

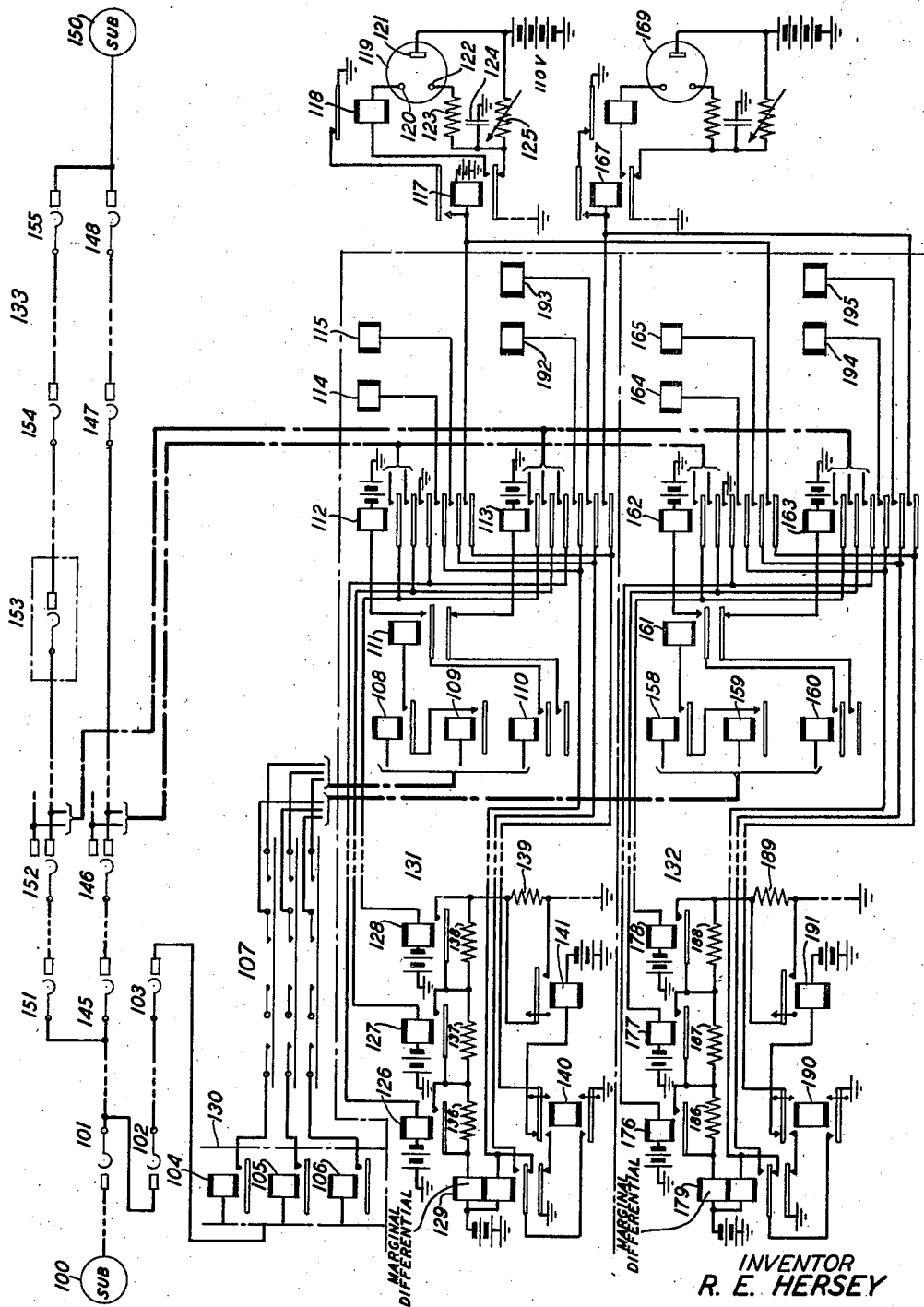
Dec. 2, 1947.

R. E. HERSEY

2,431,692

ALTERNATE ROUTE TELEPHONE SWITCHING MECHANISM

Filed May 15, 1945



UNITED STATES PATENT OFFICE

2,431,692

ALTERNATE ROUTE TELEPHONE
SWITCHING MECHANISM

Ralph E. Hersey, Madison, N. J., assignor to Bell
Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

Application May 15, 1945, Serial No. 593,957

11 Claims. (Cl. 179—18)

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This invention relates to telephone systems and more particularly to systems employing automatic switching mechanisms under common control.

In such systems connections between subscriber's lines terminating in different offices are established over groups of interoffice trunks. Arrangements have heretofore been suggested whereby, when a group of interoffice trunks is insufficient to carry the calls directed thereover, a part of the calls are routed over trunks leading to a tandem point where they are completed to the desired office.

The present invention is more particularly directed to the type of telephone system disclosed in Patent No. 1,862,549, granted June 14, 1932, to R. Raymond and W. J. Scully, in which panel type switches, known as district and office selectors are used for selecting a trunk to a wanted office. These selectors are operated under the control of register senders, which receive the wanted line designation as dialed by the calling subscriber. When the office code has been received, the sender summons a decoder and transmits to it the office code. The decoder translates this code and returns to the sender an indication of the selections to be made, the nature of the called office and other information required for the completion of the call.

Plans heretofore proposed for the alternate routing of interoffice traffic from panel type dial offices have employed considerable equipment individual to the trunk groups which is effective to switch from the normal route to the alternate route before all of the trunks of the normal route become busy and have therefore resulted in unnecessary rerouting.

In accordance with the present invention each decoder is equipped with means for testing trunk groups of such a nature that plurality of decoders may test a line group simultaneously.

The testing means of the invention operates a direct route relay if there are idle trunks available and an alternate route relay if no idle trunks appear available, means being provided individual to the direct trunk group to simulate one busy trunk for a predetermined interval after a trunk group is tested.

Means is also provided for varying the length of time for simulating the busy trunk in accordance with the size and location of the trunk group.

These and other features of the invention will be more apparent from a consideration of the following detailed description taken in connec-

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tion with the accompanying drawing which shows in schematic form a calling and a called subscriber's line with panel type switching equipment for establishing a connection between them, together with a sender, decoder-connector and parts of two decoders, only the circuits embodying the invention having been shown in detail.

For a complete disclosure of a telephone system to which the present invention relates, reference may be made to the above-mentioned patent to Raymond and Scully, while a tandem office, suitable for use in the alternate route, is disclosed in Patent 1,840,132, granted January 5, 1932, to T. H. Roberts.

Assuming that the subscriber at substation 100 wishes to talk with the subscriber at substation 150, he removes his receiver to originate the call. In response to the removal of the receiver the line finder 101 is automatically operated to connect with the calling line, while the district finder 102 and sender selector 103 are also operated to extend the line 100 to the sender 130. The subscriber now dials the number of the substation 150, which is made up of the code designation of the office 133 at which the line 150 is located and the numerical designation of the line.

When the code designation has been recorded on the code registers represented by relays 104, 105 and 106, the decoder-connector 107 is operated to connect the sender 130 with an idle decoder, for example, decoder 131. The code registers of the decoder, represented by relays 108, 109 and 110 then take the code registration from the sender.

All these operations take place as described in the Raymond-Scully patent. However, instead of immediately operating a route relay in response to the translation performed by the code registers as takes place in the above patent, an intermediate or code relay such as relay 112 or 113 is operated. Relay 112 is shown associated with a group of trunks leading to the wanted office while relay 113 is shown associated with a group of trunks leading to an intermediate office. Either one of these code relays may be operated as a result of dialing the appropriate code, but since it was assumed that the code of office 133 was dialed, code relay 112 will be operated.

Included in each decoder is a set of test relays 126, 127, 128, etc. sufficient in number to test the largest group of trunks. When a code relay operates, it connects the sleeve conductors of the group of trunks associated with that code to the windings of the test relays. Busy trunks have

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ground connected to their sleeve conductors from the district selector circuit, so that the test relays 126, 127, 128, etc. connected with busy trunks are operated. Where there are fewer trunks in a group than the number of test relays, the code relay connects direct ground to the test relays not connected to a trunk. This is illustrated by relay 112, where two of the trunks outgoing to office 133 are shown connected over the two inner contacts of relay 112 to the windings of relays 127 and 128 while direct ground is connected over the third contact of relay 112 to the winding of relay 126. Assuming that the two trunks indicated are idle, relays 127 and 128 will not operate, but relay 126 will be operated by the ground supplied by relay 112. A circuit is closed through the upper winding of relay 129 through resistances 136, 137, 138, and 139 to ground as soon as the decoder 131 is seized. When relay 126 operates it short-circuits resistance 136, reducing the resistance in series with the upper winding of relay 129 by that amount. However, relay 129 is so adjusted that it will operate only in series with a single resistance such as resistances 136, 137, etc. and does not operate at this time.

When relay 140 operates, a measured time interval after the operation of relay 112, since relay 129 has not operated, a circuit is closed from ground, over the lower contact of relay 140, inner lower contact of relay 129, to battery through the lower winding of relay 129 and over the fourth contact of relay 112 to the winding of direct route relay 114. Route relay 114 performs the functions of a route relay as described in the Raymond-Sculley patent, transmitting to the sender the necessary information to permit it to control district selector 145, office selector 146, incoming selector 147 and final selector 148 and complete the connection to the called line 150.

The code register relays 108 to 110, code relay 112, route relay 114 and test relays 126 to 128 all release when the decoder releases in the usual manner.

If all of the trunks outgoing to office 133 had been busy, resistances 136, 137 and 138 would have been short-circuited, leaving only resistance 139 in series with the winding of relay 129, causing relay 129 to operate. When relay 140 operates under this condition, it closes a circuit from ground over its lower contact, front contact of relay 129, fifth contact of relay 112 to the winding of route relay 115 which is the alternate route relay for the direct route relay 114. Relay 115 transmits the necessary information to the sender to cause it to select brush set 151 of the district selector and to employ that brush set to extend the connection by way of office selector 152 to intermediate office 153 from which it is extended to office 133 and over incoming selector 154 and final selector 155 to the called line.

There may be other office codes, for example, one which operates code relay 113 for which the route by way of office 153 will represent the first choice or most direct route. In that case route relay 192, which is operated in response to testing the trunks to office 153 will transmit the same information to the sender for controlling the district and office selections but would transmit different information for controlling the extension of the call from office 153 toward the wanted office.

Each trunk group is provided with a test recording relay which is effective to maintain an indication for a predetermined time after the test.

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Each time that the trunk group associated with code relay 112 is tested, and relay 129 is not operated, a circuit is closed from ground at the lower back contact of relay 129, front contact of relay 140, lower front contact of relay 112 to the winding of relay 117 and battery. Relay 117 operates and locks over its upper contact to ground at the back contact of relay 118. At its lower contact, relay 117 disconnects ground from in shunt of condenser 124 and permits that condenser to charge from +110-volt battery through resistance 125. At its lower front contact, relay 117 connects ground to the winding of relay 118 which is connected to the anode of gas-filled tube 119. As condenser 124 gradually charges it increases the potential on the control anode 122 of the tube 119 to a point where the control gap breaks down causing the main gap to flash and operate relay 118. Relay 118 in operating releases relay 117 which discharges the timing condenser. Resistance 125 is indicated as variable since it may be set at different values to control the time which is to be consumed in charging the condenser 125 in accordance with the size and location of the trunk group.

If this same group of trunks is again seized for test while relay 117 is locked, the operation of code relay 112 closes a circuit from battery through the winding of relay 141, back contact of relay 140, lowest contact of relay 112, upper contact of relay 117 to ground at the back contact of relay 118. Relay 141 operates in this circuit and short-circuits resistance 139. If at this time there is only one idle trunk in the group, that trunk will be seized as a result of the trunk test which operated relay 117 and is not available for this second call. Relay 129 operates, and causes the operation of alternate route relay 115 to direct this call over the alternate route. After relay 117 releases, relay 129 can only operate if all of the trunks are busy. Relay 167 and tube 169 are individual to the group of trunks outgoing to office 153 and similar relays are provided for each trunk group.

The circuit previously traced to the lower winding of relay 129 in parallel with the operating circuit for the direct route relay opposes that through the upper winding. Since the circuit is open at the time that relay 129 normally operates it does not interfere with that operation. Furthermore, after relay 129 has operated, the circuit is opened at the contact of relay 129 so that it has no tendency to falsely release relay 129. Its chief value appears at a time when the seizure of an additional trunk might cause the operation of relay 129 in the middle of a test and interfere with the operation of the route relay. Such a time might be when two trunks are idle, but one will be seized because of a prior test as indicated by the operation of relay 117. Under this condition relay 129 will not operate, but if the prior call seizes its trunk before the route relay has been operated and this marker released, another resistance would be short-circuited, leaving only one in series with relay 129 and tending to operate relay 129. However, under this condition the circuit through the lower winding is of sufficient strength to neutralize the current through the upper winding and hold the back contacts closed.

It will be noted that this arrangement is such that two decoders such as decoders 131 and 132 can test a trunk group at the same time since the grounded sleeve conductors merely operate two test relays in parallel.

What is claimed is:

1. In a telephone exchange system, a calling

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office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connections may be further extended to said called offices, a plurality of control means in said calling office each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means, means responsive to the operation of a code relay in one of said control means for connecting said trunk testing means with the trunks extending to the corresponding office, means effective to operate the route relay of the corresponding office if one of said trunks is idle, and means to simulate to said trunk testing means a busy condition of one of said trunks for a predetermined time after the operation of said route relay.

2. In a telephone exchange system, a calling office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connections may be further extended to said called offices, a plurality of control means in said calling office each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means, means responsive to the operation of a code relay in one of said control means for connecting said trunk testing means with the trunks extending to the corresponding office, means effective to operate the route relay of the corresponding office if one of said trunks is idle, a relay individual to said trunk group, means to operate said individual relay under the control of said code relay, timing means, means to lock said relay under the control of said timing means, and means under the control of said individual relay to simulate to said trunk testing means a busy condition of one of said trunks after the operation of said route relay for a time interval measured by said timing means.

3. In a telephone exchange system, a calling office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connections may be further extended to said called offices, a plurality of control means in said calling office each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means, means responsive to the operation of the code relay of a particular office in a plurality of said control means for simultaneously connecting the trunk testing means of said plurality of control means to the group of trunks extending to said particular office, and means effective in each control means to operate the route relay of said particular office.

4. In a telephone exchange system, a calling

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office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connections may be further extended to said called offices, a plurality of control means in said calling office each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means, means responsive to the operation of the code relay of a particular office in a plurality of said control means for simultaneously connecting the trunk testing means of said plurality of control means to the group of trunks extending to said particular office, means effective in each control means to operate the route relay of said particular office, means individual to said group of trunks to simulate a busy condition of one trunk, and means responsive to the connection of said group of trunks to the testing means in any one of said control means for rendering said busy simulating means effective.

5. In a telephone exchange system, a calling office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connection may be further extended to said called offices, a plurality of control means in said calling office each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means, means responsive to the operation of the code relay of a particular office in a plurality of said control means for simultaneously connecting the trunk testing means of said plurality of control means to the group of trunks extending to said particular office, means effective in each control means to operate the route relay of said particular office, means individual to said group of trunks to simulate a busy condition of one trunk and means responsive to the connection of said group of trunks to the testing means in any one of said control means for rendering said busy simulating means effective, and means for holding said busy simulating means operated for a predetermined length of time.

6. In a telephone exchange system, a calling office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connections may be further extended to said called offices, a plurality of control means in said calling office, each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means, means responsive to the operation of a code relay in one of said control means for connecting said trunk testing means with the trunks extending to the corresponding office, means effective to

operate the route relay of the corresponding office if one of said trunks is idle, a relay individual to said trunk group, means to operate said individual relay under the control of said code relay, timing means, means to lock said relay under the control of said timing means, means under the control of said individual relay to simulate a busy condition of one of said trunks after the operation of said route relay for a time interval measured by said timing means, and means to adjust said timing means to provide different predetermined times for different trunk groups.

7. In a telephone exchange system, a calling office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connection may be further extended to said called offices, a plurality of control means in said calling office each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means, means responsive to the operation of the code relay of a particular office in a plurality of said control means for simultaneously connecting the trunk testing means of said plurality of control means to the group of trunks extending to said particular office, means effective in each control means to operate the route relay of said particular office, means individual to said group of trunks to simulate a busy condition of one trunk, and means responsive to the connection of said group of trunks to the testing means in any of said control means for rendering said busy simulating means effective, means for holding said busy simulating means operated for a predetermined length of time, and means to adjust said timing means to provide different predetermined times for different trunk groups.

8. In a telephone exchange system, a calling office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connections may be further extended to said called offices, a plurality of control means in said calling office each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means including a resistance for each trunk and an auxiliary resistance arranged in series, means responsive to the operation of a code relay in one of said control means for connecting said trunk testing means with the trunks extending to the corresponding office and for short-circuiting the resistances associated with busy trunks, a marginal relay operative when all of said trunk resistances are short-circuited, means under the control of said marginal relay to operate the route relay of the corresponding office if at least one of said trunks is idle, means to operate a different route relay if said marginal relay is operated, and means to simulate a busy condition of one of said trunks for a predetermined time after the op-

eration of said route relay by short-circuiting said auxiliary resistance.

9. In a telephone exchange system, a calling office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connections may be further extended to said called offices, a plurality of control means in said calling office each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means including a resistance for each trunk and an auxiliary resistance arranged in series, means responsive to the operation of a code relay in one of said control means for connecting said trunk testing means with the trunks extending to the corresponding office and for short-circuiting the resistances associated with busy trunks, a marginal relay operative when all of said trunk resistances are short-circuited, means under the control of said marginal relay to operate the route relay of the corresponding office if at least one of said trunks is idle, means to operate a different route relay if said marginal relay is operated, a relay individual to said trunk group, means to operate said individual relay under the control of said code relay, timing means, means to lock said relay under the control of said timing means, and means under the control of said individual relay to simulate a busy condition of one of said trunks after the operation of said route relay by short-circuiting said auxiliary resistance for a time interval measured by said timing means.

10. In a telephone exchange system, a calling office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connections may be further extended to said called offices, a plurality of control means in said calling office each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means including a resistance for each trunk and an auxiliary resistance arranged in series, means responsive to the operation of a code relay in one of said control means for connecting said trunk testing means with the trunks extending to the corresponding office and for short-circuiting the resistances associated with busy trunks, a marginal relay operative when all of said trunk resistances are short-circuited, means effective a predetermined time after the operation of said code relay under the control of said marginal relay to operate the route relay of the corresponding office if at least one of said trunks is idle, means to operate a different route relay if said marginal relay is operated, means to simulate a busy condition of one of said trunks for a predetermined time after the operation of said route relay by short-circuiting said auxiliary resistance, and means under the control of said route relay operating means for preventing the subsequent operation of said marginal relay.

11. In a telephone exchange system, a calling office, called offices, an intermediate office, switching mechanism located in said calling office, a group of direct trunks extending from said switching mechanism to each of said called offices, a group of trunks extending from said switching mechanism to said intermediate office over which connections may be further extended to said called offices, a plurality of control means in said calling office each including a code relay and a route relay for each called office and means responsive to the operation of said route relay for controlling said switching mechanism to seize a trunk leading to the corresponding office, trunk testing means in said control means including a resistance for each trunk and an auxiliary resistance arranged in series, means responsive to the operation of a code relay in one of said control means for connecting said trunk testing means with the trunks extending to the corresponding office and for short-circuiting the resistance associated with busy trunks, a marginal relay operative when all of said trunk resistances are short-circuited, means effective a predetermined time after the operation of said code relay under the control of said marginal relay to oper-

ate the route relay of the corresponding office if at least one of said trunks is idle, means to operate a different route relay if said marginal relay is operated, a relay individual to said trunk group, means to operate said individual relay under the control of said code relay, timing means, means to lock said relay under the control of said timing means, means under the control of said individual relay to simulate a busy condition of one of said trunks after the operation of said route relay by short-circuiting said auxiliary resistance for a time interval measured by said timing means, and means under the control of said route relay operating means for preventing the subsequent operation of said marginal relay.

RALPH E. HERSEY.

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