

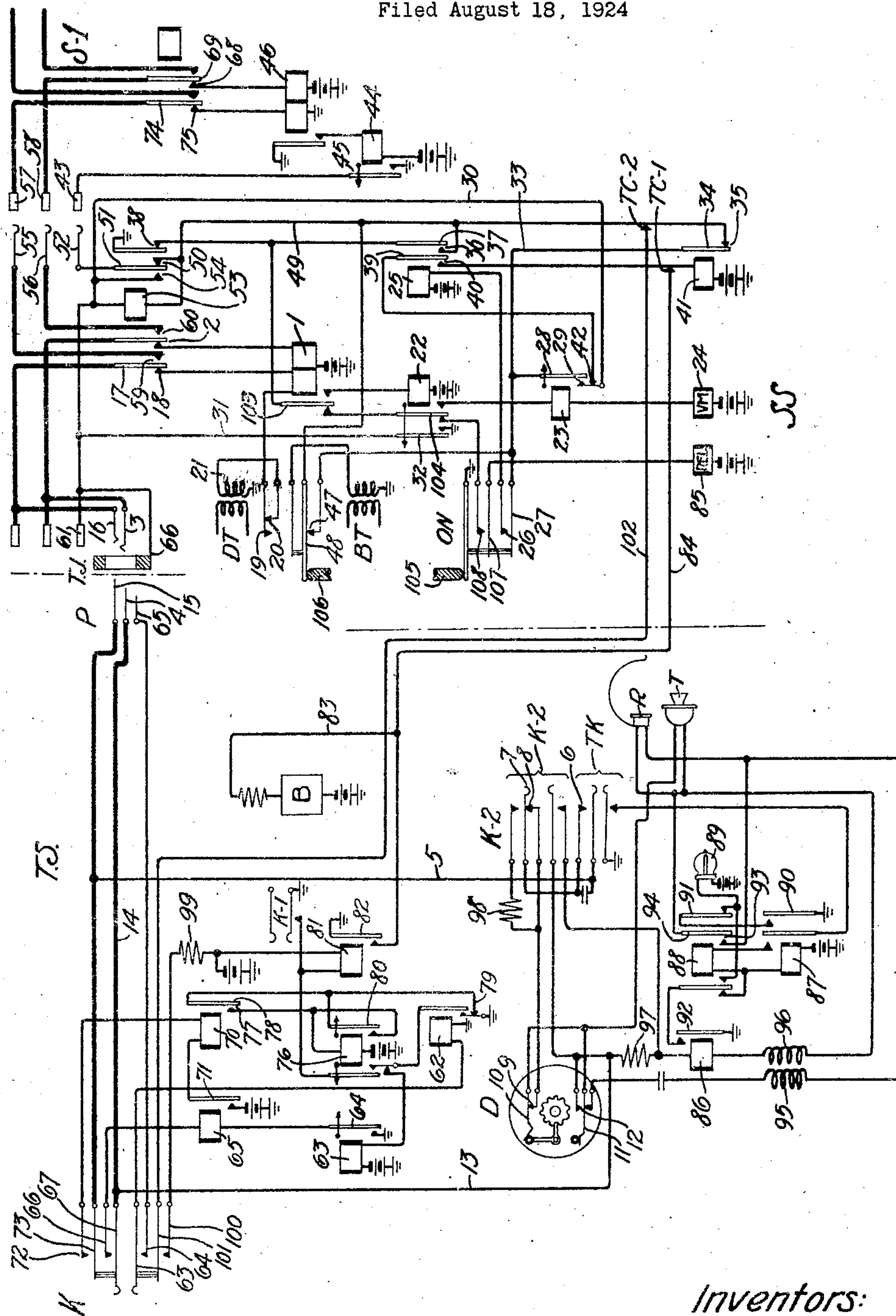
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J. N. WALTERS ET AL

TESTING SYSTEM

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UNITED STATES PATENT OFFICE.

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TESTING SYSTEM.

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To all whom it may concern:

Be it known that we, JAMES N. WALTERS and CLAUDE EWING, residing at East Orange and Brooklyn, in the counties of Essex and Kings and States of New Jersey and New York, respectively, have invented certain Improvements in Testing Systems, of which the following is a specification.

This invention relates to testing systems and more particularly to a testing system for check testing selector and connector switches and their associated trunks in a full mechanical step-by-step machine switching system.

Heretofore, it has been customary to test the selector and connector switches and their associated trunk circuits by operating the switching mechanism by hand.

The object of this invention is the speedy and thorough automatic testing of selector and connector switches and their associated trunk circuits.

In accordance with this invention, a test set is equipped with a dial and suitable means for linking the test set to a selector switch. The dial is operated to set the switch on any desired trunk level, and the switch automatically hunts for and connects with the first idle trunk, whereupon the apparatus in the test set functions and subjects the switch and the seized trunk to a series of tests. If the tests progress properly indicating that the switch and trunk are in proper condition, an audible signal is received and the selector switch is caused to step ahead automatically to the next idle trunk in the group. If a defective circuit is encountered the switch stops and must be stepped ahead by the tester. After the last trunk in a given level has either been tested or passed by, the switch releases and the tester proceeds to dial another digit corresponding to some other level in the switch.

In the drawing comprising but a single sheet, the invention is diagrammatically represented applied to a selector switch. The test set TS is shown at the left and a typical selector switch SS of the well known Strowger type at the right. A circuit at S¹ represents the first idle trunk in a group of trunks accessible to the selector switch.

It is believed that the invention will be

fully understood from the following detailed description of its operation during a typical test.

Testing trunks between selectors.

Dialing.—The clips TC¹ and TC² are respectively connected to the winding and the back contact 35 of the rotary magnet 41 as shown in the drawing, and the plug P is inserted in the test jack TJ of the selector switch SS. The key TK of the test set TS is operated, closing the impulse circuit to operate the relay 1 of the selector switch SS as follows: battery, right winding of relay 1, 2, 3, 4, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 15, 16, 17, 18, left winding of relay 1, 19, 20, 21 to ground. Relay 1, operated, closes at its armature 103 an obvious circuit to operate relay 22. Relay 22, operated, connects ground by way of its armature 32 to the test terminal 61 of the selector switch SS, causing the switch to test busy to all selector switching having access thereto.

The dial D is now operated and released in accordance with the digit corresponding to the particular level desired, and as the dial returns to normal, the impulse circuit previously traced is intermittently opened and closed at the impulse springs 9 and 10 of the dial D. When the impulse circuit is opened, relay 1 releases, and a circuit is closed to operate the vertical magnet 24 and relay 23 in series as follows: battery, winding of the vertical magnet 24, winding of relay 23, 104, 103, 38 to ground. Relay 22 is made slow-to-release so that it will remain operated when its circuit is momentarily opened at 103 by the release of the impulse relay 1. The vertical magnet 24, operated, steps the selector rod 105 one step in accordance with the primary movement of the switch, thus permitting the off-normal contact springs ON to close for a purpose hereinafter described. With relay 23 operated and the off-normal contact springs closed, the following circuit is closed to operate relay 25: battery, winding of relay 25, 26, 27, 28, 29, 30, 31, 32 to ground. Relay 25, operated, locks in the following circuit: battery, winding of relay 25, 26, 27, 33, 34, 35, 36, 37, 38 to ground. When the impulse circuit is again closed by the closure

of the impulse springs 9 and 10 of the dial D, relay 1 reoperates momentarily, thus opening the circuit through the vertical magnet 24 and relay 23 in series, but relay 23, which is designed to be slow-to-release, remains operated until the circuit previously established through the vertical magnet 24 and relay 23 is again closed by the release of the impulse relay 1.

The vertical magnet 24 operates in response to each impulse produced by the impulse springs 9 and 10 of the dial D, stepping the selector rod 105 a corresponding number of steps in accordance with the primary movement of the selector switch SS. At the end of the impulse train, relay 1 remains operated and relay 23 and the vertical magnet 24 release. When relay 23 releases, a circuit is closed to operate the rotary magnet 41 as follows: battery, winding of rotary magnet 41, 40, 39, 42, 29, 30, 31, 32 to ground. The rotary magnet 41, operated, initiates the secondary movement of the switch and opens at 34 and 35 the locking circuit previously traced for relay 25, which releases. Relay 25, released, opens at 39 and 40 the operating circuit for the rotary magnet 41, which likewise releases. The brushes 55, 56 and 52 are now resting upon the terminals associated with the first trunk in the selected level, which we will assume to be busy, in which case solid ground at the test terminal will be connected to the brush 52.

Trunk hunting.—With ground connected to the brush 52 by way of test the terminal of the busy trunk, a circuit is closed to operate relay 25 as follows: battery, winding of relay 25, 26, 27, 47, 48, 49, 50, 51, 52 to ground. Relay 25, operated, again closes the circuit previously traced to operate the rotary magnet 41, which causes the brushes 55, 56 and 52 to be stepped to the terminals associated with the next trunk in the group. The operation of the rotary magnet 41 likewise opens at 34 and 35 the locking circuit for relay 25, which again releases. If the selected trunk is busy, ground at its test terminal will close the circuit previously traced by way of the brush 52 to reoperate relay 25, which in turn will reoperate the rotary magnet in the manner previously described, and the brushes 55, 56 and 52 will be stepped to the terminals associated with the next succeeding trunk in the group, as previously described. This cycle of operations will continue until an idle trunk is found, which we will assume to be the trunk associated with the selector switch S^1 , shown in the drawing.

Trunk testing.—With the brushes 55, 56 and 52 resting upon the terminals 57, 58 and 43 of the selector switch S^1 , the following circuit is closed to operate relay 53: battery, winding of relay 25, 26, 27, 47, 48, 49, winding of relay 53, 31, 32 to ground. Relay 25 will not operate over this circuit due to the high resistance of the winding of relay 53 in series with it. The operation of relay 53 extends the test set TS through to the trunk circuit of the selector switch S^1 . The key TK of the test set TS is now released and the key K is operated. The operation of relay 53 opened the circuit through the windings of relay 1, which released, and in turn opened the circuit through relay 22, which likewise releases, opening at 32 the operating circuit for relay 53. Relay 53, however, does not release as a holding circuit is established by the operation of the key K over the following circuit: battery, winding of relay 25, 26, 27, 47, 48, 49, winding of relay 53, 66, 65, 64, 63, winding of relay 62 to ground. Relay 62 operates in series with relay 53 over the circuit previously traced, closing an obvious circuit to operate relay 63. With relay 63 operated, the ring conductors of the test set TS, selector switch SS and switch S^1 are connected in series, and if they are continuous, ungrounded and free from foreign battery, a circuit will be closed as follows to operate relay 65 of the test set TS: battery, right winding of relay 46 of the switch S^1 , 68, 69, 58, 56, 60, 2, 3, 4, 14, 67, 66, winding of relay 65, 64 to ground. Relay 46 will not operate over this circuit due to the high resistance of the winding of relay 65 in series with it. Relay 65, operated, connects the tip conductors of the test set TS, selector switch SS and switch S^1 in series, and if they are continuous and free from foreign battery and ground, a circuit will be closed to operate relay 70, traced for convenience as follows: ground, left winding of relay 46, 75, 74, 57, 55, 59, 17, 16, 15, 73, 72, winding of relay 70, 71 to battery. Relay 46 now operates, closing an obvious circuit to operate relay 44. Relay 44, operated, connects ground by way of its armature 45 to the test terminal 43 of the selector switch S^1 . A holding circuit is now established for relay 53 of the selector switch SS as follows: battery, winding of relay 25, 26, 27, 47, 48, 49, winding of relay 53, 54, 51, 52, 43, 45 to ground. Grounding the test terminal 43 results in the short circuiting of the winding of relay 62 of the test set TS, which releases. Relay 62, released, opens the circuit of relay 63 and closes a circuit to operate relay 76 as follows: battery, winding of relay 76, 77, 78, 79 to ground. Relay 76 locks by way of 80 and 79 independently of relay 70. Relay 63 is made slow-to-release to delay the release of relays 65 and 70 until after relay 76 is operated and locked. Relay 63 released opens the circuit through relay 65, which releases. Relay 65, released, opens at 71 the circuit through relay 70, which releases. The release of relays 63 and 65 opens at 64

and 71 the circuits through the windings of relay 46 of the selector switch S^1 , which releases, in turn opening the circuit through relay 44, which being slow-to-release, permits an interval of time to elapse before releasing. Relay 44, released, removes at 45 the ground which short-circuited the winding of relay 62, permitting relay 62 to re-operate in series with the windings of relays 25 and 53 over the circuit previously traced. Relay 62, reoperating, closes a circuit to operate relay 81 before opening at 79 the locking circuit for relay 76. Relay 62, fully operated, opens the locking circuit for relay 76, which being slow-to-release, does not release immediately but remains operated for a sufficient length of time to permit relay 81 to hold and perform the functions required of it. Relay 81, operated, closes an obvious circuit by way of 82 and 83 to operate the buzzer B, as an audible indication that the tests upon the selector switch SS in conjunction with the switch S^1 have been completed and that the switch SS and the trunk circuit from the switch SS to the switch S^1 are in proper condition.

Stepping ahead.—Relay 81, operated, connects ground at 82 to the lead 84, thence by way of the test clip TC^1 to the winding of the rotary magnet 41, operating the rotary magnet and causing the brushes 55, 56 and 52 to be moved in accordance with the secondary movement of the selector switch SS to the terminals associated with the next trunk in the same level. The rotary magnet operating to step the switch ahead, opens at 34 and 35 the circuit through the windings of relays 25 and 53 in series, but relay 53 does not release because the following substitute holding circuit is closed: battery, resistance 99 of the test set TS, 100, 101, 102, test clip TC^2 , winding of relay 53, 66, 65, 64, 63, winding of relay 62 to ground. With the brushes 55, 56 and 52 resting upon the terminals associated with the next trunk in the level, the test set functions in the manner previously described to check the various circuit conditions of the succeeding circuit, and at the completion thereof, the brushes 55, 56 and 52 of the selector switch SS are stepped to the terminals associated with the next succeeding trunk in the level.

This cycle of operations continues until every succeeding trunk in the level has been tested.

Last trunk test.—After testing the last trunk in the level, the brushes 55, 56 and 52 step to what is known as the 11th step position, when the cam 106 of the selector switch SS separates the contact springs 47 and 48, opening the circuit through relay 53, which releases. Relay 53, released, closes a circuit to operate the release magnet 85 as follows: battery, winding of release magnet 85, 107, 108, 104, 103, 38 to ground. The release

magnet 85, operated, releases the rod 105 of the selector switch SS, in a manner not shown, restoring it to normal. In its normal position, the rod 105 separates the spring contacts 26 and 27, thus opening the circuit through the release magnet 85, which releases and restores the switch to normal.

The trunks on the other levels of the selector switch SS are tested in the manner previously described.

Trunk busy or in trouble.—When a trunk under test is in trouble, the series of tests will fail to proceed and the failure of the buzzer B to buzz will indicate to the tester that a defective circuit has been encountered. After noting the number of the defective trunk, the tester will operate the key K^1 , thus operating the relay 81 over an obvious circuit which closes at 82 the circuit which causes the selector switch SS to pass by the defective circuit and to step ahead to the terminals associated with the next trunk in the level.

If at any time after the selector switch SS has encountered an idle trunk which has been tested, the brushes 55, 56 and 52 come to rest upon the terminals associated with a busy trunk, relay 62 in the test set will be short circuited and will not operate, hence the test will not progress. The tester, who is furnished with the receiver R, will be able to hear the conversation, if in progress, or the ringing induction or busy tone in case the called line is being signaled or is busy, owing to the fact that his receiver R is bridged across the test circuit TS, and consequently across the tested line over the following circuit: tip conductor 15 of the plug P, 5, 6, 7, 8, 9, 10, 11, 95, receiver R, 96, winding of relay 86, 97, 13, 14 to the ring conductor 4 of the plug P. After satisfying himself that the test has not progressed because the circuit is busy, the tester may operate the key K^1 thus operating relay 81 and stepping the selector switch SS ahead in the manner previously described. The tester may prefer to wait until the circuit becomes idle, in which case, as soon as ground is removed from the test terminal by the circuit becoming idle, relay 62 operates, and the series of tests upon the circuit progresses in the manner previously described.

Testing trunks between offices.

The test set TS may also be used for testing a group of trunks leading from the local office to a distant office, in which case the plug P is inserted in the test jack TJ of a selector switch having access to the trunks leading to the distant office, the key TK is operated and the dial D operated and released in accordance with the digits corresponding to the number of a test line at the distant office.

The test line, not shown (but which may

be of the type disclosed in the patent to Sandalls, No. 1,561,524, issued Nov. 17, 1925) at the distant office is so arranged that after it has been seized it will cause the direction of the current supplied to the test set TS by the connector to be reversed intermittently (usually at the rate of about 60 reversals per minute).

After dialing is completed, the following bridge is closed across the tip and ring conductors of the trunk circuit: tip conductor 15 of the plug P, 5, 6, 7, 8, 9, 10, transmitter T, 96, winding of the polarized relay 86, 97, 13, 14 to the ring conductor 4 of the plug P. The relay 86 being polarized will not operate until, by the operation of the test line at the distant office, the direction of the current furnished to the test set TS, and consequently to the polarized relay 86, is reversed in a manner shown in the Sandalls application cited. When the polarized relay 86 operates on the reversed current, a circuit is closed to operate relay 87, thereby closing at 90 an obvious circuit to light the lamp 89. When the direction of the current supplied to the test set TS is again reversed, the polarized relay 86 releases, thus permitting the relay 88 to operate in series with the winding of relay 87. Relay 88 operated locks under control of the key TK, and opens at 91 the circuit through the lamp 89, which is extinguished. The test line at the distant office continues to cause current to be supplied to the test set, first in one direction and then in the opposite direction, and the polarized relay 86 continues to operate and release in unison therewith, thus flashing the lamp 89 until the tester releases the circuit by restoring the key TK to normal.

The test set is also equipped with a transmitter T so that the tester may converse over the circuit established if he so desires.

What is claimed is:

1. A test set for testing a switching device and the groups of circuits accessible thereto comprising, means for operating the switching device to select any one of the several groups of circuits, and means after an idle circuit in the group has been seized by the switching device for automatically and sequentially checking the various circuit conditions which arise during the normal operation of the switch and the seized circuit.

2. A test set for testing a switch and the groups of trunks accessible thereto comprising, means for setting the switch on the level assigned to any desired trunk group, means after the switch has seized an idle trunk in the selected level for automatically and sequentially testing the various circuit conditions which arise during the normal operation of the switch and the seized trunk, and means for causing the switch to pass on and seize the next idle trunk in the selected level,

after the tests on the trunk previously seized are completed.

3. A test set for testing a switch and the groups of trunks accessible thereto comprising, means for setting the switch on the level assigned to the desired trunk group, means after the switch has seized an idle trunk in the selected level for automatically and sequentially testing the various circuit conditions which arise during the normal operation of the switch and the seized trunk, and means for preventing the tests from progressing when an improper circuit condition is encountered.

4. A test set for testing a switch and the groups of trunks accessible thereto comprising, means for setting the switch on the level assigned to the desired trunk group, means after the switch has seized an idle trunk in the selected level for automatically and sequentially testing the various circuit conditions which will arise during the normal operation of the switch and the seized trunk, means for preventing the tests from progressing when an improper circuit condition is encountered, and means for causing the switch to step to the next trunk in the selected level.

5. A test set for testing a two-movement switch and the groups of trunks accessible thereto comprising means for initiating the primary movement of the switch which is thereby set on the level assigned to any desired trunk group, and means, operative after the secondary movement of the switch is completed by the seizure of the first idle trunk in the group, for automatically and sequentially testing the various circuit conditions which arise during the normal operation of the switch and the seized trunk.

6. A test set for testing a two-movement switch and the groups of trunks accessible thereto comprising means for initiating the primary movement of the switch which is thereby set on the level assigned to any desired trunk group, means, operative after the secondary movement of the switch is completed by the seizure of the first idle trunk in the group, for automatically and sequentially testing the various circuit conditions which arise during the normal operation of the switch and the seized trunk, and means for causing the switch to reinitiate its secondary movement, whereby the next trunk in the level is seized after the series of tests on the trunk previously seized is completed.

7. A test set for testing a two-movement switch and the groups of trunks accessible thereto comprising means for initiating the primary movement of the switch which is thereby set on the level assigned to any desired trunk group, and means, operative after the secondary movement of the switch

is completed by the seizure of the first idle trunk, responsive to the various circuit conditions encountered during the operation of the switch and the seized trunk, whereby a series of tests progress automatically provided the circuit conditions encountered are normal.

8. A test set for testing a two-movement switch and the groups of trunks accessible thereto comprising means for initiating the primary movement of the switch which is thereby set on the level assigned to any desired trunk group, and means, operative after the secondary movement of the switch is completed by the seizure of the first idle trunk, responsive to the various circuit conditions encountered during the operation of the switch and the seized trunk, whereby a series of tests progresses automatically provided the circuit conditions encountered are normal, but does not progress if an abnormal circuit condition is encountered.

9. A test set for testing a two-movement switch and the groups of trunks accessible thereto comprising means for initiating the primary movement of the switch which is thereby set on the level assigned to any desired trunk group, means operative after the secondary movement of the switch is completed by the seizure of the first idle trunk, responsive to the various circuit conditions encountered during the operation of the switch and the seized trunk, whereby a series of tests progresses automatically provided the circuit conditions encountered are normal, but does not progress if an abnormal circuit condition is encountered, means for causing the switch to reinitiate its secondary movement whereby the next trunk in the level is seized, means for testing the trunk last seized to determine its busy or idle condition, and means for preventing the series of tests from being repeated so long as the trunk last seized is busy.

10. A test set for testing a two-movement switch and any group of trunks accessible thereto comprising means for initiating the primary movement of the switch which is thereby set on the level assigned to the desired trunk group, means, operative after the secondary movement of the switch is completed by the seizure of the first idle trunk, for initiating a series of tests on each trunk in the group in succession until a busy trunk is encountered, and means for resuming the test by initiating the series upon the busy trunk immediately it becomes idle.

11. A test set for testing a two-movement switch and any group of trunks accessible thereto comprising means for initiating the primary movement of the switch which is thereby set on the level assigned to the desired trunk group, means, operative after the secondary movement of the switch is

completed by the seizure of the first idle trunk, for initiating a series of tests on each trunk in the group in succession until a busy or an abnormal circuit condition is encountered on any trunk in the group, and means for reinitiating the secondary movement of the switch to pass by the busy or defective trunk circuit.

12. A test set for testing a two-movement switch and any group of trunks accessible thereto comprising means for initiating the primary movement of the switch which is thereby set on the level assigned to the desired trunk group, means, operative after the secondary movement of the switch is completed by the seizure of the first idle trunk, for initiating a series of tests on each trunk in the group in succession until the last trunk in the group has been tested, and means thereupon effective for allowing the two-movement switch to restore to normal.

13. A testing system, for testing a selector switch having both a primary and a secondary movement, and any group of trunks accessible thereto, comprising a test set, means in said test set including an impulse sender for initiating the primary movement of said switch which is thereby set on the level assigned to the desired trunk group, means in said test set operative after the secondary movement of the switch is completed by the seizure of the first idle trunk for initiating a series of tests on the remaining trunks in the group in succession until a busy trunk is encountered, and means included in said test set for resuming the test by initiating the series upon the busy trunk immediately it becomes idle.

14. A testing system, for testing a selector switch having both a primary and a secondary movement, and any group of trunks accessible thereto, comprising a test set, means in said test set including an impulse sender for initiating the primary movement of said switch which is thereby set on the level assigned to the desired trunk group, means in said test set operative after the secondary movement of the switch is completed by the seizure of the first idle trunk for initiating a series of tests on the remaining trunks in the group in succession until a busy or abnormal circuit condition is encountered on any trunk in the group, and means in said test set for reinitiating the secondary movement of the switch to pass by the busy or defective trunk circuit.

15. A testing system, for testing a selector switch having both a primary and a secondary movement, and any group of trunks accessible thereto, comprising a test set, means in said test set including an impulse sender for initiating the primary movement of said switch which is thereby set on the level assigned to the desired

- trunk group, means in said test set operative after the secondary movement of the switch is completed by the seizure of the first idle trunk for initiating a series of tests on the
5 remaining trunks in the group in succession until the last trunk in the group has been tested, and means thereupon effective for allowing the selector switch to restore to normal.

In testimony whereof, we have signed our names to this specification this 15th day of August, 1924. 10

JAMES N. WALTERS.
CLAUDE EWING.