July 31, 1934. A. S. BERTELS 1,968,435

TESTING CIRCUIT

Filed April 12, 1933 4 Sheets-Sheet 1

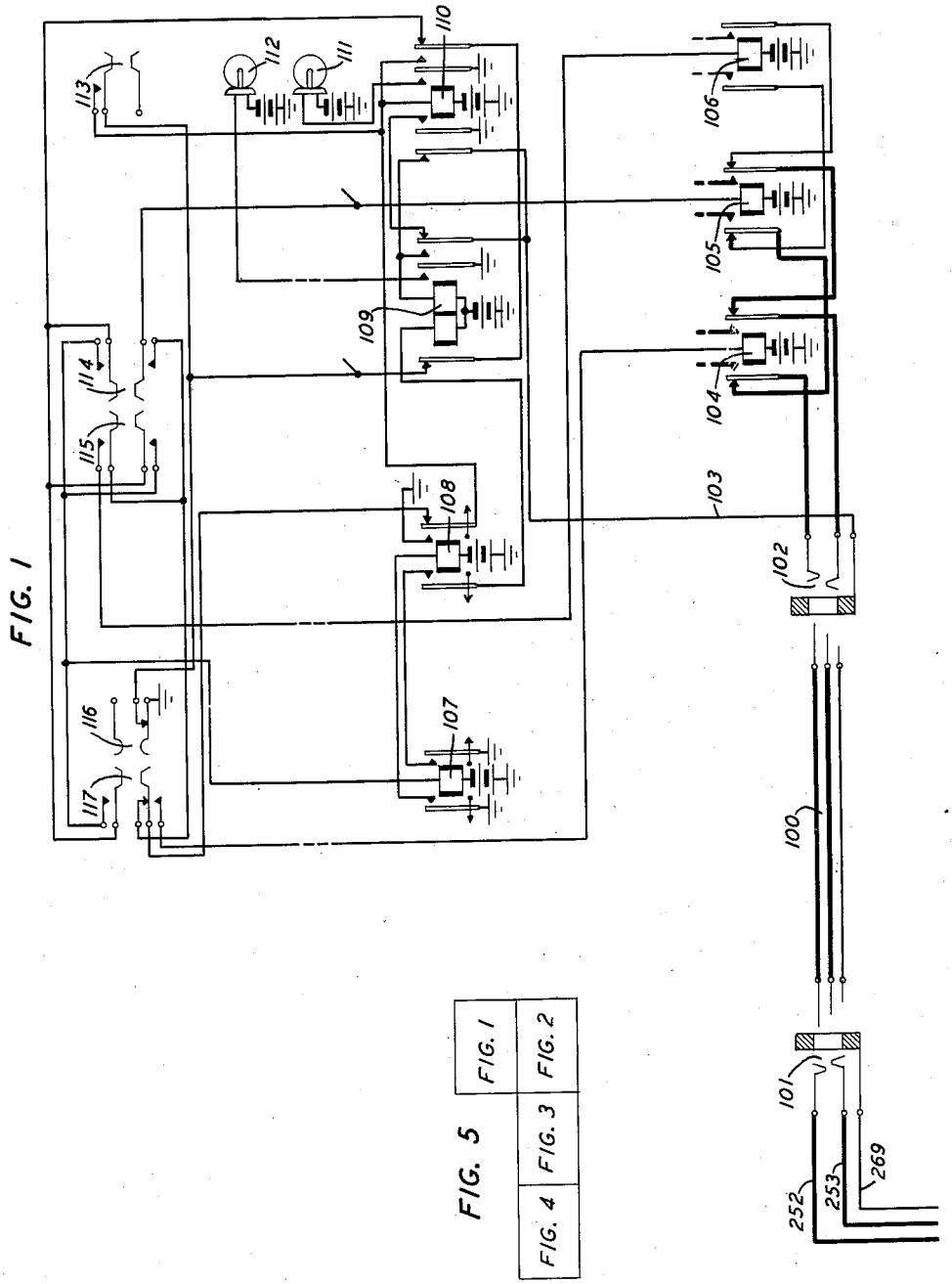

FIG. 1

FIG. 5

FIG. 1	FIG. 2
FIG. 3	
FIG. 4	

INVENTOR
A. S. BERTELS
BY P. C. Smith
ATTORNEY

July 31, 1934. A. S. BERTELS 1,968,435

TESTING CIRCUIT

Filed April 12, 1933 4 Sheets-Sheet 2

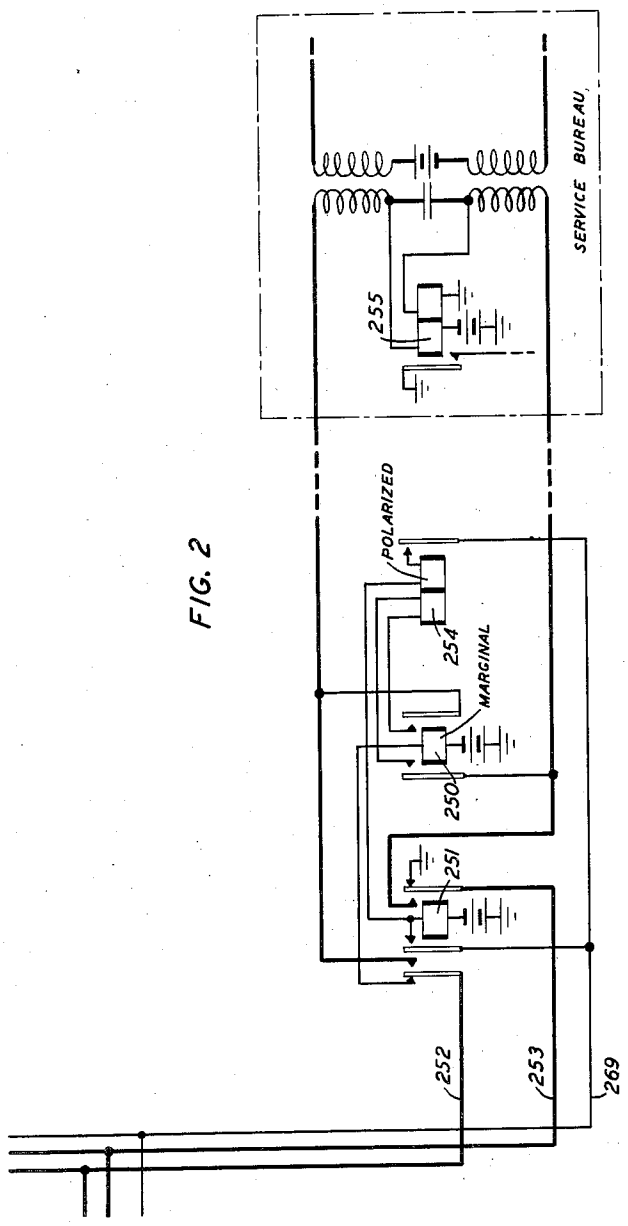

FIG. 2

INVENTOR
A. S. BERTELS
BY P. C. Smith
ATTORNEY

July 31, 1934. A. S. BERTELS 1,968,435

TESTING CIRCUIT

Filed April 12, 1933 4 Sheets-Sheet 3

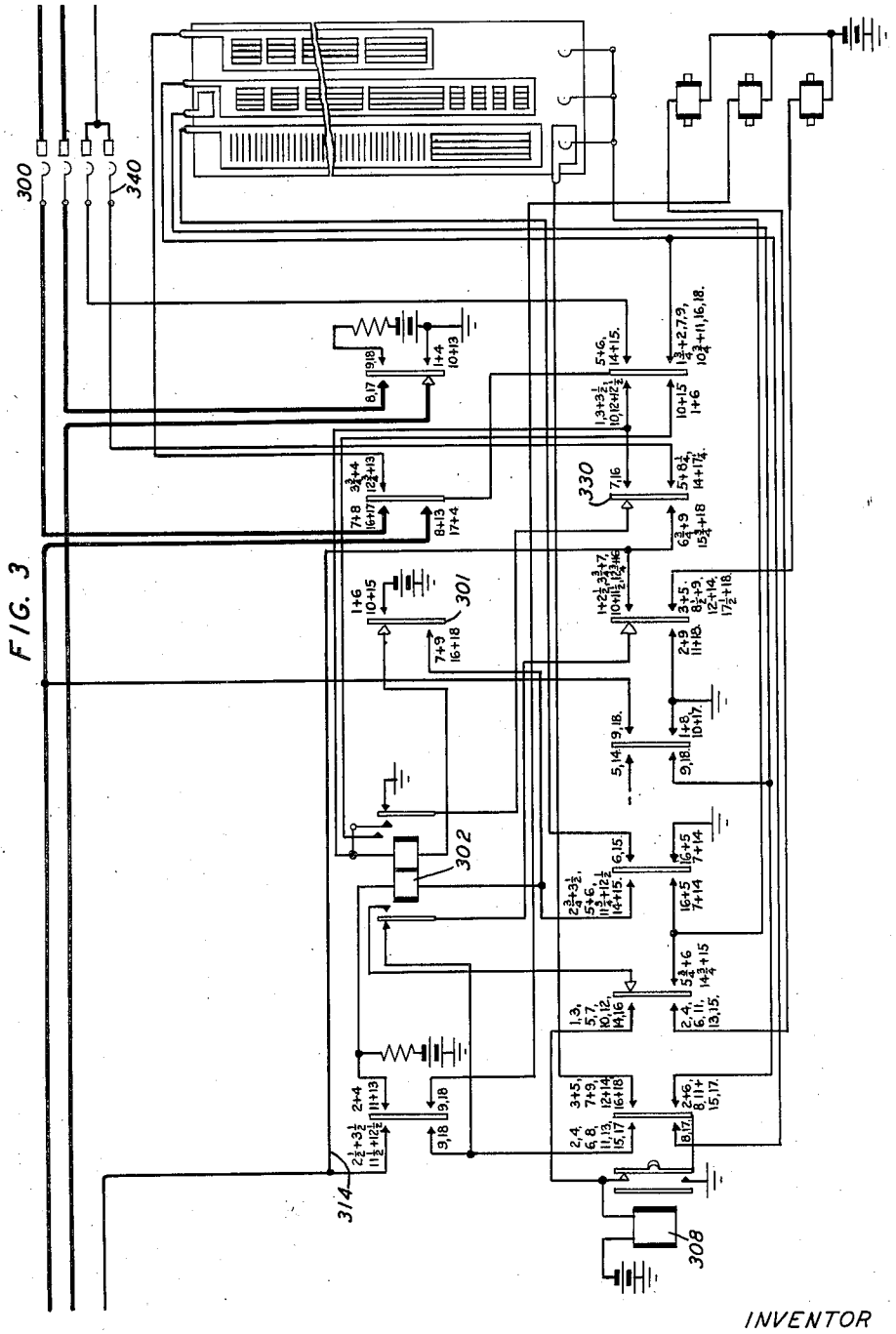

FIG. 3

INVENTOR
A. S. BERTELS
BY P. C. Smith
ATTORNEY

July 31, 1934. A. S. BERTELS 1,968,435

TESTING CIRCUIT

Filed April 12, 1933 4 Sheets-Sheet 4

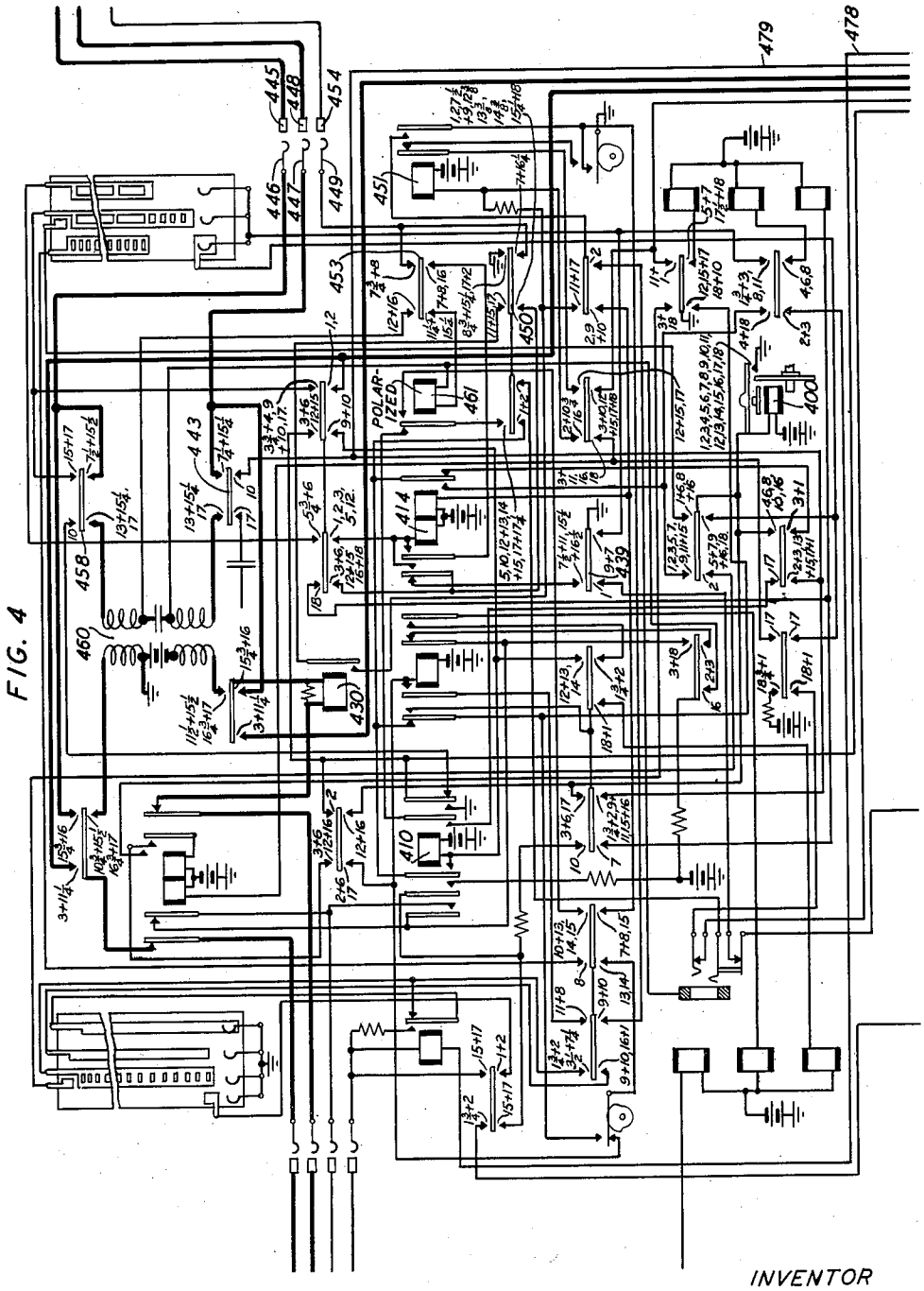

FIG. 4

INVENTOR
A. S. BERTELS
BY P. C. Smith
ATTORNEY

Patented July 31, 1934 1,968,435

UNITED STATES PATENT OFFICE

1,968,435

TESTING CIRCUIT

Arnold S. Bertels, Tenafly, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application April 12, 1933, Serial No. 665,688

11 Claims. (Cl. 179—175.21)

This invention relates to the testing of telephone systems and has for its object to prevent interference with the normal operation of such systems when initiating tests thereon.

Certain telephone equipment is provided with a busy test terminal extending to apparatus associated with the equipment and marked busy by the circuits by which it is normally seized. An appreciable interval may therefore elapse between the removal of the busy indication by the seizing circuit and the complete restoration to normal of the apparatus associated with the equipment. In testing such equipment it is therefore desirable to delay marking the busy test terminal of equipment to be tested for an interval to insure the complete release of this apparatus. However, during this delay busy marking from a service connection may become effective.

In accordance with the present invention, means is provided for connecting with the equipment to be tested, delaying the application of a busy marking and preventing the test from becoming effective if the equipment is seized in normal service before such busy marking is applied.

The invention is particularly applicable to the testing of trunk circuits outgoing to automatic switches of various sorts. The testing arrangement itself would therefore resemble that disclosed in Patent 1,543,900, granted to A. S. Bertels, June 30, 1925. A trunk of the type for which the present busy test was designed is disclosed and claimed in Patent 1,852,747 to A. E. Hague, granted April 5, 1932.

In the drawings which illustrate the invention, Fig. 1 shows the busy test arrangement of the test circuit;

Fig. 2 shows the trunk circuit to be tested;

Fig. 3 shows an office selector circuit;

Fig. 4 shows a district selector circuit; and

Fig. 5 shows the manner in which Figs. 1 to 4, inclusive are to be arranged.

Figs. 2 and 4 are identical with Figs. 3 and 6 of the above mentioned Hague patent, while Fig. 3 differs but slightly from the office selector shown in Patent 1,601,058 to C. H. Berry, granted September 28, 1926. Reference is made to these patents for a complete description of the operation of the selector switches and their circuits.

The trunk circuit of Fig. 2 may be connected to terminals of district selectors or to terminals of office selectors according to the traffic requirements. Assuming first that it is connected to multiple terminals appearing in the bank of the district selector of Fig. 4, the trunk will be seized in response to a trunk hunting operation which takes place in position 8 of sequence switch 400. Assuming that the trunk of Fig. 2 is the first idle one in the group selected brush 449 on engaging terminal 454 finds no potential thereon and permits relay 414 to release, immediately connecting ground over the upper contact of cam 439, left back contact of relay 414, lower contacts of cam 450 to brush 449, terminal 454 and conductor 269 to mark the trunk busy to other selectors. The release of relay 414 also advances sequence switch 400 to position 9 where relay 414 is reoperated and the sequence switch advanced to position 10, in which position further selections normally take place. As soon as sequence switch 400 reaches position 8¾, ground over the right contacts of cam 450 is connected to brush 449.

When the sender establishes the fundamental circuit for trunk test, a relay is connected across the fundamental tip and ring conductors thereby establishing a circuit from battery through the winding of relay 250, left back contact of relay 251, conductor 252, terminal 445, brush 446, lower right and upper left contacts of cam 458, right back contact of relay 410, conductor 478, through the trunk test relay of the sender (not shown), back to conductor 479, right contacts of cam 443, brush 447, terminal 448, conductor 253, right back contact of relay 251 to ground. The sender relay operates, but relay 250 of the trunk circuit, being marginal, does not. The operation of the sender relay causes the disconnection of the link circuit from the district selector and the advance of the district selector sequence switch to a talking position, for example, to position 13. When sequence switch 400 reaches position 11½, relay 430 is operated under the control of the calling subscriber in turn holding relay 451 operated. When sequence switch 400 reaches position 13, a new circuit for relay 250 is established extending as previously traced to cam 458 and over the lower left contact of that cam, upper right winding of repeating coil 460, left contacts of cam 453, winding of relay 461, lower right winding of repeating coil 460 to the upper left contact of cam 443 and thence to ground as previously traced. The resistance of this circuit is low enough to enable marginal relay 250 to operate, but is not in the proper direction to operate relay 461.

With relay 250 operated, a circuit is established from battery and ground through the windings of relay 255 at the distant end of the trunk, over the front contacts of relay 250, and through the left winding of polarized relay 254. Relays 255 and 254 operate in this circuit, relay 255 starting the operations at the distant end of the trunk and relay 254 closing a locking circuit for itself from battery through the winding of relay 251, right winding and front contact of relay 254 to the grounded sleeve conductor 269. Relay 251 also operates and locks to ground over conductor 269 and connects the tip and ring terminals 445 and 448 to the outgoing trunk conductors. The operation of relay 251 also releases relay 250 to disconnect the left

winding of relay 254 from the trunk and leaves the connection under the control of the sleeve conductor.

When the calling subscriber hangs up to release the connection, relay 430 releases in turn releasing relay 451. The release of relay 451 causes the advance of sequence switch 400 to position 18 where the line finder and district selector switches are restored to normal. As the sequence switch 400 leaves position 16¼, ground is disconnected from conductor 269, permitting relays 251 and 254 to release. If a ground were applied to conductor 269 from the test circuit, at the moment that it was removed by the district selector, the release of relays 251 and 254 would be prevented and the test would be mutilated.

If the trunk circuit is attached to the terminals of the office selector, the district selector functions as above described advancing to position 10. In this position the fundamental circuit is extended to the office selector which functions as described in the above identified Berry patent. Ground from the district selector connected to terminal 454 is extended over the upper normal contact of jack 350 to conductor 314. Selections take place under the control of relay 302 and sequence switch 308 advances to position 6 where trunk hunting takes place. As soon as an idle trunk is found, relay 302 releases, advancing sequence switch 308 to position 7, and connects ground over its right back contact, upper left and lower right contacts of cam 330 to sleeve brush 340. When sequence switch 340 reaches position 6¾, ground from the district selector over conductor 314 and the lower contacts of cam 330 is substituted for the ground from relay 302. In position 7 of sequence switch 308, relay 302 is reoperated, locking to ground on conductor 314 over the left contacts of cam 330. Relay 302 also advances sequence switch 308 to position 8 in which position talking takes place. Relay 250 is operated in series with relay 461 over the tip and ring conductors of the office selector. Relay 254 operates over the outgoing trunk conductors locking in series with relay 251 to sleeve conductor 269 and thence to ground at the district selector.

When the calling subscriber hangs up, ground is disconnected from the sleeve brush 449 of the district selector thereby also removing ground from the sleeve brush 340 of the office selector and the sleeve conductor 269 of the trunk circuit. Removal of ground at the district selector permits relay 302 to release and advances sequence switch 308 to position 9 where the office selector is restored to normal. It may be noted that circuit exists from battery through the left winding of relay 302, left contacts of cam 301, right winding of relay 302, outer right front contact of relay 302, upper left and lower right contacts of a cam 330, to brush 340 by which relay 302 might be held operated and the release of the office selector prevented by the application of premature ground to conductor 269.

Referring now to Fig. 1, when a trunk circuit such as that of Fig. 2 is to be tested, the patching cord 100 is inserted in the test jack 101 of the trunk and in the jack 102 leading to the test circuit. If the trunk is busy, ground connected to conductor 269, completes a circuit over the sleeves of jack 101, cord 100, and jack 102, conductor 103, left back contact of relay 110, through the right winding of relay 109 to battery. Relay 109 in operating closes an obvious circuit for busy lamp 112 indicating to the testman that the trunk is not in condition to be tested. Relay 109 in operating locks over its outer right contact to grounded conductor 103, thus maintaining the busy signal as long as the condition continues.

The test circuit is arranged to make three different types of test under the control of test keys 117, 115 and 114. These keys in turn control relays 104, 106 and 105, respectively to extend the tip and ring conductors of the trunk to the testing equipment.

Assuming that busy lamp 112 is not lighted following the patching connection between the test circuit and the trunk circuit and that key 117 is operated to initiate the corresponding test, a circuit is closed from battery through the winding of relay 107, upper contact of key 117, right back contact of relay 110, left back contact of relay 109 to ground at the contact of disconnect key 116. Relay 107 in turn operates relay 108 which operates relay 110. With relay 107 operated, the operation of relay 108 closes a circuit from ground over the right contact of relay 107, left contact of relay 108, left winding of relay 109 to battery. Relays 109 and 110 open the energizing circuit of relay 107 which is slow to release thereby holding relays 108, 109 and 110 operated for an appreciable interval. Relay 109 in operating prepares a holding circuit for itself from battery through its right winding and outer right contact to sleeve conductor 103 so that, if the trunk circuit has been seized subsequent to the operation of key 117, relay 109 will be held operated to prevent key 117 from being effective. Since the circuit of relay 110 is held closed at the contact of relay 108 after the circuit of relay 109 is opened by relay 107, the release of relay 109 closes a holding circuit for relay 110 over the outer right contact of relay 110, left back contact of relay 109 to ground over disconnect key 116. Relay 110 lights lamp 111 to indicate that the test may proceed. It also connects ground over its left front contact, right back contact of relay 109 to conductor 103 to mark the trunk busy to service connections during the time that the test is in progress. When relay 108 closes its back contact, a circuit is closed from battery through the winding of relay 104, lower operated contact of key 117, back contact of relay 108 to the locking circuit of relay 110. Relay 104 extends the tip and ring conductors of the trunk circuit to the testing equipment (not shown) where a circuit is established for relay 250 to initiate the operation of the equipment in which the trunk terminates.

If key 117 is left operated after relay 109 indicates by lighting lamp 112 that the trunk has become busy, relay 109 will release when the busy condition is removed and the operations above described will take place before the test circuit marks the trunk busy. This delay is to permit relays 251 and 254 to release and restore the trunk to normal. It also permits the office selector to advance and open the holding circuit of relay 302 if the trunk appears in the office selector multiple. Key 116 is used to open the locking circuit of relay 110 at the completion of the test, while key 113 closes a circuit in parallel with the contact of relay 109 to permit making a test in spite of the busy condition if it seems desirable.

What is claimed is:

1. In a telephone system, telephone equipment, means for seizing said telephone equipment,

means immediately effective to test whether said equipment is busy, independently operable means for initiating the operation of said equipment, means under the control of said initiating means to mark said equipment busy, and means to delay said marking operation for a predetermined period following the operation of said initiating means.

2. In a telephone system, a trunk circuit, means for seizing said trunk circuit, means immediately effective to test whether said trunk is busy, independently operable means for initiating the operation of said trunk circuit, means under the control of said initiating means to mark said trunk circuit as busy, and means to delay said marking operation for a predetermined period following the operation of said initiating means.

3. In a telephone system, a trunk circuit, means for seizing said trunk circuit, means immediately effective to test whether said trunk is busy, means to initiate the operation of said trunk circuit, means under the control of said initiating means to mark said trunk circuit as busy, means to delay said marking operation for a predetermined period following the operation of said initiating means, and means effective during said delay to test whether said trunk circuit becomes busy.

4. In a telephone system, a trunk circuit, means for seizing said trunk circuit, means immediately effective to test whether said trunk is busy, means to initiate the operation of said trunk circuit, means under the control of said initiating means to mark said trunk circuit as busy, means to delay said marking operation for a predetermined period following the operation of said initiating means, means effective during said delay to test whether said trunk circuit becomes busy, and means under the control of said testing means to render said initiating means ineffective.

5. In a telephone system, a trunk circuit, a testing device for testing said trunk circuit, means to connect said testing device with said trunk circuit, means immediately responsive to said connection to test whether said trunk circuit is busy, means to initiate the operation of said testing device, means under the control of said initiating means to disable said busy testing means and to mark said trunk busy, and means to delay the operation of said marking means for a predetermined period following the operation of said initiating means.

6. In a telephone system, a trunk circuit, a testing device for testing said trunk circuit, means to connect said testing device with said trunk circuit, a busy test relay, a circuit for said relay immediately effective following said connection to test whether said trunk circuit is busy, means to initiate the operation of said testing device, means under the control of said initiating means to open said circuit for said busy test relay, and to mark said trunk busy, means to delay the operation of said marking means for a predetermined period following the operation of said initiating means, and means effective during said delay to prepare a second circuit for said busy test relay.

7. In a telephone system, a trunk circuit, a testing device for testing said trunk circuit, means to connect said testing device with said trunk circuit, a busy test relay, a circuit for said relay immediately effective following said connection to test whether said trunk circuit is busy, means to initiate the operation of said testing device, means under the control of said initiating means to open said circuit for said busy test relay and to mark said trunk busy, means to delay the operation of said marking means for a predetermined period following the operation of said initiating means, means effective during said delay to prepare a second circuit for said busy test relay and means under the control of said busy test relay to render said initiating means ineffective.

8. In a telephone system, a trunk circuit, a testing device for testing said trunk circuit, means to connect said testing device with said trunk circuit, a busy test relay, a first circuit for said relay immediately effective following said connection to test whether said trunk circuit is busy, means to initiate the operation of said testing device, means under the control of said initiating means to open said first circuit for said busy test relay and to mark said trunk busy, means to delay the operation of said marking means for a predetermined period following the operation of said initiating means, and means effective during said delay to close a local circuit for said busy test relay and to prepare a testing locking circuit for said relay.

9. In a telephone system, a trunk circuit, means for seizing said trunk circuit, means immediately effective to test whether said trunk is busy, means to initiate the operation of said trunk circuit, means under the control of said initiating means to mark said trunk circuit as busy, means to delay said marking operation for a predetermined period following the operation of said initiating means, means effective during said delay to test whether said trunk circuit becomes busy, means under the control of said testing means to render said initiating means ineffective, and other means to render said initiating means immediately effective.

10. In a telephone system, a trunk circuit, a testing device for testing said trunk circuit, means to connect said testing device with said trunk circuit, means immediately responsive to said connection to test whether said trunk circuit is busy, means to initiate the operation of said testing device, means under the control of said initiating means to disable said busy testing means and to mark said trunk busy, means to delay the operation of said marking means for a predetermined period following the operation of said initiating means, and other means to render said delay means inoperative.

11. In a telephone system, a trunk circuit, a testing device for testing said trunk circuit, means to connect said testing device with said trunk circuit, a busy test relay, a circuit for said relay immediately effective following said connection to test whether said trunk circuit is busy, means to initiate the operation of said testing device, means under the control of said initiating means to open said circuit for said busy test relay and to mark said trunk busy, means to delay the operation of said marking means for a predetermined period following the operation of said initiating means, means effective during said delay to prepare a second circuit for said busy test relay, means under the control of said busy test relay to render said initiating means ineffective, and other means to render said initiating means independent of said busy test relay.

ARNOLD S. BERTELS.