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TELEPHONE SYSTEM

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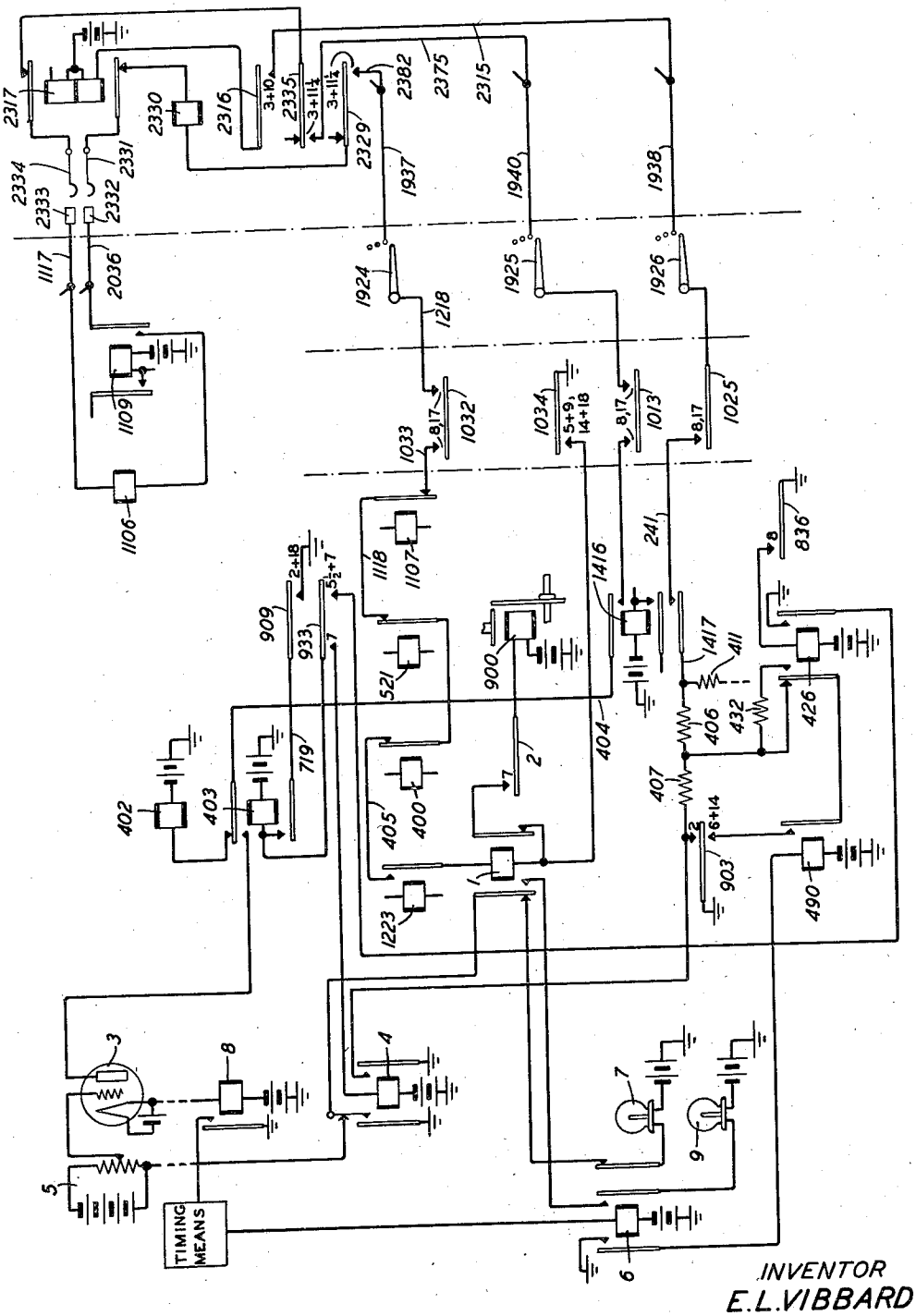

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TELEPHONE SYSTEM

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7 Claims. (Cl. 179—175.2)

This application relates to telephone systems and has for its objects to facilitate the testing of the functioning of relays used in such systems.

Throughout the telephone system there are circuits which are maintained over contacts of relays which, if opened by the failure of the relay contacts, would cause the release of the connection involved or other mutilation of the operation. Heretofore, such relay contacts have been tested by the use of other relays in which case poor adjustment of the relay under test is not detected until it is bad enough to cause trouble in service.

In accordance with the present invention, means is provided for detecting poor relay contacts before they become bad enough to mutilate connections. More specifically, the invention contemplates the inclusion of a gas-filled tube in a circuit including the contact to be tested, ionizing the tube to complete the circuit, with means responsive to the deionization of the tube to indicate failure of the contact.

The invention will be more clearly understood from a consideration of one embodiment thereof as shown in the attached drawing and set forth in the description which follows.

One case in which relays have been tested for their ability to remain operated under adverse conditions is described in U. S. Patent No. 1,650,721 granted to R. E. Peoples on November 29, 1927 and, for convenience, the present invention has been shown as it would be embodied in such a testing arrangement. A skeletonized showing has been made and the same reference characters employed as in the Peoples patent. Reference characters less than 100 apply to equipment added for the present disclosure.

The Peoples patent covers the routine testing of district selectors and for that purpose picks the district selectors one at a time by means of switches which are indicated by brushes 1924, 1925, and 1926. After the selector has been freed from the service link circuit, the test circuit causes the line finder, represented by brushes 2334 and 2331, to find the test line appearing in the line finder frame in terminals 2333 and 2332. The test circuit simulates the action of the sender in directing the selector brushes (not shown) to the test line which appears in the district selector frame and then tests the supervisory relays, the charging equipment, etc.

As soon as the line finder has found its test line, a circuit is closed from battery through the winding of relay 402, back contact of relay 403, conductor 404, upper front content of relay 1416, contacts of cam 1013, brush 1925, conductors 1940 and 2375, contact of cam 2335, upper back contact of relay 2317, brush 2334, terminal 2333, conductor 1117, winding of relay 1106, right front contact of relay 1109, conductor 2036, terminal 2332, brush 2331, lower back contact of relay 2317, winding of relay 2330, contact of cam 2329, conductors 2382 and 1937, brush 1924, conductor 1218, contacts of cam 1032, conductor 1033, back contact of relays 1107, 521 and 400, front contact of relay 1223, winding of relay 1, contact of cam 1034 to ground. At the same time, a circuit is closed from battery through the lower winding of relay 2317, contact of cam 2316, conductors 2315 and 1938, brush 1926, contact of cam 1025, conductor 241, outer lower contact of relay 1416, conductor 1417, resistances 406 and 407 to ground at the contact of cam 903. This circuit contains sufficient resistance to make a non-operate test of relay 2317 and the release of either relay 1106 or 402 due to the opening of the back contacts of relay 2317 would indicate serious lack of adjustment of relay 2317 and would block the test.

In order to detect lack of adjustment in relay 2317 while it is still insufficient to actually mutilate a call, a more severe test is made of the relay during the test of the district selector in connection with a simulated abandoned call which takes place with the test class sequence switch in position 8. When this sequence switch reaches position 8, a circuit is closed from ground over cam 836 through the winding of relay 426 to ground.

After the line finder has been positioned on the line finder test line, the test previously traced is made with sequence switch 900 in position 2. Other tests are then made and sequence switch 900 is advanced in response thereto to position 7. When sequence switch 900 reaches position 5½ a circuit is closed from ground at the right contact of relay 426, right contact of cam 933 to the winding of relay 403 and battery. Relay 403 locks to ground over cam 909 and transfers the test circuit from the winding of relay 402 to the anode of the gas-filled tube 3. When sequence switch 900 reaches position 7, ground from the front contact of relay 426 is extended over the left contact of cam 933 to the winding of relay 4 and battery. Relay 4 connects ground to resistances 407 and 406 to complete the non-operate circuit of relay 2317.

The tube 3 is a gas-filled tube of the three-electrode type in which a negative biasing potential on the control element or grid of the tube holds the tube inert. A momentary reduction of this negative biasing potential causes the tube

to ionize and current to flow from the cathode to the anode, this current flow being independent of subsequent changes in the potential of the grid.

The grid of tube 3 normally receives its negative bias from potentiometer 5. When relay 4 operates, it momentarily connects ground over its left following contacts to potentiometer 5, reducing the negative bias on the grid of the tube long enough to cause the tube to flash and extend the test circuit through the tube between anode and cathode and through the winding of relay 8 to battery. If the test circuit is completed properly, relay 8 operates connecting ground to the timing means which measures off a predetermined time interval.

At the end of this interval, if relay 8 is still operated, ground is extended from the timing means to the winding of relay 6 and battery. Relay 6, in operating, closes a circuit for relay 490 which connects ground from the lower contact of cam 903, over the front contacts of relays 490 and 426, through resistance 432 to the circuit of relay 2317 in parallel with resistance 407. This reduces the resistance in this circuit to the maximum through which relay 2317 should operate. If relay 2317 is correctly adjusted it will operate, opening the test circuit, quenching tube 3, releasing relays 1 and 8. Relay 1, in releasing, connects ground from cam 1034, over the back contact of relay 1, contact of cam 2 to the winding of sequence switch 900 which advances out of position 7, releasing relay 4 and initiating other tests of the district selector which are of not interest in this connection.

During the non-operate test of relay 2317, ground from the left front contact of relay 4 is connected to the left armature of relay 1. If relay 1 releases during the time interval measured by the timing means, it completes a circuit over its back contact and the back contact of relay 6 through lamp 7 to battery, lighting lamp 7 as an indication that relay 2317 operated falsely on the non-operate test. When relay 6 is operated at the end of the time interval, it connects the left front contact of relay 1 over the right front contact of relay 6 to lamp 9 and battery. Since relay 6 causes the closure of the operate circuit of relay 2317, the circuit of lamp 9 would be closed for too short an interval to permit it to light fully if relay 2317 operates properly.

If relay 2317 is not properly adjusted so that it attracts its armatures in response to the non-operate current sufficient to break one of its back contacts for as short an interval as .001 second, the tube 3 will quench and cannot be reionized except by the reoperation of the test circuit, thus making it possible to detect much shorter openings of a circuit than was formerly the case.

It is, of course, understood that the present embodiment of the invention is merely a typical use of the invention in the testing of electrical contacts.

What is claimed is:

1. In a telephone system, a contact to be tested, testing equipment including a gas-filled tube having a cathode, an anode and a grid, means to prepare a circuit including the contact to be tested, said cathode and said anode, and means to ionize said tube to complete the test circuit.

2. In a telephone system, a contact to be tested, testing equipment including a gas-filled tube having a cathode, an anode and a grid, means to prepare a circuit including the contact to be tested, said cathode and said anode, means to normally hold said grid at a potential to prevent the ionization of said tube, and means to momentarily vary the potential on said grid to ionize said tube to complete said testing circuit.

3. In a telephone system, a contact to be tested, testing equipment including a gas-filled tube having a cathode, an anode and a grid, means to prepare a circuit including the contact to be tested, said cathode and said anode, means to normally hold said grid at a potential to prevent the ionization of said tube, means to momentarily vary the potential on said grid to ionize said tube to complete said testing circuit, and means responsive to the deionization of said tube to indicate the failure of said contact.

4. In a telephone system, a contact to be tested, testing equipment including a gas-filled tube having a cathode, an anode and a grid, means to prepare a circuit including the contact to be tested, said cathode and said anode, means to normally hold said grid at a potential to prevent the ionization of said tube, means to momentarily vary the potential on said grid to ionize said tube to complete said test circuit, means responsive to the deionization of said tube to indicate the failure of said contact, and means to prevent the reionization of said tube following such deionization.

5. In a testing system, a relay to be tested, a gas-filled discharge tube, means for simultaneously establishing a non-operate circuit for said relay and for causing said tube to flash, and means to maintain the flashing circuit of said tube under the control of said relay.

6. In a testing system, a relay to be tested, a non-operate circuit for said relay, a gas-filled discharge tube including a cathode, an anode and a grid, a testing circuit including a test relay, a contact of said first relay and the cathode and anode of said tube, means to normally maintain said grid at a potential to prevent the flow of current in said testing circuit, means for momentarily grounding said grid to render said tube conductive and means responsive to said test relay to indicate the result of the test.

7. In a testing system, a relay to be tested, a non-operate circuit for said relay, a gas-filled discharge tube including a cathode, an anode and a grid, a testing circuit including a test relay, a contact of said first relay and the cathode and anode of said tube, means to normally maintain said grid at a potential to prevent the flow of current in said testing circuit, means for momentarily altering the potential on said grid to render said tube conductive and means responsive to said test relay to indicate the result of the test.

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