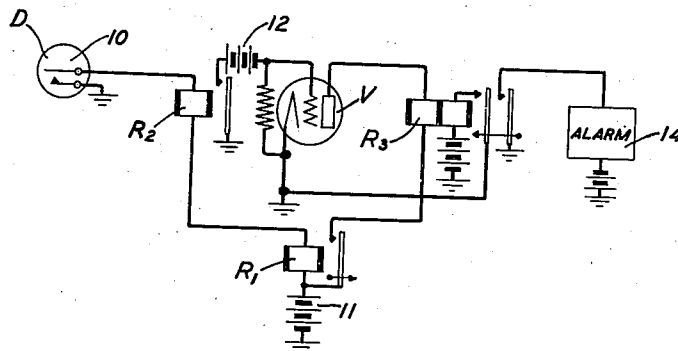


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J. H. McCONNELL
CONTACT TESTING DEVICE

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INVENTOR
J. H. McCONNELL
BY *A. G. Kingman*
ATTORNEY

UNITED STATES PATENT OFFICE

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CONTACT TESTING DEVICE

John H. McConnell, West Brighton, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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This invention relates to means for testing contact operating mechanisms and more particularly to means for indicating rebounds of the contact element of a telephone dial.

In the operation of circuit controlling contact devices the movable contact spring tends to rebound due to such causes as resiliency, momentum, etc. In the case of telephone dials or pulsing mechanisms, this rebounding of the contact element results in what are generally referred to as preliminary or secondary openings, depending upon whether they occur during the wind-up or return movement of the dial, and cause the transmission of imperfect pulses.

It is the object of this invention to provide a simple and reliable device for detecting untimely openings in the pulses generated by telephone dials and thus to detect improperly operating dials.

This object is attained in accordance with a feature of the invention by the provision of means which function to detect and to furnish a positive indication of the occurrence of a premature opening of the pulse generating contacts of a telephone dial and which discriminate between such premature opening and the standard opening which occurs at the end of a pulse. More specifically, the means resorted to comprise a gas-filled triode having an alarm control relay in its plate circuit and a pair of serially connected relays, controlled by the dial pulsing contacts, which cooperate to render the triode conductive only upon the occurrence of a premature opening of the dial contacts and to preclude the possibility of the alarm control relay operating when the contacts open at the end of a pulse.

The invention will be readily understood from the following detailed description made with reference to the accompanying drawing, the single figure of which illustrates the circuit arrangement embodying the features of the invention.

In the following description made with reference to the drawing, it will be assumed that the pulsing spring 10 of dial D closes and remains closed without any rebounding for the duration of the pulse period. Upon closure of the spring 10 upon its associated contact an obvious circuit including the serially connected windings of relays R₁ and R₂ is completed. It will be observed that normally the plate and grid electrodes of the triode V are disconnected from their respective battery supplies 11 and 12, the plate circuit being open at the armature and contact of relay R₁ and the grid circuit being

open at the armature and contact of relay R₂. Relay R₂ is designed to operate and release faster than relay R₁. Upon closure of the dial contact, therefore, relay R₁ will connect plate battery 11 to the plate electrode of tube V by way of the left winding of relay R₃ immediately after relay R₂ functions to connect battery 12 to the grid of tube V. The potentials of batteries 11 and 12 are such that under the condition just described the tube V is blocked and does not fire, so that no current flows in the plate circuit. This condition prevails as long as the dial contact remains closed, so that relay R₃ whose operating winding is included in the plate circuit of tube V does not operate.

At the end of the pulse period, the dial spring 10 leaves its associated contact, thus opening the circuit to relays R₁ and R₂. Relay R₂ being designed to restore faster than relay R₁ releases its armature before relay R₁ restores its armature. The plate circuit of tube V is therefore maintained complete while the blocking bias of battery 12 is removed from the grid of tube V. Relay R₃, however, does not operate because it is designed so as to require a longer time for its operation than is required for the release of relay R₁. It follows therefore that though the plate circuit of tube V is momentarily energized, the operating winding of relay R₃ does not receive sufficient current to operate the relay before relay R₁ releases its armature and opens the plate circuit. Relay R₃ does not operate therefore, to bring in an alarm when the dial contact spring functions without rebounding.

It will now be assumed that, after the closure of the dial spring 10 on its associated contact, the contacts open momentarily as in a secondary or preliminary opening. The circuit for the windings of relays R₁ and R₂ is opened at the dial contacts and relay R₂ being a speed relay, immediately releases its armature, but relay R₁ being relatively slow releasing, maintains its armature contact closed. Relay R₂ in releasing its armature opens the grid battery circuit thus removing the blocking potential from the grid of tube V. At the end of the momentary open, the dial contacts close, and the circuit for relays R₂ and R₁ is reestablished. Relay R₁ accordingly is maintained in its operated condition and, in turn, maintains the plate circuit of tube V closed. Though relay R₂ operates in series with relay R₁ and connects the blocking battery 12 to the grid of the tube, the tube continues to operate since its plate circuit was completed before the reconnection of battery 12 to the tube grid. In

other words, relay R₁, due to its slow releasing characteristics, does not have sufficient time to release its armature when the dial contacts open on a rebound, and since its operating circuit is closed when the dial contacts close at the end of the rebound, relay R₁ holds operated on the momentary open of the dial contacts. With relay R₁ operated, relay R₃ operates to establish an obvious circuit for the alarm 14. At its inner armature and front contact relay R₃ establishes a locking circuit for itself so that the relay R₃ remains operated after relay R₁ restores its armature at the end of the pulse period. The operation of the alarm 14 indicates to the test man that the contact device or dial under test is imperfect in that it does not transmit true pulses.

The operate and release characteristics of relays R₁, R₂ and R₃ are critical in the sense that the relays must function in definite time periods relative to one another. For example, relay R₂ must be a speed relay so as to operate ahead of relay R₁ when the dial contact is closed and must release immediately upon opening of the dial contact. If relay R₂ cannot release in the period of the secondary opening, no alarm will be given. The release time of relay R₂ should, therefore, be fast enough to detect the minimum amount of secondary opening which is objectionable. Relay R₁ must take longer to release than relay R₂ so that the arrangement may discriminate between a secondary open and the standard open at the end of a pulse period. The operate time of relay R₃ should be a little longer than the release time of relay R₁ less the release time of relay R₂. If the difference is too large, a secondary opening at the end of the pulse will not be registered as relay R₃ will not have time to operate before relay R₁ falls off.

From the foregoing description it is apparent that any secondary opening having a duration equal to or greater than the objectionable minimum opening and less than the standard opening occurring at the end of a pulse period is detected and a positive indication thereof provided, and that the duration of the minimum objectionable opening is determined by the release time of relay R₁. It is also apparent that the operate time of relay R₂ determines the period of time after the initial closure of the spring 10 on its contact during which rebounding cannot be detected. It has been found, however, that any rebounding of the contacts at the very start of the pulse period is of a high frequency nature as distinguished from a positive secondary opening and does not objectionably effect the pulse generated by the dial, so that a dial which might be characterized by such high frequency openings at the start of the pulse period need not be rejected as faulty. Irrespective of this fact, it has also been found that any dial which produces secondary openings at the very start or finish of the pulse period is always characterized by subsequent secondary openings in pulses of the same train which are readily detected by the circuit arrangement herein described and consequently no defective dials will be passed when tested with the arrangement disclosed.

What is claimed is:

1. A device for detecting rebounds of contacts whose initial closure initiates the transmission of a useful pulse, comprising a gas-filled triode, an alarm control relay included in the plate circuit of said triode and apparatus controlled by said contacts for discriminating between an open-

ing of said contacts occurring at the end of a pulse and a preceding premature opening occurring subsequent to the initial closure of said contacts whereby said triode is rendered conductive during the occurrence of the premature opening and the alarm control relay accordingly operated.

2. A device for detecting rebounds of contacts whose initial closure initiates the transmission of a useful pulse, comprising a gas-filled triode, an alarm control relay included in the plate circuit of said triode and means for discriminating between an opening of said contacts of predetermined duration and an opening thereof of less than the predetermined duration whereby the plate circuit of said triode is effectively completed and said alarm control relay operated only upon the occurrence of an opening of less than the predetermined duration, said means comprising a pair of serially connected relays controlled by said contacts and having distinctive time operate and release characteristics.

3. In a device for detecting rebounds of the contact springs of a circuit controlling device, an alarm control relay, a gas-filled triode having a plate circuit including the operating winding of said alarm control relay, and means responsive to a closure of said contact springs for completing said plate circuit and applying a blocking potential to the control electrode of said triode, whereby said alarm control relay is rendered inoperative upon closure of said contact springs, said means functioning upon a rebound of said contact springs to remove the blocking potential from the control electrode of said triode for the duration of the rebound without interrupting the continuity of the plate circuit of said triode whereby said alarm control relay operates to indicate the rebound.

4. In a device for detecting rebounds of the contact springs of a circuit controlling device, an alarm control relay, a gas-filled triode having a plate circuit including the operating winding of said alarm control relay, and means responsive to a closure of said contact springs for completing said plate circuit and applying a blocking potential to the control electrode of said triode whereby said alarm control relay is rendered inoperative upon closure of said contact springs, said means functioning upon a rebound of said contact springs to remove the blocking potential from the control electrode of said triode for the duration of the rebound without interrupting the continuity of the plate circuit of said triode, whereby said alarm control relay operates to indicate the rebound, and said means also functioning when said contacts open for a predetermined interval of time after the initial closure thereof to remove the blocking potential from the control electrode of said triode and open the plate circuit thereof.

5. In a device for detecting rebounds of the contact springs of a circuit controlling device, an alarm control relay, a gas-filled triode having a plate circuit including the operating winding of said alarm control relay, and means responsive to a closure of said contact springs for completing said plate circuit and applying a blocking potential to the control electrode of said triode whereby said alarm control relay is rendered inoperative upon closure of said contact springs, said means functioning upon a rebound of said contact springs to remove the blocking potential from the control electrode of said triode for the duration of the rebound without interrupting the continuity of the plate circuit of said triode,

whereby said alarm control relay operates to indicate the rebound, said means comprising a pair of serially connected relays controlled by said contact springs, one of said relays having faster operate and release characteristics than the other.

6. A device for testing a telephone dial for rebounds of the pulsing contacts thereof comprising a gas-filled triode, a source of blocking potential for the control electrode of said triode, an alarm control relay included in the plate circuit of said triode, a first relay operating in response to a closure of the pulsing contacts of the dial for connecting said source of blocking potential to the control electrode of said triode, a second relay connected in series with said first relay and having a time operate characteristic such that it operates subsequently to the operation of said first relay upon closure of the pulsing contacts to complete the plate circuit of said triode, whereby said triode is rendered non-conducting and said alarm control relay inoperative, said second relay having a time release characteristic such that it remains operated when the pulsing contacts rebound to momentarily open the series circuit including the windings of said first and

second relays and to cause said first relay to release and remove said blocking potential from the control electrode of said triode whereby said triode is rendered conducting and causes said alarm control relay to operate to indicate the occurrence of the rebound, and a locking circuit for said alarm control relay.

7. A circuit for testing telephone dials for rebounds of the pulsing contacts thereof comprising a gas-filled triode, an alarm control relay included in the plate circuit of said triode, a source of blocking potential for the control electrode of said triode, a first and second relay whose windings are connected in series with the contacts under test, means controlled by said first relay for completing the connection of said source of blocking potential to the control electrode of said triode, means controlled by said second relay for completing the plate circuit of said tube, said first relay having faster operate and release characteristics than said second relay and said alarm control relay having a time operate characteristic greater than the difference between the release times of said first and second relays, and an alarm controlled by said alarm control relay.

JOHN H. McCONNELL.