting the rest of the circuit. In position 21, the brush 11 will connect ground through a lamp 70 to grounded battery at 71 to light the lamp, thereby indicating that the switching unit under test in its various operations placed ground or battery on the proper leads 21, 22, 23 and 24 or had no potential on those leads when no potential should have been on them. The operator may then release the start key 14 and in so doing, the left hand pair of contacts of the start key 14 will connect ground through brush 10, the left hand contacts of key 14, which are normally closed, through the interrupter contact 53 of the electromagnet 13 to cause the brushes 9, 10 and 11 to step back to normal position, as shown, thereby to place the test set in condition for another testing operation.

Although a specific embodiment of the invention has been described hereinbefore, it will be understood that various modifications thereof may be made without departing from the scope of the appended claims.

What is claimed is:

1. An apparatus for testing telephone switching units comprising a series of differential relays, a switch for normally energizing the secondary windings of said relays, a selector switch operable under control of said relays for supplying potential to various parts of the unit under test and for selectively supplying potential to short circuit the secondary windings of said differential relays, and a plurality of leads extending to the unit under test for energizing the primary windings of said relays in a predetermined order.

2. An apparatus for testing telephone switching units comprising a series of differential relays, a switch for normally energizing the secondary windings of said relays, a selector switch operable under control of said relays for supplying potential to various parts of the unit under test and for selectively supplying potential to short circuit the secondary windings of said differential relays, and a plurality of leads extending to the unit under test for energizing the primary windings of said relays in a predetermined order, said selector switch and leads from the unit under test cooperating to energize only one winding of each differential relay when the unit under test operates correctly to continue operation of the testing apparatus.

3. An apparatus for testing telephone switching units comprising a series of differential relays, a switch for normally energizing the secondary windings of said relays, a selector switch operable under control of said relays for supplying potential to various parts of the unit under test and for selectively supplying potential to short circuit the secondary windings of said differential relays, and a plurality of leads extending to the unit under test for energizing the primary windings of said relays in a predetermined order, said selector switch and the leads extending to the unit under test serving to maintain only one winding of each differential relay energized if the unit under test operates correctly.

4. An apparatus for testing telephone switching units comprising a series of differential relays, a switch for normally energizing the secondary windings of said relays, a selector switch operable under control of said relays for supplying potential to various parts of the unit under test and for selectively supplying potential to short circuit the secondary windings of said differential relays, and a plurality of leads extending to the unit under test for energizing the primary windings of said relays in a predetermined order, said selector switch and the leads extending to the unit under test serving to maintain only one winding of each differential relay energized if the unit under test operates correctly to maintain the energizing circuit of the selector switch.

5. An apparatus for testing telephone switching units comprising a series of differential relays, a switch for normally energizing the secondary windings of said relays, a selector switch operable under control of said relays for supplying potential to various parts of the unit under test and for selectively supplying potential to short circuit the secondary windings of said differential relays, and a plurality of leads extending to the unit under test for energizing the primary windings of said relays in a predetermined order, only one winding of each differential relay being connected to be energized either by the selector switch or by the unit under test if the unit under test operates correctly.

6. An apparatus for testing telephone switching units comprising a series of differential relays, a switch for normally energizing the secondary windings of said relays, a selector switch operable under control of said relays for supplying potential to various parts of the unit under test and for selectively supplying potential to short circuit the secondary windings of said differential relays, and a plurality of leads extending to the unit under test for energizing the primary windings of said relays in a predetermined order, said selector switch being adapted to supply potential of a predetermined polarity to the secondary windings of said differential relays in a predetermined order and said leads from the unit under test being adapted to supply potential of a predetermined polarity to the primary windings of the differential relays in a predetermined order.

7. An apparatus for testing telephone switching units comprising a series of differential relays, a switch for normally energizing the secondary windings of said relays, a selector switch operable under control of said relays for supplying potential to various parts of the unit under test and for selectively supplying potential to short circuit the secondary windings of said differential relays, a plurality of leads extending to the unit under test for energizing the primary windings of said relays in a predetermined order, said selector switch being adapted to supply potential of a predetermined polarity to the secondary windings of said differential relays in a predetermined order and said leads from the unit under test being adapted to supply potential of a predetermined polarity to the primary windings of the differential relays in a predetermined order, and a brush on said selector switch for controlling the sequence of operation of the various parts of the unit under test for controlling the order in which potential is supplied to the primary windings of the differential relays.

8. An apparatus for testing telephone switching units for the presence or absence and polarity of potential on the leads thereto during the operation thereof comprising means for supplying operating potential to the actuating relays in a unit in automatic succession, a plurality of dif-

ferential relays having their primary windings connected to the leads to be tested, and a selector switch for controlling the supply of potential to the unit under test and to the secondary windings of the differential relays.

9. An apparatus for testing telephone switching units for the presence or absence and polarity of potential on the leads thereto during the operation thereof comprising means for supplying operating potential to the actuating relays in a unit in automatic succession, a plurality of differential relays having their primary windings connected to the leads to be tested, a selector switch for controlling the supply of potential to the unit under test and to the secondary windings of the differential relays, and means under control of the differential relays for interrupting the operation of the selector switch.

EDWARD B. MORROW.