

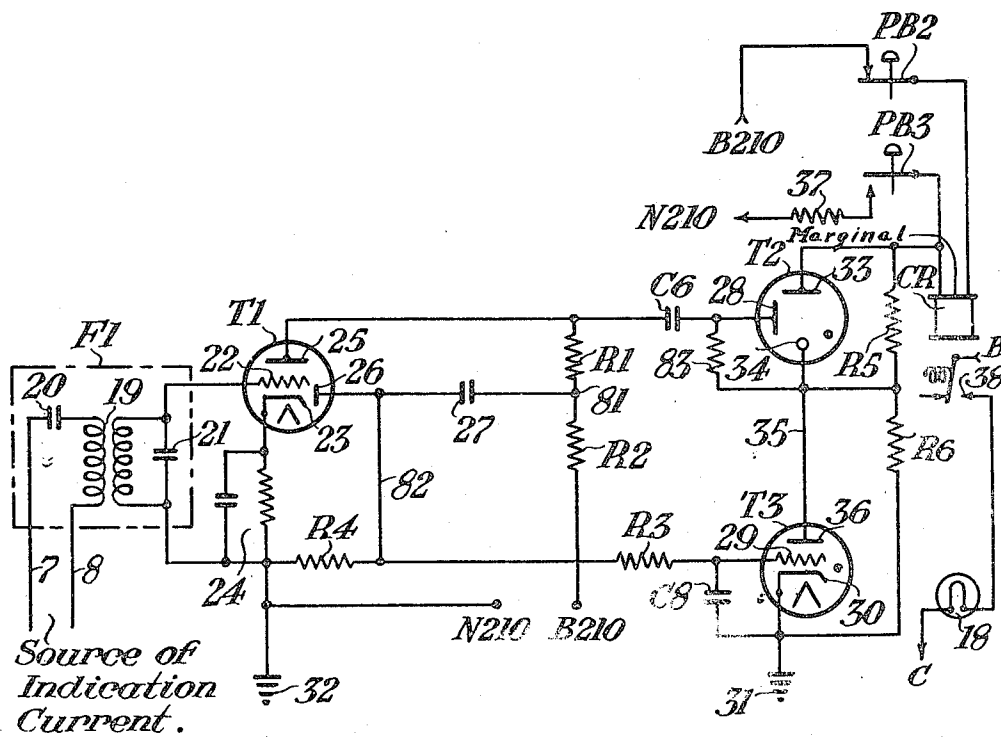
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SELECTIVE INDICATION APPARATUS

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SELECTIVE INDICATION APPARATUS

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4 Claims. (Cl. 177—353)

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My invention relates to indication apparatus.

The present application is a division of my co-pending application for Letters Patent of the United States, Serial No. 460,238, filed September 30, 1942, now U. S. Letters Patent 2,400,258, granted May 14, 1946, for Apparatus for selective control and indication systems.

When a group of similar electrical equipments are to be individually indicated through a common circuit reliability, safety and selectivity are of great importance.

Accordingly, a feature of my invention is the provision of novel and improved apparatus for indicating the condition of an electrical equipment.

Other features, objects and advantages of my invention will appear as the specification progresses.

To attain the above features, objects and advantages of my invention, I provide indication apparatus including two gas tubes connected with their anode circuits in series and the control electrode of which tubes are connected to the transmitting circuit in such a manner that indication current of a first characteristic causes one tube to be fired and indication current of a second characteristic causes the other tube to be fired. An indication relay is connected in series in the anode circuit for the tubes and a voltage divider including two resistors is connected in multiple with the two tubes. The junction terminal of the resistors is connected to the intertube connection. In this way when either tube is fired it remains conductive due to the path through the resistor around the non-fired tube. When both tubes are fired they remain conductive due to the path through the tubes. The relay is preferably adjusted to be energized sufficiently to operate its contacts only when both tubes are conductive. The tubes are normally deenergized and when once made conductive they can be deenergized through a controller operable to open the anode circuit of the tubes.

The indication relay governs any form of desired indicator, the indicator being preferably energized through an operated position contact of the relay.

The indication current may take different forms and preferably it is an alternating current of a preselected frequency and of a given normal value or amplitude. In response to one preselected condition, the amplitude of the indication current is increased above the normal given value, such increase in amplitude serving as a first characteristic of the indication current. In

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response to a second preselected condition the indication current is decreased below the normal given value, such decrease in amplitude serving as a second characteristic. In this way the indication relay is operated to control the indicator only when these two characteristics of the indication current follow one after the other.

I shall describe one form of apparatus embodying my invention, and shall then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view showing one form of indication apparatus embodying my invention.

Referring to the drawing, the reference characters 7 and 8 indicate a transmitting circuit connected to a remote electrical equipment not shown. The form of electrical equipment is immaterial, and it is provided with a source of indication current and means to cause the current supplied by such source to attain at times a greater than the given normal value and to at other times cause the indication current supplied to be below such normal given value. This indication current is preferably of a preselected frequency, such as, for example, 10,000 cycles per second.

It is to be understood, of course, that the invention is not limited to indication current of the characteristics recited above, and current of other characteristics can be used.

A filter F1, including a transformer 19 and two condensers 20 and 21, has its input side connected to wires 7 and 8 of the transmitting circuit and its output side connected to a control grid of a tube T1, to be described presently. Filter F1 is tuned to pass only current of the frequency used for the indication current and in the case here assumed for illustration it is tuned to pass current of 10,000 cycles per second.

Tube T1 is a high vacuum type of diode-triode tube for amplifying and rectifying the indication current passed by filter F1. Control grid 22 and cathode 23 of tube T1 are connected to filter F1 through a bias unit 24. Plate voltage for tube T1 is derived from power terminals B210 and N210, which are connected to a suitable source of direct current, such as a generator not shown, and which generator supplies current of a suitable voltage, such as, for example 210 volts. The plate circuit for tube T1 can be traced from terminal B210 through resistors R2 and R1 in series, plate 25 and intervening tube space to cathode 23 of tube T1, and biasing unit 24 to terminal N210. The junction terminal 81 of resistors R1 and R2 is connected to diode element 26 of tube

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T1 through a condenser 27. It is clear that the indication current passed by filter F1 is amplified in the plate circuit of tube T1 and a portion of the amplified current is rectified through the diode element 26.

Tubes T2 and T3 are gas filled tubes governed by the amplified energy of tube T1, and preferably tube T2 is of the cold cathode type and tube T3 is of the hot cathode type. The control electrode 28 of tube T2 is coupled to the plate circuit of amplifier tube T1 through a condenser C6 and a resistor 83 is connected across electrode 28 and cathode 34, and consequently an alternating electromotive force is applied to electrode 28 of tube T2 due to the alternating current component of the plate circuit current of tube T1, and such applied electromotive force is proportional to the amplitude of such alternating current component. In other words, the amplitude of the electromotive force applied to control electrode 28 of tube T2 is proportional to the amplitude of the indication current passed by filter F1. The parts are so arranged that the electromotive force applied to control electrode 28 due to indication current of normal amplitude is not enough to excite the tube T2 to a breakdown point for a given anode voltage, but if the applied electromotive force is increased a certain amount, tube T2 becomes sufficiently excited to break down. The control electrode 29 of tube T3 is coupled to the diode element 26 of tube T1 to receive a direct bias electromotive force or voltage due to the rectifying action of the diode element 26. Control electrode 29 of tube T3 is connected to the cathode 30 of the tube through a condenser C8, the junction of condenser C8 and cathode 30 being connected to a ground electrode 31. By another connection the electrode 29 is connected to cathode 23 of tube T1 through resistors R3 and R4 and the bias unit 24, the junction of resistors R3 and R4 being connected to diode element 26 by wire 82, and the junction of resistor R4 and bias unit 24 being connected to a ground electrode 32. Due to the diode element 26 rectifying a portion of the alternating component of the plate circuit current, the condenser C8 is charged with a direct voltage through the circuit connection traced above, and electrode 29 of tube T3 is made negative in potential with respect to cathode 30. The parts are so arranged that this negative bias voltage of tube T3 is sufficient to prevent tube T3 from breaking down for a given anode voltage when the indication current is of normal amplitude, but when the indication current falls a certain amount below the normal value, the charge on condenser C8 leaks away through resistors R3 and R4 and allows tube T3 to become conductive.

Tubes T2 and T3 are connected in series in an anode circuit for controlling the relay CR, a voltage divider made up of resistors R5 and R6 distributing the voltage to the two tubes. This anode circuit extends from terminal B210 of the current source through controller PB2, winding of relay CR, anode 33 and intervening tube space to cathode 34 of tube T2, an intertube connection 35, anode 36 and intervening tube space to cathode 30 of tube T3, and ground electrodes 31 and 32 to terminal N210. Resistors R5 and R6 in series are connected across anode 33 of tube T2 and cathode 30 of tube T3 and their junction terminal is connected to the intertube connection 35. As stated hereinbefore, the voltage applied to the anode of each tube T2 and T3 is not sufficient to break down the tube when the grid bias voltage is that effected in response to indication

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current of normal amplitude. The anode voltage, however, is sufficient to break down tube T2 or T3, as the case may be, when the grid bias voltage is varied a certain amount from the normal value, and also the anode voltage of each tube is sufficient to maintain the tube conductive after it has been broken down. When tube T2 alone breaks down, current flows through resistor R6 to maintain tube T2 conductive, and if tube T3 alone breaks down, current flows through resistor R5 to maintain tube T3 conductive. Relay CR is preferably a biased polar relay, and as disclosed the armature of the relay is spring biased to a normal or left-hand position. Relay CR is interposed in the anode circuit of tubes T2 and T3, as explained above, and the relay is energized by the anode current at a polarity as required to operate the relay armature to the reverse or right-hand position. Relay CR is adjusted so that when neither one or when either one of the tubes T2 or T3 alone is conductive, the anode current is not sufficient to operate the relay to the reverse position, but that when both tubes T2 and T3 are conductive simultaneously, the resultant anode current energizes relay CR sufficiently to reverse the relay.

A typical operation condition may be helpful in the understanding of the operation of tubes T2 and T3 and relay CR. Taking the voltage of the current source B210—N210 to be 210 volts, relay CR to have a resistance of 10,000 ohms, resistor R5 to be of 0.5 megohm, and resistor R6 to be of 0.2 megohm, the voltage drop through the relay is negligible when neither tube is conductive and about 150 volts is impressed across tube T2 and about 60 volts is impressed across tube T3. If tube T2 alone breaks down, the current flowing will be equal to 210 volts minus the voltage drop through tube T2 which is about 70 volts, divided by the resistance of resistor R6 and relay CR (0.2 megohm plus 10,000 ohms) and is about 0.7 milliampere. A voltage of approximately 140 volts is now applied across the anode-cathode of tube T3 and makes this tube somewhat more ready to break down should its grid bias voltage be varied. If tube T3 alone breaks down, the current flowing in the anode circuit is about 0.4 milliampere since the drop through tube T3 is about 18 volts and relay CR is in series with resistor R5 (10,000 ohms plus 0.5 megohm). The voltage across the anode-cathode of tube T2 is now increased to about 190 volts and that tube becomes somewhat more sensitive to a change in its grid voltage. If both tubes T2 and T3 are broken down, the current flowing in the anode circuit is equal to 210 volts minus the voltage drop of both tubes (70 plus 18 volts) divided by the resistance of relay CR (10,000 ohms) and is about 12 milliamperes. This current is sufficient to operate relay CR.

Relay CR can also be energized by means of a circuit controlled by the manual operable controller PB3, the circuit including terminal B210, controller PB2, winding of relay CR, controller PB3, resistor 37 and terminal N210. It is to be seen therefore that relay CR can be operated either automatically through tubes T2 and T3 in response to the indication current received from the transmitting circuit, or it can be operated manually through push button PB3, automatic operation of relay CR requiring both tubes T2 and T3 to be conductive.

Relay CR is used to control indication lamp 18, lamp 18 being illuminated through an obvious circuit including reverse polar contact 38 of relay

CR and a current source whose terminals are indicated at B and C.

It is to be seen from the foregoing description that when indication current of a given frequency and of a given normal value is received by the indication apparatus, the indication relay CR remains inactive, but that when such indication current increases in its amplitude and then decreases in its amplitude, or vice versa, the tubes T2 and T3 are fired one after the other, and with both tubes conductive the relay CR is operated to energize the indication lamp 18.

It is to be understood that although I have shown a form of apparatus which responds to an alternating indication current of a preselected frequency and having an increase and a decrease of the amplitude of the current with respect to a normal value, other forms of indication current having other forms of characteristics can be used.

Although I have herein shown and described but one form of indication apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, a first and a second gas filled tube, an anode circuit to include the anode and cathode tube space of said tubes in series, a current source for said anode circuit normally insufficient to break down either tube, a voltage divider including two resistors connected to the first tube anode and second tube cathode and having the junction terminal of said resistors connected to the first tube cathode and second tube anode connection, said voltage divider serving to maintain either one of said tubes conductive by by-passing the non-conductive tube, control means connected to the control electrodes of the tubes to control the tubes independent of each other, and means governed by said anode circuit and effectively energized when said tubes are made conductive simultaneously.

2. In combination, a first and a second gas filled tube, an anode circuit to include the anode to cathode tube space of said tubes in series, a current source for said anode circuit normally insufficient to break down either tube, a voltage divider including a first and a second resistor connected in series across the first tube anode and second tube cathode and having their junction terminal connected to the first tube cathode and second tube anode connection, said first resistor to by-pass said first tube when the second tube alone is conductive and said second resistor to by-pass said second tube when the first tube alone is conductive, a control means for each of said tubes and each such control means connected to the control electrode of the respective tube to at times excite the tube to its break down point, and a relay interposed in said anode circuit and

operated only when both tubes are conductive simultaneously.

3. In combination, a first and a second gas filled tube, an anode circuit to include the anode to cathode tube space of said tubes in series, a current source for said anode circuit normally insufficient to break down either tube, a voltage divider including a first and a second resistor connected in series across the first tube anode and second tube cathode and having their junction terminal connected to the first tube cathode and second tube anode connection, a diode-triode electron tube having a plate circuit connected to the diode element of the tube to rectify a portion of an alternating voltage created in the plate circuit in response to an alternating current applied to the control grid of the tube, means including a condenser and a resistor to couple said plate circuit to the control electrode of said first tube to break down the tube when said alternating voltage increases above a given normal value, means including another condenser and another resistor to couple said diode element to the control electrode of said second tube to break down said second tube when said alternating voltage decreases below said normal value, and a relay interposed in said anode circuit and operated when both said first and second tubes are simultaneously conductive.

4. In apparatus for detecting an alternating indication current characterized by variations above and below a predetermined normal amplitude, the combination comprising, a diode-triode electron tube provided with a control grid circuit to receive such indication current and a plate circuit in which such indication current is amplified, the diode element of said tube connected to said plate circuit to rectify a portion of the amplified alternating current, a first and a second gas filled tube, means to couple the control electrode of said first tube to said plate circuit to excite that tube by an electromotive force proportional to the amplified alternating current, other means to couple the control electrode of said second tube to said diode element to excite the second tube by an electromotive force inversely proportional to the amplitude of the amplified alternating voltage, an anode circuit including the anode to cathode tube space of said tubes in series, and an indication relay means controlled by the anode circuit and effectively energized only when both of said tubes are conductive.

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REFERENCES CITED

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

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