Fault Signaling Impulse Repeater

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This invention relates to improvements in fault signalling impulse repeater, particularly to impulse repeaters in automatic telephone systems, and has for an object to provide in an impulse repeater an improved arrangement for disconnecting the repeater in the event that an outgoing trunk, to which the repeater is connected, includes a faulty condition.

Another object of the invention is to provide an improved impulse repeater in which a faulty condition is revealed on a connected outgoing trunk only upon the repeater being seized by an incoming line.

Still another object of the invention is to provide an improved impulse repeater in which, upon a faulty outgoing trunk being revealed, the repeater is automatically made busy to further calls until the fault has been corrected.

A further object of the invention is to provide an improved repeater in which an indication of a faulty outgoing trunk is not effected during the idle period of the impulse repeater.

With the above objects in view, one embodiment of the invention discloses an impulse repeater of well-known type, to which is added a self-locking cut-off relay, which is controlled by a called subscriber's supervisory relay bridged across the outgoing trunk. Should a fault, such as a ground, open circuit, or short circuit, appear in the outgoing trunk, the cut-off relay, which is normally ineffective, will be operated upon seizure of the impulse repeater by a calling party, whereupon the preceding switches will be released, an alarm lamp will be energized for attention of the maintenance attendant, and the repeater will be rendered busy to further incoming calls until the fault has been cleared. Upon clearance of the trouble on the outgoing trunk the cut-off relay may then be released by the attendant's inserting a test plug into the repeater test jack, which is adapted to release the cut-off relay, the repeater thereby being put into condition for further calls.

A more complete understanding of the invention will be obtained from the following description of a preferred embodiment thereof, taken in conjunction with the accompanying drawing in which a circuit arrangement of an impulse repeater is interposed between a calling subscriber's loop and an outgoing trunk to a called subscriber's loop of an automatic telephone system.

Referring now to the drawing, there is shown an impulse repeater connected at the left, as viewed in the drawing, though suitable switches (not shown), such as selectors, to a calling subscriber's line or loop; and at the right to an outgoing trunk, which is connected, in a manner well-known in automatic telephone practice, to a called subscriber. Before proceeding with a description of the circuit, however, the manner of illustrating the relays and associated contacts on the drawings will be first explained. It will be observed that each relay is identified by a lettered character with a horizontal bar underneath the character and a numeral thereunder. The lettered character indicates the designation of the relay, while the numeral thereunder indicates the number of contacts associated with the particular relay. For example, relay E indicates a relay having one contact, which is designated E1, while relay B indicates a relay having four contacts, which are designated B1, B2, B3, and B4. The contacts are, as illustrated, disposed in the circuit in a manner to shorten the leads interconnecting the component elements of the circuit.

The invention will be more readily understood from a detailed description of the operation.

Assuming a call to have been originated at a subscriber station (not shown), a circuit is closed upon removal of the receiver from the mounting (not shown), which closure energizes line relay A in a circuit that can be traced from grounded battery through upper winding of relay A, non-operated break contact D4, over conductor, through conventional switches and calling subscriber's loop (not shown), back over + conductor, and thence through non-operated break contact D3 to ground via lower winding of relay A. Relay A operates, contact A1 closing the positive conductor of the outgoing trunk and contact A2 closing an obvious operating circuit for relay B. Relay B in operating at contact B1 prepares an operating circuit for relay C; at contact B2 prepares an operating circuit for relay F and relay CO; at contact B3 closes the — conductor of the outgoing trunk and in conjunction with contact A1 connects an energizing circuit for relay E; and at contact B4 grounds the test lead P.

The circuit for energizing relay E may be traced from a grounded battery connection provided by an impulse relay (not shown) in the distant office, over the — conductor of the outgoing trunk, through make contact B3, break contact C1, right winding of relay F, break contact D2, upper wind-
ing of relay E, make contact A1 and thence over the positive conductor of the outgoing trunk to ground furnished by the aforesaid impulse relay. Relay E is energized and opens at contact E1 an operating circuit for relay CO, which, in turn, has been closed simultaneously at contact B2. In other words, relays B and E operate substantially at the same time, so that slow operate relay CO is not permitted to operate. Relay F is an electro-polarized relay and, as is well-known, will not operate until the polarity of the outgoing trunk is reversed, these left-hand right windings of this relay producing substantially equal amounts of opposing magnetic flux.

The subscriber now operates his dial (not shown) and intermittently interrupts the calling loop circuit, line relay A releasing in accordance with the interruption in the well-known manner. At the first release of relay A, contact A1 retracts and opens the outgoing trunk circuit and contact A2 closes an operating circuit for relay C. This circuit may be traced from grounded battery through winding of relay C, make contact B1, and to ground through retracted contact A2. Relay C operates and at contact C1 short circuits relay E; at contact C2 places a further ground on the test lead P; and at contact C3 opens a circuit to relay CO. It will be noted that contact C3 opens the circuit for relay CO prior to retraction of contact E1 upon release of relay E, thereby preventing the cut-off relay CO from operating during the impulsive period. Relay C is of the slow-release type and continues operated only during the impulsive period.

Upon cessation of dialing by the calling party and assuming that the called party answers, the called party's battery feed relay (not shown) operates and reverses the current over the + and - conductors of the outgoing trunk. Relays F and D then operate in the usual manner to provide reversed battery supervision to the calling party, as is well known in the art.

At the end of the conversation, relays A, B, D, and F release. Since relay C receives an impulse at contact A2, the operating circuit of relay CO is still interrupted at contact C3 until contact B2 is retracted, thereby maintaining the cut-off relay inoperative. It is thus apparent that at no time during the normal operation of the repeater is the cut-off relay operated, particular precaution being taken to prevent operation thereof.

Assuming now that the outgoing trunk includes a faulty condition, such as an open, a ground, or a short, or further, a disconnected selector at the distant office, it will be seen that relay E cannot be energized in response to seizure of the repeater by a calling party. In other words, the battery and ground furnished by the impulse relay at the distant office will not be available for energizing relay E. Thus, upon operation of relay A and subsequent operation of relay B, contact B2 completes an operating circuit for relay CO which may be traced from grounded battery through the 1000 ohm winding of relay CO, back contact E1, back contact C3, and make contact B2 to ground. Relay CO, in operating, contact CO1 provides a locking circuit to ground via 1000 ohm winding thereof and resistance R, which is preferably non-inductive; at contact CO2 energizes an obvious alarm circuit, including lamp L, and the initiators of the maintenance attendant; and at contact CO3 disconnects the test conductor P from ground, thereby releasing the previous switch train. In view of the release of the preceding switch train, relays A and B release. Contact B4, in retracting, re-connects ground to the test lead P via the make contact CO3, thus guarding this repeater against further intrusion and preventing the test phone from being caused until the faulty condition has been corrected.

The maintenance attendant, now aware of the trouble condition, plugs the well-known hand test telephone set into the test jack, which comprises springs T1, T2, and T3, as shown. Battery and ground are connected through springs T1 to operate relays A and B in the hereinafore-described manner, and spring T2 and T3 are bridged, with the 1000 ohm holding winding of relay CO short circuited. If the faulty condition still exists on the outgoing trunk, relay CO will not release because the hereinafore-described operating circuit thereof is still maintained by make contact B2 and back contacts C3 and E1, relay E failing to operate in view of the continued fault on the outgoing trunk. The attendant, in removing the test phone, will re-introduce the 1000 ohm holding coil of relay CO so that this relay continues in an operating condition. If the test phone is plugged into the test jack after the outgoing trunk has been repaired, relay E, in operating, at contact E1 opens the operating circuit for relay CO and the test jack short circuits the holding winding thereof. Consequently, the cut-off relay CO releases and at contact CO1 opens the holding circuit, contact CO2 extinguishes the alarm lamp, and contact CO3 removes the guarding ground from test conductor P, thereby conditioning the repeater for further use.

While this invention has been shown and described in accordance with the preferred embodiment merely for the purpose of illustration, it is, of course, understood that various modifications may be made and that the features thereof may be applied to many other fields without departing from the scope of the invention, as defined in the appended claims.

What is claimed is:
1. In a signaling system of the automatic telephone service, comprising relay means, and dial impulses, the dial impulses are impressed upon a line, means for repeating said impulses over an outgoing trunk to a distant switch, said repeating means including a supervisory relay bridged across said outgoing trunk, said relay being energized by a source of energy supplied from said distant switch, a cut-off relay immediately responsive to release of said supervisory relay upon occurrence of a fault on said outgoing trunk, means responsive to said cut-off relay for indicating said fault, and means responsive to said cut-off relay for rendering said repeater busy to further incoming calls.
2. An impulse repeater adapted for interconnecting an incoming line and an outgoing trunk, including a first relay adapted to be energized under control of said line, a second relay disposed across said trunk, a source of energy connected to said trunk for energizing said second relay, said second relay being ineffective upon occurrence of a faulty condition on said trunk, a third relay of the slow-operating type, an operating circuit for said third relay, said circuit under control of said first and said second relays, alarm means to indicate a fault on said trunk and means to render said repeater busy to said line, both said means under control of said third relay.
3. An impulse repeater as claimed in claim 2 further comprising means for rendering said third
relay inoperative upon clearance of the fault on said trunk.

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REFERENCES CITED

The following references are of record in the file of this patent:

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