Dec. 3, 1929. L. A. KILLE 1,738,299

INTERMITTENTLY OPERATED SIGNALING DEVICE

Filed Nov. 30, 1926

Fig. 1.

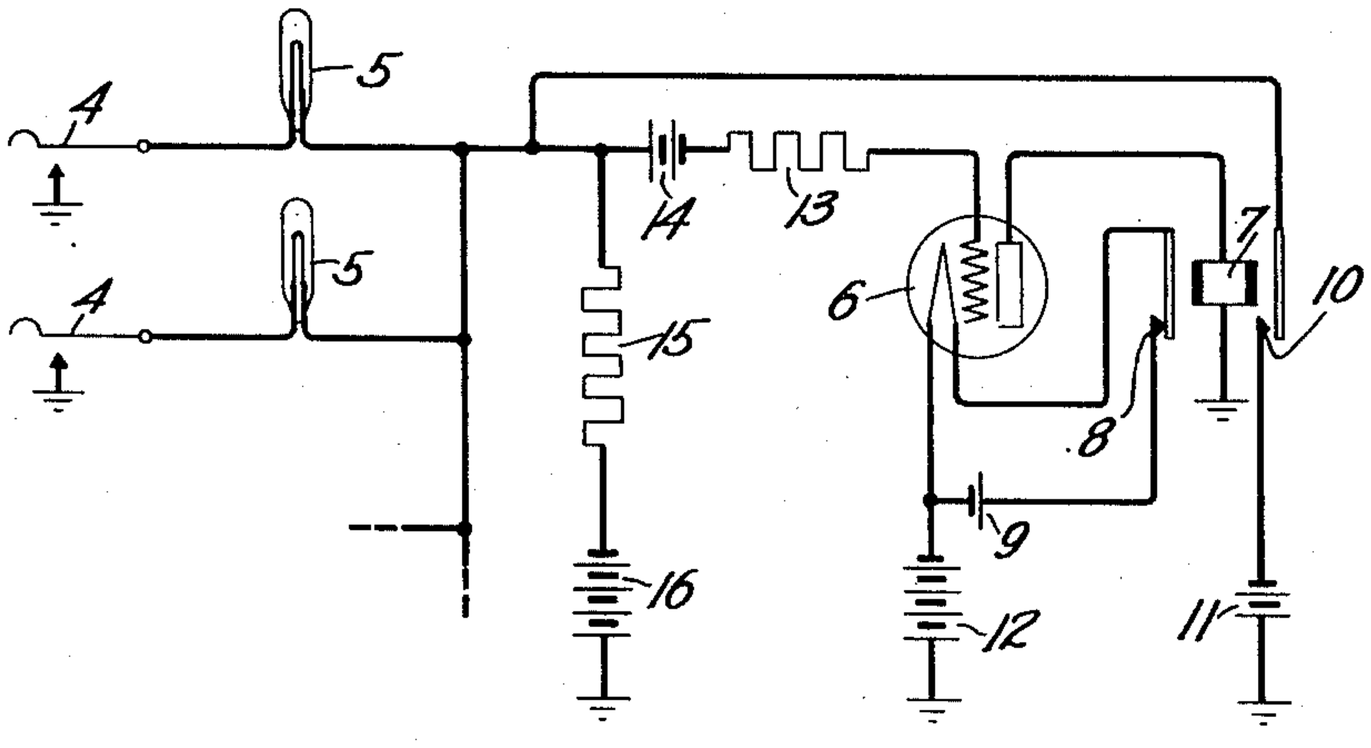
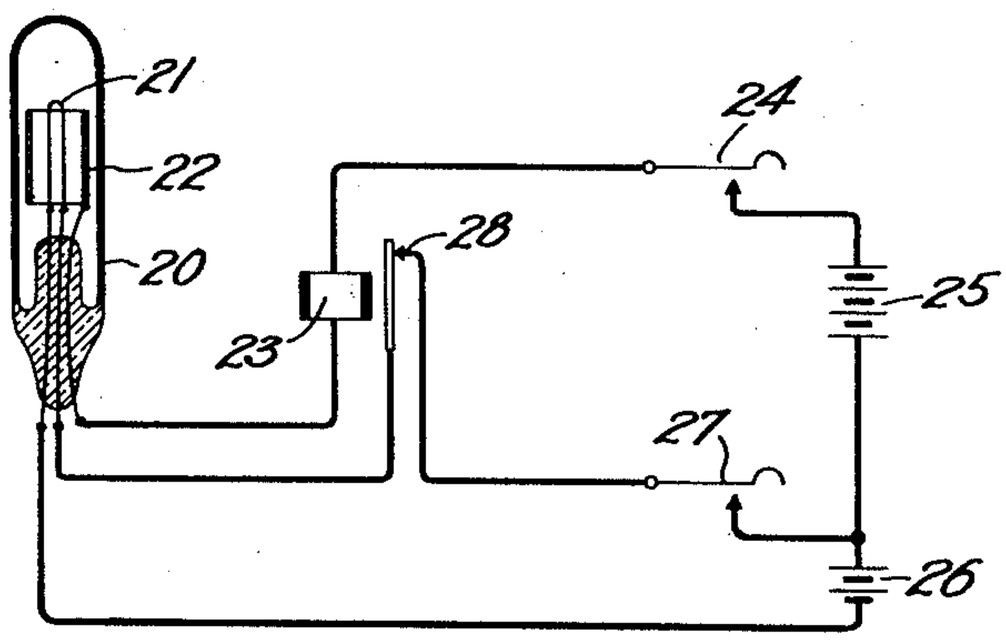


Fig. 2.



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UNITED STATES PATENT OFFICE

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INTERMITTENTLY-OPERATED SIGNALING DEVICE

Application filed November 30, 1926. Serial No. 151,626.

This invention relates to intermittently operated signaling devices and circuits for electron discharge relays adapted to operate such devices and particularly to flashing circuits for lamps.

An object of the invention is to intermittently operate a lamp or other signaling devices.

A further object of the invention is to simplify the circuits for operating intermittent signaling devices.

In telephone systems and elsewhere, it is often desirable to intermittently operate a signaling device, such as a lamp to provide a flashing signal. In such cases, it has heretofore been the practice to use rather complicated arrangements of vibrating relays or the like.

A feature of this invention is an intermittently operated circuit employing an electric discharge device and a relay having a winding connected in the space current circuit thereof and a contact connected in the cathode heating circuit, so that the operation of the relay will open the heating circuit, thus cooling the cathode and releasing the relay to again close the heating circuit and repeat the cycle of operations.

In one embodiment the flashing of the discharge device itself is used as a signal.

In the preferred embodiment a single discharge device and relay are employed for operating one or more flashing lamps. The grid of the discharge device is normally biased so that substantially no current will flow in the space current circuit. The operation of a switch will impress a positive potential upon the grid producing a flow of space current which operates the relay to close a circuit for lighting the lamp and to open the cathode heating circuit. The lamp will remain lighted during the period required for the cathode to cool sufficiently to reduce the space current to a point at which the relay will release, at which time the circuit through the lamp is opened and the cathode heating circuit is closed, causing the cathode to again heat up to produce space current to operate the relay thus repeating the flashing cycle so long as the switch remains operated.

This invention can be more readily understood by reference to the following detailed description in connection with the drawing in which Fig. 1 shows a circuit employing an electric discharge device and relay for operating a plurality of signaling lamps, and Fig. 2 shows a special type of switchboard lamp and circuit for intermittently operating it.

Referring to Fig. 1 there is shown a plurality of signaling lamps 5 arranged to be operated by a single flashing circuit. Associated with each of the lamps is a switch or key 4. The flashing circuit employs an electric discharge device 6. In the plate circuit of the device is connected the winding of a relay 7. The back contact 8 of the relay is connected in circuit with a heating battery 9 and the cathode of the device 6. The front contact 10 of the relay is connected in circuit with the lamps and a battery 11 which supplies current for lighting them. Space current is supplied to the device from a battery 12. The grid of the discharge device 6 is connected to the resistance 13, battery 14, resistance 15, battery 16 and battery 12 to the cathode. Battery 16 is of substantially the same voltage as the battery 12 to counteract its effect on the grid. The battery 14 is employed for biasing the grid to prevent space current from flowing when all the keys 4 are open. With some types of discharge devices, this battery may not be necessary. Resistance 13 is preferably one-tenth to one megohm and resistance 17 of the order of 50,000 ohms. The circuit arrangement shown, particularly with regard to battery and ground connections, is best suited for telephone switchboard wiring, and of course, may be greatly simplified for other uses.

The operation of the circuit is as follows: The cathode of the device 6 is normally heated, the grid of the device being biased so that the space current is insufficient to operate the relay 7. When a key 4 is closed, the grid of the tube is brought to a positive potential with respect to the cathode by means of the battery 12 since the resistance 15 is high compared with the resistance of the lamp 5. This causes a space current to flow operating relay 7. The operation of the relay lights the lamp 5 by supplying current from battery 11 through front contact 10, lamp 5 and key 4. The operation of the relay also opens the back contact 8 opening the cathode heating circuit. When the cathode has cooled sufficiently to reduce the space current to a point at which the relay 7 releases, the lamp is extinguished by the breaking of contact 10 and the cathode heating circuit is again closed. This cycle repeats itself, flashing the lamp as long as the key 4 remains closed. If both keys 4 are closed both lamps will flash. Any number of lamps may thus be flashed by a single flashing circuit, the number being limited only by the current carrying capacity of the relay contact 10. When all of the keys 4 are opened, the grid of the device again assumes a negative potential through resistances 15 and 13, reducing the space current sufficiently to release the relay 7.

It will be noted that when a key 4 is closed the low impedance lamp 5 is connected in shunt to the high resistance 15 and battery 16 thus effectively short-circuiting battery 16 so far as the polarization of the grid is concerned. This enables battery 12 to overcome the opposing polarizing battery 14 and to render the grid highly positive with respect to the cathode. As soon, however, as relay 7 operates, closing its armature contact 10, current from the battery 11, flowing through the low resistance lamp 5 to ground, increases the potential difference across the terminals of the lamp 5. This potential difference operates as a counter E. M. F. to the battery 12 in the grid polarizing path including resistance 13, battery 14 and lamp 5. This action reduces somewhat the positive potential of the grid with respect to the cathode.

The speed of flashing is determined by the characteristics of the cathode and may be controlled by regulating those characteristics, much more accurate control being possible than with vibrating relays.

Fig. 2 shows a circuit employing a special type of lamp. This lamp 20 has a thermionically active filament 21 and an anode 22 surrounding the filament. This anode is made cylindrical in shape so as not to interfere with the end luminosity of the filament. A relay 23 is employed for producing flashing. The winding of the relay is connected from the anode 22 through key 24 and battery 25 to the filament 21. The battery 26 is connected through key 27 and contact 28 of relay 23 to the filament for supplying heating current thereto. When the relay is released, the contact 28 is closed so that the closing of the key 27 lights the lamp. When the key 24 is closed space current flows from the battery 25 through the winding of the relay, actuating it and opening the contact 28 which opens the filament heating circuit. When the filament has cooled so as to reduce the space current sufficiently to release the relay 23 the filament heating circuit is again closed to relight the lamp and repeat the flashing operation. The lamp cannot flash too rapidly for proper illumination since its flashing speed is largely regulated by the time characteristic of its own filament.

What is claimed is:

1. The combination with a relay of means to cause said relay to operate intermittently, said means comprising an electric discharge device having a thermionic cathode, a control electrode, a circuit controlled by said relay for varying the thermionic activity of said cathode and a second circuit controlled by said relay for varying the electrostatic condition of said control electrode.

2. An intermittently operated circuit comprising a space discharge device having a thermionic cathode, an anode, and a control electrode, a relay having a winding connected in the anode-cathode circuit of said device, a contact connected in the cathode heating circuit whereby the operation of the relay by the space current of the device opens the cathode heating circuit and the release of the relay closes the cathode heating circuit and a circuit controlled by said relay for varying the electrostatic condition of said control electrode.

3. An intermittently operated circuit comprising an electric discharge device having a thermionic cathode, an anode and a control electrode, a cathode heating circuit therefor, a relay having a winding connected in circuit with said anode and cathode and a contact connected in said cathode heating circuit, means for normally biasing said control electrode to prevent the flow of space current sufficient to operate said relay, means for impressing a potential on said electrode to produce sufficient space current to operate said relay and means controlled by said relay for varying the bias of said control electrode.

4. The combination with an electron discharge device having a cathode, an anode, an impedance control element, an input circuit and an output circuit, of a source of potential common to said circuits, a second source of potential in said input circuit for balancing the effect of said first mentioned source of potential upon said impedance control element and means for disturbing said balance.

5. The combination with an electron discharge device having a cathode, an anode,

an impedance control element, an input circuit and an output circuit, of a source of potential common to said circuits, a second source of potential in said input circuit for balancing the effect of said first mentioned source of potential upon said impedance control element, and a circuit control element for disturbing said balanced condition.

6. The combination with an electron discharge device having a cathode, an anode and an impedance control element, of a circuit connecting said cathode and anode, a source of potential in said circuit for producing a space discharge between said cathode and anode, a circuit connection extending from said control element to a point in said first circuit between said source and said anode, in said circuit connection, including a second source of potential of substantially equal value as said first source but connected in an opposite direction and means for varying the effective potential of said second source.

7. The combination with an electron discharge device having a cathode, an anode, and an impedance control element, an input circuit, an output circuit and a heating circuit for said cathode, of a source of potential, and a relay in said output circuit for intermittently varying the heating current applied to said cathode and for associating said source of potential with said impedance control element when current in said heating circuit is at its minimum value.

8. The combination with an electron discharge device having a cathode, an anode, and an impedance control element, an output circuit connecting said cathode and anode, an input circuit connecting said filament and said impedance control element, and a heating circuit for said cathode, of means in said output circuit for simultaneously affecting the electrical condition of said input circuit and said heating current circuit.

9. The combination with an electron discharge device having a cathode, an anode and an impedance control element, an input circuit and an output circuit, a source of bias potential for said control element in said input circuit, a second source of potential common to said circuits, a third source of potential in said input circuit for balancing the effect of said second mentioned source of potential upon said impedance control element, and a circuit control element for disturbing said balanced condition.

10. The combination with an electron discharge device having a cathode, an anode and an impedance control element, a circuit connecting said cathode and anode, a source of potential in said circuit for producing a space discharge between said cathode and anode, a circuit connection extending from said control element to a point in said first circuit between said source and said anode, said circuit connection including a second source of potential of substantially equal value as in said first source but connected in an opposite direction and a third source of potential connected in such a direction as to impress a negative polarity on said control element, and means for varying the effective potential of said second source.

In witness whereof, I hereunto subscribe my name this 29th day of November, A. D. 1926.

LINDLEY A. KILLE.