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CONTACT CHATTER INDICATOR

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FIG. 1

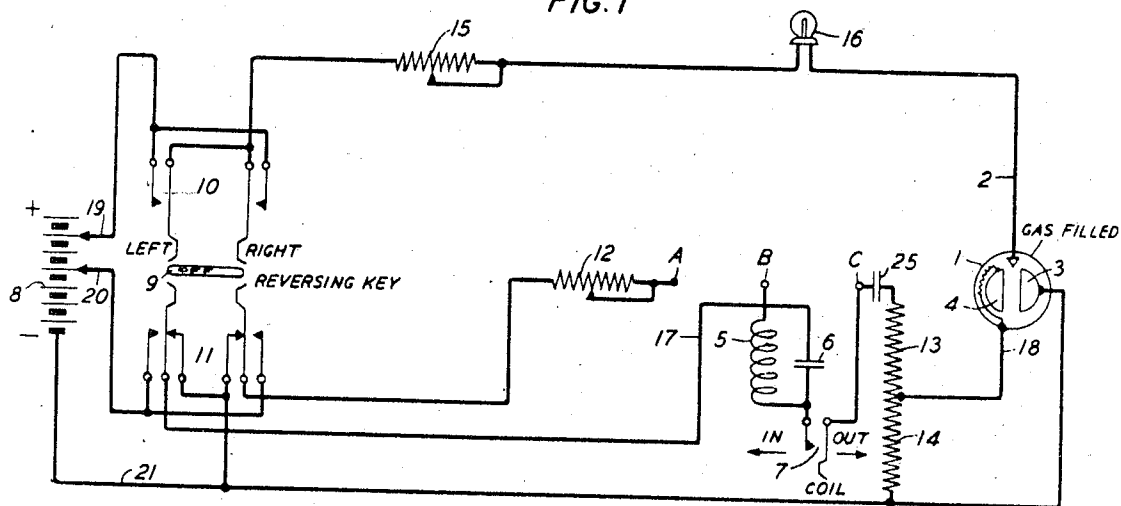


FIG. 2

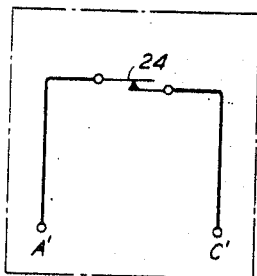
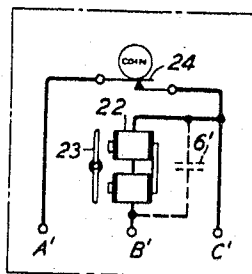


FIG. 3



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CONTACT CHATTER INDICATOR

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5 Claims. (Cl. 175-183)

This invention relates to apparatus for electrical testing and more particularly to apparatus for testing electric contacts for chattering.

Contact chattering very often takes place between a pair of contacts either when these contacts are in the process of closing or after they have been closed for some time due to mechanical vibration of either the contact closing mechanism itself or to the vibration of associated apparatus. Such chattering produces numerous undesirable effects among which are the generation of undesirable transients in associated circuits, the partial or complete failure of certain associated apparatus to operate and excessive burning of contacts where they carry heavy currents in inductive circuits. In testing electrical circuits containing contacts and particularly when making routine tests of such circuits, it is desirable to have apparatus which will quickly and reliably indicate the occurrence of chattering.

It is therefore the object of this invention to provide suitable means for quickly and reliably indicating the occurrence of contact chattering.

The foregoing object is attained by this invention by providing a gas-filled electron discharge device adapted to be responsive to the oscillatory discharge of a resonant circuit whose oscillations are started by the momentary opening of the contacts under test.

The invention may be better understood by referring to the drawing, in which:

Fig. 1 discloses the preferred embodiment of the circuits of this invention;

Fig. 2 shows a simple pair of contacts which may be connected to Fig. 1 for chatter test; and

Fig. 3 is a schematic disclosure of a coin collector relay which may be connected to Fig. 1 for chatter test of the coin signal contacts.

Referring now to Fig. 1, a gas-filled electron discharge device 1 is specifically disclosed as a cold cathode-triode such as the Western Electric 333-A tube. Most any other type of gas-filled tube with either hot or cold cathode may be used provided it has at least some kind of control electrode and an anode. In Fig. 1 tube 1 contains an anode 2, a cathode 3 and control electrode 4. The oscillatory control circuit comprises inductor 5 and capacitor 6 connected in parallel relationship. One side of this oscillatory circuit is connected by way of conductor 17 through an obvious circuit including the reversing section 11 of reversing key 9 to the cathode 3 of tube 1. A voltage divider comprising two resistors 13, 14 is connected in series relation

between cathode 3 and to the other side of the oscillatory circuit by way of key 7 and condenser 25. A tap on resistors 13, 14 is connected to control electrode 4 by way of conductor 18. The purpose of condenser 25 will be described later.

A direct current source of voltage supply 8 is disclosed specifically in the form of a battery although obviously it may be any other form of direct current supply. An adjustable tap along the positive end of this voltage supply is connected to anode 2 of tube 1 via conductor 19, switch section 10 of reversing key 9, rheostat 15 and indicating lamp 16. Terminals A and C are provided to furnish means for connection to the contacts under chatter test. Current supply for this test is obtained from battery 8 via conductors 20 and 21, reversing section 11 of key 9, rheostat 12, inductor 5 and key 7.

Fig. 2 discloses a simple pair of contacts 24 having terminals A' and C'. It is assumed that these contacts are normally closed by some means not shown and that they are subject to chattering from any cause whatever. In order to test these contacts terminals A' and C' are connected to terminals A and C, respectively, of Fig. 1. Rheostat 15 is adjusted to properly limit the current for lamp 16, depending upon the voltage selected at battery 8 for the anode circuit and the type of gas-filled electron device employed, and rheostat 12 is adjusted for the proper test current through the contacts under test. Key 7 is operated to "in" and reversing key 9 may be operated either to left or right. Should the contacts 24 chatter when connected in the circuit, that is, should they momentarily open, the electromagnetic field included in coil 5 will suddenly collapse thereby setting up an oscillatory current between inductor 5 and capacitor 6. This will give rise to a relatively large alternating current voltage being generated across the terminals of inductor 5 which will be impressed across resistors 13 and 14. Since the test voltage selected by conductor 19 at source 8 is below the normal anode-cathode flash-over voltage tube 1 will normally remain deenergized. However, the higher oscillatory voltage generated in inductor 5 is sufficiently large that when its first positive cycle is impressed on terminal C it initiates a discharge of tube 1 by raising the potential of its control electrode 4 above the normal flash-over point. Tube 1 thereupon discharges and maintains its anode-cathode circuit from source 8 via conductor 19, key section 10 of reversing key 9, rheostat 15, lamp 16 through the anode-cathode circuit of tube 1 and back

to source 8 via conductor 21. This illuminates lamp 16 and indicates that chatter has taken place.

Many types of gas-filled tubes will serve as suitable indicators by themselves and in these cases the use of a separate indicator lamp 16 is optional.

Should it be desired to observe the chatter effects of the contacts when current is passed through them in a reverse direction, reversing key 9 may be operated in the opposite direction from that which it was operated for the first test whereupon a second test may be made of the contacts.

Fig. 3 discloses a schematic of a coin collector relay having terminals A', B' and C'. It will be noted that here again the contacts 24 under test are connected between terminals A' and C' as in Fig. 2. In the coin collector relay these contacts are mechanically closed upon dropping the coin in the coin chute and should remain closed until after the coin collector relay armature 23 completes its operation to either collect or refund the deposited coin. It will be understood that the coin collector relay 22 is of the polarized type so that it will operate in one direction for one direction of current through its coil and in the other direction for the reverse direction of current, thereupon effecting refund or collect at the will of the operator. Current for operating this relay is supplied through the coin signal contacts 24 by way of terminals A', B'. In testing this relay its terminals A', B', C' are connected to terminals A, B and C, respectively, of Fig. 1. Key 7 is switched to "out" whereupon inductor 5 and capacitor 6 are switched out of the circuit. The coin collector relay does not ordinarily contain a capacitor across its coil terminals. However, the distributed capacitance thereof is sufficient to form a suitable resonant circuit equivalent to that formed by inductor 5 and capacitor 6, and to aid in understanding the invention stray capacitor 6' has been added to Fig. 3. The test is thereafter performed in the same manner as described for the simple contact of Fig. 2. Conductor 20 is adjusted to select a suitable voltage from battery 8 corresponding with the central office voltage supplied for coin collector purposes. Rheostat 12 is adjusted to correspond with a representative line circuit impedance for coin collector circuits. The reversing section 11 of reversing key 9 provides a convenient means for reversing the direction of current through the windings of relay 22 to cause it to operate in either the collect or refund direction.

Condenser 25 is provided to prevent false discharges of tube 1 when testing certain relays whose coils 22 have a low Q but operate on a high voltage. For most coils, however, this condenser may be omitted and resistor 13 connected directly to terminal C.

Key section 10 of reversing key 9 provides a suitable means of unlocking the anode-cathode circuits of tube 1 after discharge thus restoring the tube to its deenergized condition. In order to prevent false indications upon the opening of key 9, the contacts of key section 10 are adjusted to open the anode circuit appreciably before the contacts of reversing section 11 open the circuit through the contacts under test.

It should be observed that gas tube 1 is responsive to the chattering of the contacts under test irrespective of the normal direct current polarity of terminals A and B. This is because

the direct current potential of these terminals is not used to discharge the tube but rather the oscillatory discharge voltage initiated by the momentary opening of the contacts under test whereby a higher alternating current voltage is induced across inductor 5 or the winding of coin collector relay 22. While this oscillatory voltage gradually decays due to the energy loss in its resistance component the circuit constants have nevertheless been so selected that the positive half cycle of the first whole cycle of alternating current will have a voltage sufficiently high to cause tube 1 to discharge.

As previously stated the chattering of the contacts disclosed in Fig. 2 may be caused by any kind of mechanical vibration. In the case of Fig. 3 the contacts are first normally closed by means of a coin dropped in the coin chute. Some of these coin collectors have an actual mechanical linkage between armature 23 and the coin collector contacts. Although this mechanical linkage is not designed to open these contacts upon the attraction of the armature to the pole faces of winding 22, the mechanical disturbance of this linkage at times will cause the coin collector contacts to chatter resulting in an unsatisfactory condition. In so far as this invention is concerned however, it is unnecessary that any mechanical linkage actually exists between armature 23 and the coin collector contacts. All that is necessary is that the mechanical vibration or shock incident upon the operation of the coin collector relay or other auxiliary apparatus, be of sufficient magnitude and sufficiently proximate to the contacts under test as to tend to cause them to momentarily separate.

What is claimed is:

1. An apparatus for indicating contact chatter comprising a gas-filled electron discharge device, an anode, a cathode, and a control electrode therefor, an inductor and a capacitor connected to form an oscillatory circuit, means connecting said oscillatory circuit to the cathode and control electrode to cause the electron discharge device to be responsive to oscillatory voltages of predetermined magnitude generated therein, a source of direct current voltage lower than the normal anode-cathode break-down voltage, means connecting said anode in series with the source and the cathode, terminals for connection to the contacts under test, means including the said terminals for connecting said source and said inductor in series relation with the contacts under test whereby oscillatory voltages of predetermined magnitudes are generated across said coil upon a momentary opening of the contacts under test.

2. An apparatus for indicating contact chatter comprising a gas-filled electron discharge device, an anode, a cathode, and a control electrode therefor, an inductor and a capacitor connected to form an oscillatory circuit, means connecting said oscillatory circuit to the cathode and control electrode to cause the electron discharge device to be responsive to oscillatory voltages of predetermined magnitude generated therein, a source of direct current voltage lower than the normal anode-cathode break-down voltage, means connecting said anode in series with the source and the cathode, terminals for connection to the contacts under test, means including the said terminals for connecting said source and said inductor in series relation with the contacts under test, means for reversing the direction of direct current through the contacts under test

whereby oscillatory voltages of predetermined magnitudes are generated across said coil upon the momentary opening of the contacts under test irrespective of the initial direction of direct current flowing through said contacts.

3. An apparatus for indicating contact chatter comprising a gas-filled electron discharge device, an anode, a cathode, and a control electrode therefor, an inductor and a capacitor connected to form an oscillatory circuit, means connecting said oscillatory circuit to the cathode and control electrode to cause the electron discharge device to be responsive to oscillatory voltages of predetermined magnitude generated therein, a source of direct current voltage lower than the normal anode-cathode break-down voltage, means connecting said anode in series with the source and the cathode, terminals for connection to the contacts under test, means including the said terminals and a current-reversing means for connecting said source and said inductor in series relation with the contacts under test, and circuit-breaking means included in the anode circuit and adapted to cooperate synchronously with said reversing means to open the anode circuit substantially before the reversing means opens the circuit to the contacts under test.

4. An apparatus for indicating contact chatter comprising a gas-filled electron discharge device, an anode, a cathode, and a control electrode therefor, an inductor and a capacitor connected to form an oscillatory circuit, means connecting said oscillatory circuit to the cathode and control electrode to cause the electron discharge de-

vice to be responsive to oscillatory voltages of predetermined magnitude generated therein, a source of direct current voltage lower than the normal anode-cathode break-down voltage, means connecting said anode in series with the source and the cathode, terminals for connection to the contacts under test, an impedance varying means, and means including the said terminals and said impedance varying means for connecting said source and said inductor in series relation with the contacts under test.

5. An apparatus for indicating contact chatter comprising a gas-filled electron discharge device, an anode, a cathode, and a control electrode therefor, an inductor and a capacitor connected to form an oscillatory circuit, means connecting said oscillatory circuit to the cathode and control electrode to cause the electron discharge device to be responsive to oscillatory voltages of predetermined magnitude generated therein, a source of direct current voltage lower than the normal anode-cathode break-down voltage, means connecting said anode in series with the source and the cathode, terminals for connection to the contacts under test, means for obtaining a variable voltage source of controlled magnitude from said direct current source, an impedance varying means, and means including said terminals and said variable impedance means for connecting said controlled voltage source and said inductor in series relation therewith and with the contacts under test.

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