

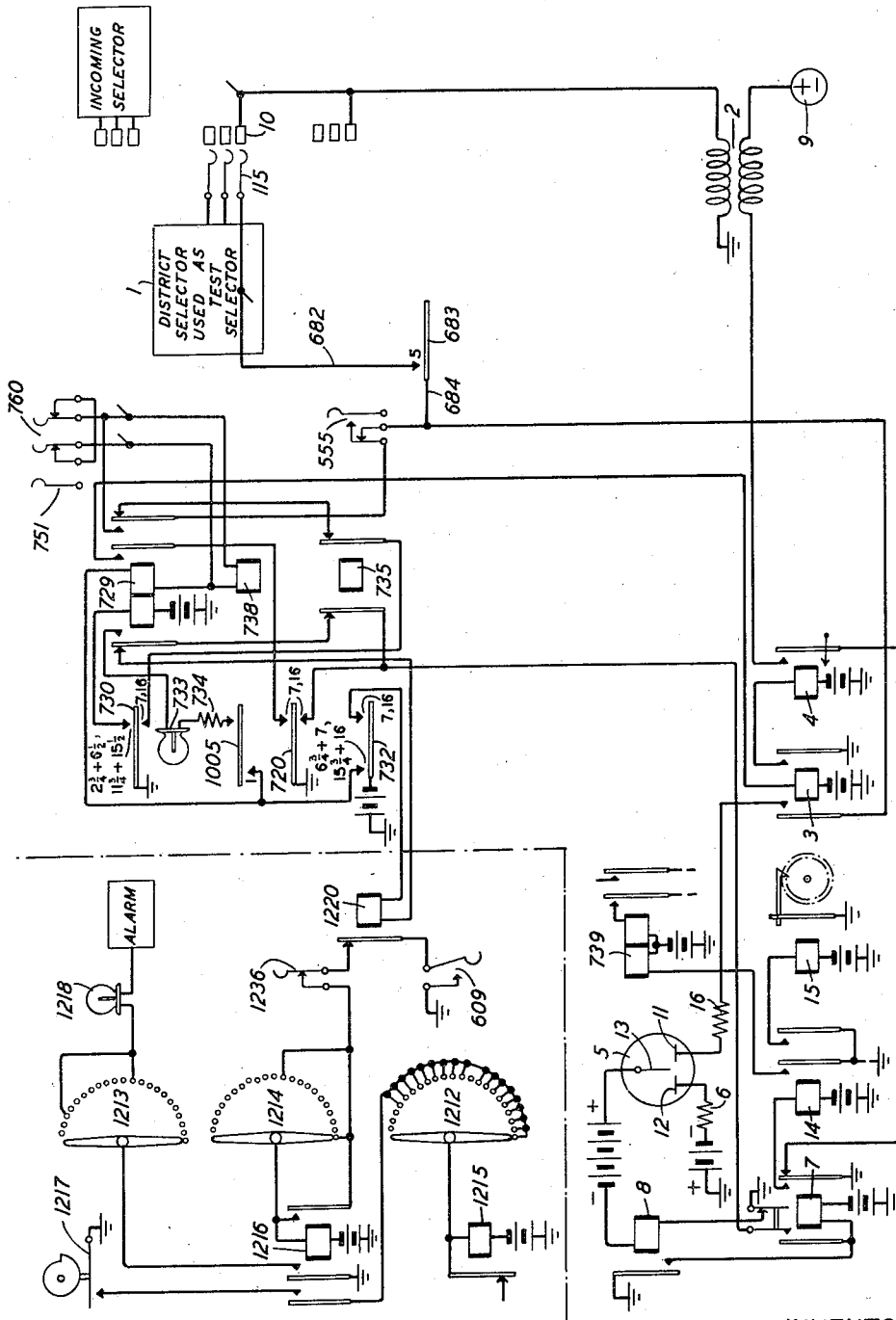
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and has for its object to facilitate the testing of automatic telephone equipment.

In the routine testing of secondary selector switches it is the practice to use as a test selector one of the selector switches which has access thereto in the establishment of service connections, withdrawing such selector from service during its use as a test selector.

Under heavy traffic conditions it is possible that each terminal of the test selector may be active, but until such a condition arises there are likely to be a number of vacant terminal sets in the bank of the test selector. Such vacant terminal sets may have their sleeve terminals connected to ground which, in the service connection, causes the selector to pass over the terminal set in the same manner as it passes busy outgoing trunks. When used in connection with a routine test, the test selector is advanced to a particular position where a test determines whether the selector to which it has access in that position is busy or idle. If the selector is idle the routine test is performed. If the selector is busy the test equipment waits for a length of time predetermined from the average holding time for the selectors under test and if the selector is not released within that time sounds an alarm. The attendant may then cause the test selector to step to the next set of terminals. Where the vacant terminals are merely made busy, an attendant is called in for each such vacant terminal set tested.

In accordance with the present invention, means is provided for advancing the test selector over vacant terminals without delay.

More specifically, the present invention contemplates the provision of means common to a plurality of vacant terminal sets, responsive to selection of any one of the vacant terminals by a test selector for indicating to the test equipment that a vacant terminal set has been selected. For this purpose, the sleeves of vacant terminal sets are connected to ground through the secondary winding of a transformer, the primary circuit of which is controlled by the routine test equipment. When an apparently busy sleeve terminal is encountered, the test circuit connects one cathode of a three-element cold cathode gas-filled tube to the sleeve brush of the test selector and completes the primary circuit of the common transformer. In the case of vacant terminal sets, the current flow induced in the secondary of the transformer causes the tube to ionize and complete a circuit for advancing the test selector to the next terminal set.

The invention will be more clearly understood from a consideration of the following description in connection with the drawing in which the invention is shown embodied in an incoming selector test circuit such as shown in U. S. Patent 1,648,053 granted November 8, 1927 to G. R. Martin. Only those portions of the Martin disclosure which are necessary for an understanding of the invention have been shown and the reference characters belonging thereto have been retained. For all additional equipment, reference numerals less than 100 have been used.

As indicated above, the test circuit is associated with the incoming selector to be tested by means of a district selector used as a test selector and indicated by the numeral 1. In order to have access to all incoming selectors, a number of test selectors are necessary and these are selected by means of sequence switches, cam 683 being one cam of one of such sequence switches. The operation of the district selector in selecting an incoming selector for test is controlled by a sequence switch carrying cams 720, 730 and 732.

The functioning of the test circuit is started by the operation of a key, one contact of which is shown at 609. When this contact is closed, the busy timing arrangement is started by closing a circuit over contact 609, back contact of relay 1229, normal contact of key 1236, brush 1214 in normal position, winding of relay 1216 and battery. Relay 1216 locks to this ground independent of brush 1214, closes a circuit from ground over interrupter 1217, outer left contact of relay 1216, strapped contacts of brush 1212, winding of magnet 1215 and battery. Magnet 1215 operates under the control of interrupter 1217 to advance brushes 1212, 1213 and 1214 over their terminal banks. Relay 1216 also connects ground to brush 1213 so that if this time alarm switch continues to advance, a circuit will be closed, after a measured interval, for lamp 1218 and the alarm.

The start key which carries contact 609 also starts the test circuit to select a test selector and advance it into connection with the first set of terminals leading to the group of incoming selectors to be tested. During these functions, sequence switch cams 720, 730 and 732 are advanced to position 7. When cam 730 reaches position $2\frac{1}{4}$ an obvious circuit is closed through the left winding of relay 729. Relay 729 prepares a circuit for testing whether the selected incoming selector is busy or idle, this circuit constituting a locking circuit for relay 729 which is closed when cam 732 reaches position $6\frac{3}{4}$ from battery over the left contact of cam 732, right winding of

relay 729, contacts of key 760, outer right contact of relay 729, normal contacts of key 555, conductor 684, cam 683, conductor 682, through the district selector to brush 115. If brush 115 engages the sleeve terminal of a busy incoming selector it will find ground thereon from the selector with which the incoming selector is engaged. Likewise it will encounter ground if the sleeve terminal is one of a vacant set, since it will be grounded in common with all similar vacant terminal sets through the secondary winding of repeating coil 2. The left contact of cam 732 and the upper contact of cam 730 overlap sufficiently to hold relay 729 operated whenever an apparent busy condition is encountered.

With relay 729 held operated, when cam 729 reaches position 7 a circuit is closed from battery over the left contact of cam 732, contacts of cam 1005 which does not leave position 1 until later, resistance 734, lamp 733, left front contact of relay 729, back contact of relay 735, lower contact of relay 720 to ground, indicating that the test selector has found the incoming selector busy.

At the same time, a circuit is closed from ground over the upper contact of cam 720, inner right front contact of relay 729, winding of relay 3 and battery. Relay 3 closes an obvious circuit for relay 4 which, being slow to operate, does not close its contact for an interval. Relay 3 also connects brush 115 over conductor 682, contact of cam 683, conductor 684, left contact of relay 3, resistance 16 to cathode 11 of tube 5.

Tube 5 is a gas-filled tube of the type in which no current normally flows but in which, when the tube is ionized by a change in condition of the cathode 11, the current will flow between cathode 12 and anode 13 and will continue to flow irrespective of further changes in the condition of cathode 11. A circuit is prepared from ground at the left normal contact of relay 7, winding of relay 8 to positive battery and the anode 13 of tube 5 and from the cathode 12 through resistance 6 to negative battery and ground.

When relay 4 closes its contact, it completes a circuit from ground at the right back contact of relay 7, contact of relay 4, secondary winding of repeating coil 2 to source of ringing current 9. An alternating potential is, therefore, induced in the secondary winding of coil 2 which is transmitted to the sleeve terminals of all vacant lines. Assuming that brush 115 is engaging terminal 10 of a vacant set, this potential is further transmitted to cathode 11, ionizing tube 5 and causing current to flow through the winding of relay 8. Relay 8, in turn, operates relay 7 which locks to ground at the lower contact of cam 720, disconnects ground from relay 3, quenching the tube 5, and operates relay 14. Relay 14, in turn, operates relay 739 and vacant terminal meter 15. Relay 739 locks and initiates the advance of the test selector to the next terminal set in the manner completely described in the Martin patent above mentioned. Relay 7 also opens the primary circuit of coil 2.

To service selectors, the vacant terminals appear busy because of the low resistance of the secondary winding of coil 2.

If the test circuit encounters a busy selector, the closure of the primary circuit of coil 2 is ineffective since brush 115 will not be engaging one of the terminals to which the secondary winding is connected. Relay 729 remains locked as long as the selector remains busy. If it becomes idle before the alarm circuit is closed, relay 729 releases and connects ground from the lower contact

of cam 730, right back contacts of relays 735 and 729, key 555, conductor 684, cam 683 and conductor 682 to brush 115 to mark the incoming selector busy while it is being tested. Relay 729 also closes a circuit from battery over the right contact of cam 732, winding of relay 1220, left back contact of relay 729, back contact of relay 735 to ground at the lower contact of cam 720. Relay 1220 operates in this circuit, stopping the busy timing operation and initiating the testing of the incoming selector.

It will appear from the foregoing description that the present invention is effective to save not only the time and attention of the attendant, but useless holding time and thereby unnecessary current drain at the test circuit. It will also be obvious that a gas-filled tube of the hot cathode type might be employed in lieu of the tube disclosed, the grid or control electrode being connected to resistance 16, the anode being connected to the positive terminal of anode battery and thence to the winding of relay 8 and the cathode being connected in the same manner as cathode 12.

What is claimed is:

1. In a telephone system, testing equipment, a test selector for connecting said testing equipment with equipment to be tested, a terminal bank for said selector including terminal sets connected to equipment to be tested and vacant terminal sets, means to position said selector on one of said terminal sets, and means connected in multiple to said vacant terminal sets and controlled by said testing equipment for identifying said vacant terminal sets to said testing equipment.

2. In a telephone system, testing equipment, a test selector for connecting said testing equipment with equipment to be tested, a terminal bank for said selector including terminal sets connected to equipment to be tested and vacant terminal sets, means to position said selector on one of said terminal sets, and means connected in multiple to said vacant terminal sets and responsive to the association of said testing equipment with any one of said vacant terminal sets to indicate to said testing equipment that a vacant terminal set has been selected.

3. In a telephone system, testing equipment, a test selector for connecting said testing equipment with equipment to be tested, a terminal bank for said selector including terminal sets connected to equipment to be tested and vacant terminal sets, means to position said selector on one of said terminal sets, and means common to said vacant terminal sets and responsive to the association of said testing equipment with any one of said vacant terminal sets to indicate to said testing equipment that a vacant terminal set has been selected, said means comprising a gas-filled tube having a cathode, an anode and a control electrode, means for connecting said control electrode to the sleeve brush of said test selector, means under the control of said testing equipment to momentarily apply a potential to the sleeve terminals of said vacant terminal set sufficient to ionize said tube and indicating means in the cathode-anode circuit of said tube.

4. In a telephone system, testing equipment, a test selector for connecting said testing equipment with the equipment to be tested, a terminal bank for said selector including terminal sets connected to equipment to be tested and vacant terminal sets, a transformer, one winding of said transformer being connected in common to said vacant terminal sets, a gas-filled tube having a

cathode, an anode and a control electrode, means for connecting said control electrode to the sleeve brush of said test selector, means in said testing equipment to energize the primary winding of said transformer to produce a momentary potential at said vacant terminal, and means included in the cathode-anode circuit of said tube effective when said tube ionizes to advance said test selector.

5 10 15 20 5. In a telephone system, testing equipment, a test selector for connecting said testing equipment with the equipment to be tested, a terminal bank for said selector including terminal sets connected to equipment to be tested and vacant terminal sets, busy terminal sets and vacant terminal sets being marked by similar potentials, said vacant terminal sets receiving their marking in common through the secondary winding of a transformer, means to position said selector on one of said terminal sets, means to test the condition of said terminal set, means in said testing equipment responsive to a busy terminal marking

to momentarily energize the primary winding of said transformer, a gas-filled tube in said testing equipment comprising a cathode, an anode and a control electrode, means to connect said control electrode to the test terminal of said test selector and a circuit including the cathode and the anode of said tube for advancing said selector if said selected terminal set is vacant. 5

6. In a telephone system, testing equipment, a test selector for connecting said testing equipment with the equipment to be tested, a terminal bank for said selector including terminal sets connected to equipment to be tested and vacant terminal sets, busy terminal sets and vacant terminal sets being similarly marked, means to position said selector on one of said terminal sets and means common to said vacant terminals only and controlled by said testing equipment for discriminating between busy terminal sets and vacant terminal sets. 10 15 20

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