

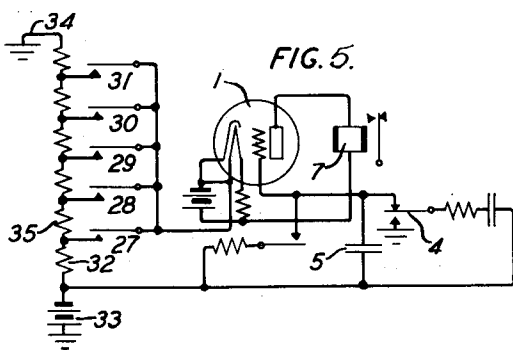
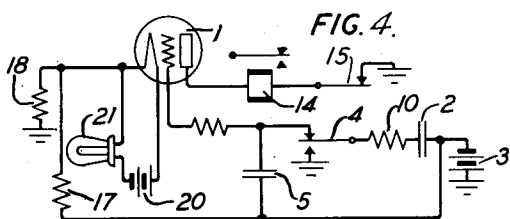
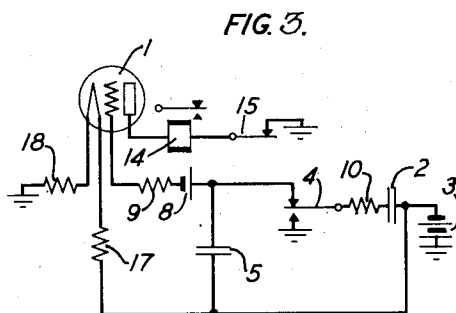
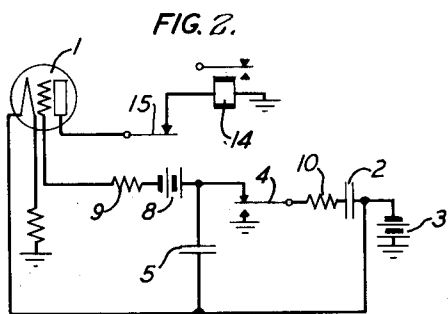
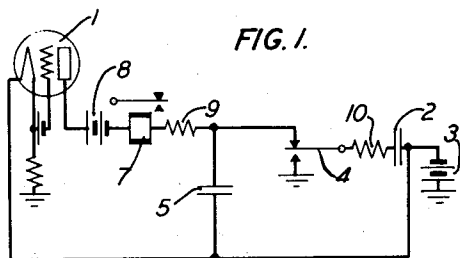
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ELECTRICAL COUNTING SYSTEM

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2,114,016

ELECTRICAL COUNTING SYSTEM

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14 Claims. (Cl. 173-90)

This invention relates to electrical counting systems, and its object is to secure improvements in counting and denoting electrical impulses.

Heretofore systems have been provided for recording or measuring by means of repeated operations of a meter the time a contact remains closed on a relay. Such systems usually consist of a condenser shunted by a neon lamp or space-discharge device, the condenser being charged gradually by the closing of the contacts in series with a source of energy and when the condenser has received a certain charge the potential causes the neon lamp to break down and thereby cause a relay in series with this breakdown path through the tube to operate and cause the operation of the meter. These operations are repeated as long as the contacts are closed to record by the repeated operations of the meter the time the contacts are closed. This time may be calculated due to the constant charging time of the condenser, that is, the charging time of the condenser being constant, the number of times the meter operates may be used as an indication of the time the contacts are closed.

It is a feature of the present invention to count and denote, by means of similar circuits, the number of operations of contacts. The arrangement is such that a first condenser is charged from a source of energy under control of the contacts and then a second condenser is charged from the first condenser under control of the contacts. This operation is repeated until the second condenser has accumulated a charge equal to the breakdown potential of a discharge device, for example, of the three-element type in series with the second condenser. The breaking down of the discharge device indicates or denotes that the contacts have operated a certain number of times. The number of operations of the contacts required to cause the breakdown of the discharge device is governed by the ratio of the capacities of the condensers. Relays or other electrically responsive apparatus may be inserted in the breakdown path through said device to operate each time said device breaks down for indicating purposes.

Another feature of this invention is the provision of means for repeatedly charging one condenser and discharging it into another condenser under control of electrical contact operations and for causing a discharge device of the control-electrode type to break down when a certain charge has been accumulated on the second condenser to denote the number of operations of the electrical contacts.

Another feature of this invention is the provision of means associated with the discharge device in a system of this kind for changing at will the number of operations of the contacts required to cause the breakdown of the device.

The invention has been illustrated in the accompanying drawing in which:

Fig. 1 shows a gas-filled tube of the three-element type used as a discharge device.

Figs. 2, 3 and 4 show a three-element tube in various modified forms of the invention.

Fig. 5 shows an arrangement similar to those disclosed in Figs. 1 to 4 with the exception that the filament potential may be varied in accordance with a modified application of the invention.

The tubes used in the circuit according to this invention may be of any suitable construction such as the three-element tubes well known in the art. They may also be of the heated cathode type, or cold cathode type such as the grid glow tubes. It should be understood that these tubes may be filled with neon or any other suitable gas, or that they may be of the vacuum type.

Referring now to Fig. 1, tube 1 is a gas-filled three-element discharge device that breaks down at a definite voltage. The discharge of tube 1 may be controlled as desired by the biasing potential applied across the cathode and control electrode. The primarily charged condenser 2 is connected to a source of unidirectional current 3 through the operating contacts 4 to ground with the contacts in one position and in series with the condenser 5 with the contacts in another position. In shunt of the condenser 5 is placed the tube 1, a relay 7 and a source of local battery 8. The contacts 4 may be a set of pulsing contacts controlled by any well-known impulse responsive relay such as is generally employed in automatic telephone systems, and the relay 7 may operate any well-known indicating circuit such as a lamp signal circuit. A specific application of the applicant's invention has been disclosed in applicant's Patent 2,002,219 of May 21, 1935.

The operation of the device is as follows: Each time the contacts 4 operate to establish the connection from ground to battery 3 with the condenser 2 and resistance 10 in series, condenser 2 is charged to a certain potential; and each time the contacts 4 establish a connection with condenser 2, resistance 10 and condenser 5 in series, condenser 2 discharges into condenser 5. When these operations have taken place a sufficient number of times depending on the ratio of capacities between these condensers, the voltage built up on condenser 5 aided by the voltage of battery

8 is equal to the breakdown voltage of the tube 1, so that the tube will then become conductive and reduce the voltage of condenser 5 to the restoring voltage of the tube. The voltage on condenser 5 will then again be built up by charges from condenser 2 and the above operations will be repeated. The discharge from condenser 5 may be utilized for operating the control relay 7 which may be used as another indicator of the number of operations of the contacts 4 for each cycle. These indications may be interpreted as counting and denoting means for the number of operations of the contacts 4. The resistance 9 may be included in the tube circuit to control the currents for the operation of the relay 7 and to protect the tube, while the resistance 10 may be included in the circuit for condensers 2 and 5 to protect the contacts 4 and to prevent direct application of the voltage across condenser 2 to the tube. Resistance 10 may be small enough so that condenser 2 will be charged and discharged practically instantaneously. The number of operations of the contacts 4 required to cause the break down of the tube 1 is, of course, governed by the ratio of the capacity of condenser 2 to that of condenser 5.

In general, the operations described in connection with Fig. 1 apply also to the operations of the modified forms of the invention, as shown in Figs. 2 to 5. The reference characters in the various figures referring to identical elements are the same.

In Fig. 2 the voltage of condenser 5 changes the voltage of the grid of the tube 1 with respect to the filament. When this voltage reaches a certain value the tube 1 breaks down and a steady current is obtained through the plate circuit and the control relay 14. This relay will then remain operated until the plate circuit is opened in any well known manner by, for example, contacts 15.

Fig. 3 shows a similar arrangement to that shown in Fig. 2. The break down of the tube in this case is accomplished after a given number of operations of the contacts 4. As the potential across the condenser 5 increases the condenser plate connected to the grid of the tube 1 becomes less and less negative with respect to the filament, the potential of which is determined by the electrical position in the potentiometer arrangement, the arms of which consist of resistances 17 and 18. When the potential drop across the condenser 5 becomes only slightly less than across the arm in which resistance 17 is located, the grid will be only slightly negative with respect to the filament. The tube will then break down and cause the operation of the control relay 14. Relay 14 remains operated until released by the breaking of the plate circuit by the opening of contacts 15. In this case a large degree of independence, from the effect of voltage variations, is obtained by placing the filament in the potentiometer circuit. The explanation for this lies in the fact that the drop across resistance 17 of the potentiometer arrangement and across the condenser 5 after a number of operations of the contacts 4 are both proportional to the applied voltage from source 3. Just previous to the break down of the tube 1 they are practically equal, since they differ only by the grid to filament potential which causes the break down. Therefore the number of operations of the contacts 4 which will cause break down of the tube is practically independent of the applied voltage from the condenser 5 within reasonable limits.

In Fig. 4 is shown a method of eliminating any inaccuracy due to the variations in filament current caused by applied voltage variations. The filament is supplied by a separate source of current 20 and the current is regulated by ballast lamp 21. Otherwise the operation of this circuit is the same as that of the circuit shown in Fig. 3.

Fig. 5 shows a modified form of the invention applied to a pulse counting arrangement in which the tube 1 of the three-element type breaks down when a sufficient charge has been accumulated on the condenser 5 by the repeated charging from condenser 2 due to the operations of contacts 4 to cause relay 7 to operate through the plate circuit. The difference here is that the tube will break down on different numbers of operations of the contacts 4 depending on which one of the keys 27 to 31 is operated. The operation of any one of these keys determines the positive bias of the filament in respect to the potential on the grid. For example, if key 27 is operated, the positive bias on the filament will be less than if, for example, key 28 is operated as the operation of this key 27 places a less positive potential on the filament in respect to the grid due to the inclusion of the resistance 32 only in the circuit between the battery 33 and the filament with respect to the ground 34, than if key 28 is operated when both resistances 32 and 35 are included between the battery 33 and the filament. Consequently a less charge is required on condenser 5 before the tube breaks when key 27 is operated than when key 28 is operated and hence a less number of operations is required of the contacts 4 before relay 7 operates. By this arrangement, the relay 7 may be made to operate to indicate various numbers of operations of the contacts 4.

What is claimed is:

1. In combination, a three-element space discharge device having a definite breakdown potential, contacts operated at intervals, two condensers, and means for accumulating a charge on one of said condensers from successive charges on the other condenser controllable by a plurality of operations of said contacts, and means for causing said device to discharge in response to an accumulated charge on said first condenser equal to the breakdown potential of the device.

2. In combination, a discharge device having a discharge path and a control element to control the discharge of said device, contacts operated at intervals, two condensers, means for accumulating a charge on one of said condensers from successive charges on the other condenser controllable by operations of said contacts, and means including said control element responsive to a predetermined potential on said first condenser for discharging said device.

3. In combination, a three-element conduction device having a definite breakdown potential, contacts operated at intervals, two condensers, and means for accumulating a potential equal to the breakdown potential of the device on one of said condensers from successive charges on the other condenser controllable by the operation of said contacts a definite number of times.

4. In combination, contacts operated at intervals, two condensers, means for accumulating a charge on one of said condensers from successive charges on the other condenser controllable by operations of said contacts, and a discharge tube having a control electrode responsive to a predetermined potential on said first condenser for discharging said first condenser.

5. In combination, a conduction device includ-

ing two discharge elements and a control element and having a definite breakdown potential, a condenser in a path across the terminals of two of the elements of said device, a relay in said path, a second condenser, and means for charging said second condenser and for discharging it periodically into said first condenser, said first condenser discharging through said device to energize said relay when said first condenser has acquired the breakdown potential of said device.

6. In combination, a three-element gaseous conduction device having a definite breakdown potential, a condenser in a path across the terminals of two of the elements of said device, a second condenser, a source of current, contacts operative at intervals, circuit means controllable by said contacts to repeatedly charge said second condenser from said current source and for discharging it into said first condenser, said first condenser discharging through said device when it has accumulated a potential equal to the breakdown potential of the device.

7. In combination, a gaseous conduction device including two discharge elements and one control element and having a definite breakdown potential, contacts operative at intervals, two condensers, means for alternately charging a first condenser and discharging it into the second condenser controlled by operations of said contacts, and means for causing the breakdown of said device across said discharge elements by the charge on said second condenser when it equals the breakdown potential of said device.

8. In combination, a three-element space discharge device, contacts operated at intervals, two condensers, means for accumulating a charge on one of said condensers from successive charges on the other condenser controlled by operation of said contacts, and means responsive to a predetermined potential on said first condenser for discharging said device.

9. In combination, a first and a second condenser, means for accumulating a charge on the first condenser by a definite number of steps from an equal number of charges on the second condenser, a three-element vacuum tube, means for changing the potential difference between two of said elements by the accumulated charge on said first condenser, and a circuit path including one of said two elements and a third element of said tube, the characteristics of said tube being such that current will flow through said circuit path when a certain potential difference has been established between said two elements by the accumulated charge on said first condenser.

10. In combination, a first and a second condenser, means for accumulating a charge on the first condenser by a definite number of steps from an equal number of charges on the second condenser, a three-element vacuum tube, means for changing the potential difference between two of said elements by the accumulated charge on said first condenser, a relay, a circuit path

including one of said two elements, a third element and said relay, the characteristics of such tube being such that current will flow through said circuit path to cause the operation of said relay when a certain potential difference has been established between said two elements by the accumulated charge on said first condenser.

11. In combination, a discharge device having a definite breakdown potential, a condenser and a source of current in a path including the terminals of said device, a second condenser, means for charging said second condenser and for discharging it periodically into said first condenser, and means for causing the breakdown of said device when the accumulated potential on said first condenser and the potential of said source of current equals the breakdown potential of said device.

12. In combination, a conduction device, means for establishing different relationships between the potentials of certain elements of said conduction device, contacts operating at intervals, and means for causing said device to break down at different numbers of operations of said contacts depending on the corresponding originally established relationship of potentials between said elements.

13. In combination, a three-element conduction device, means for establishing any one of a plurality of relationships between the potentials of the filament and of the grid element of said conduction device, contacts operated at intervals, two condensers having a fixed relationship of capacities, means for changing the relationship between the potentials of the filament and grid elements of said conduction device under control of said condensers and operations of said contacts, the characteristics of the device being such that current will flow through said device when a certain relationship between the potentials of said filament and grid elements has been established, said flow of current taking place in each instance after a certain number of operations of said contacts for each established relationship of potential between the filament and grid elements.

14. In combination, a source of current, contacts operated at intervals, two condensers, means for accumulating a charge on one of said condensers from successive charges on the other condenser from said source of current and controlled by said contacts, a three-element conduction device having a definite breakdown potential, means for normally establishing a potential relationship between two of the elements in said device by the aid of said source of current, and means controlled by the charge on said first condenser after a definite number of operations of said contacts for changing said potential relationship between said two elements to cause the breakdown of the device regardless of fluctuations of the voltage of said source of current.

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