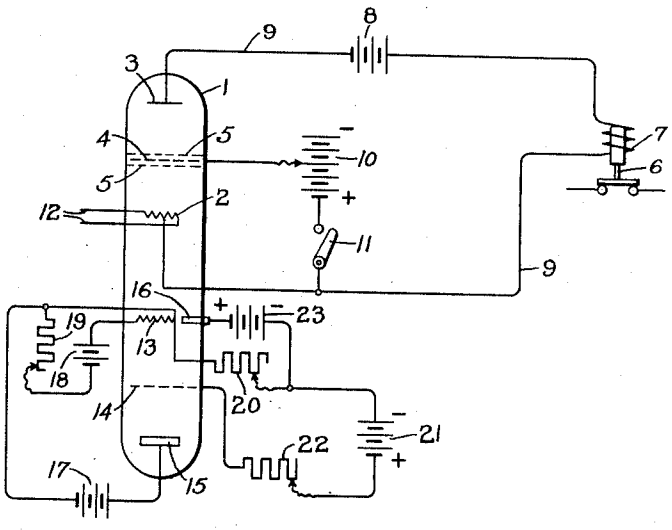
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F. W. MEYER

RELAY SYSTEM

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UNITED STATES PATENT OFFICE.

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RELAY SYSTEM.

Application filed December 8, 1924, Serial No. 754,518, and in Germany November 15, 1921.

My invention relates to electron discharge devices and to relay systems which comprise means for adjusting and controlling the duration of the time interval between different operations, and has for an object the provision of an improved relay system which possesses high sensitivity, is dependable in its operation, involves the use of small currents for controlling its operation, and obviates both the use of moving mechanical parts for producing a time delay and the use of mechanical interrupters for controlling the currents through which operation of the system is effected.

In accordance with my invention, an electron discharge device is arranged to have the potential of its grid or control circuit changed from a non-operative to an operative value in response to an operation which may be performed either manually or automatically, this change from a non-operative to an operative value of grid potential being effected at a rate predetermined by the adjustment of the apparatus.

My invention will be better understood from the following description when considered in connection with the accompanying drawing and it scope will be pointed out in the appended claims.

Referring to the drawing, the single figure thereof shows a system wherein an electron discharge device is arranged to control the operation of a translating device illustrated as an electric switch. This system is disclosed and broadly claimed in my copending application Ser. No. 754,519 filed December 8, 1924.

The figure shows an electron discharge device comprising a receptacle 1 which contains an ionizable medium such as argon for example, and in which are located a cathode 2, an anode 3, and a grid 4 surrounded by insulation, as indicated by the dotted lines 5. A switch 6 is arranged to have its operating coil 7 supplied with current from suitable source shown as a battery 8 through the operating circuit 9 of the electron discharge device. A battery 10 and a switch 11 are arranged to be connected in the control circuit of the electron discharge device for controlling the potential of the grid 4. Current for controlling the temperature of the cathode 2 may be supplied through the leads 12, or any other suitable means may be provided for ensuring a supply of electrons adequate for the proper operation of the device.

Assuming the connections to be as shown, closure of the switch 11 will immediately charge the grid 4 to a negative potential predetermined by the adjustment of the battery 10. Due to this potential, the outer surface of the grid insulation will be caused to assume a negative potential and little or no current will be transmitted through the operating circuit 9 by the battery 8. The potential at the outer surface of the grid insulation will not be maintained at the same negative value, however, but will be reduced to lower and lower negative values due to the deposition of positive ions until a point is eventually reached at which sufficient current is transmitted through the electron discharge device to cause operation of the switch 6.

The duration of the time interval between operation of the switches 11 and 6 is dependent upon a number of controllable factors. It will be observed that the grid and its insulation function somewhat as a condenser in the control circuit of the electron discharge device, that the rate at which energy is supplied to insulation by the deposition of positive ions depends on the pressure of the ionizable medium, the rate of electron emission at the cathode 2 and the adjustment of the battery 10, and that the time taken to charge the condenser formed by the grid and its insulation to a given potential will be dependent upon its capacitance. The insulated grid 4 thus serves as a means in which energy is stored at a rate dependent on the pressure of the ionizable medium, the thickness of the insulation and the grid voltage. If these factors do not change, operation of the switch 6 will always occur at a definite time interval after closure of the switch 11. It will be apparent that the grid voltage may be readily controlled. The regulation of the pressure of the ionizable medium, however, is a problem which requires some consideration.

It is well known that a certain amount of gas is absorbed in the colder parts of an electron discharge device during its operation and that this absorption of the gas produces changes in the characteristics of the device due to variations in the gas pressure. Thus, within certain limits current is transmitted through the device with greater

difficulty if the pressure of the gas decreases and with less difficulty if the pressure of the gas increases. If the characteristics of the device are to be maintained unchanged throughout its operation, it is therefore necessary that means be provided for maintaining the ionizable medium at a pressure which is substantially constant.

For the purpose of automatically controlling the pressure of the gas in response to slight changes thereof and for adjusting this pressure to different values, a pressure control apparatus comprising cathode 13, grid 14, anode 15, and auxiliary electrode 16 is provided. The cathode 13 and the anode 15 are interconnected through a source of current 17. Heating of the cathode 13 is controlled by current supplied from a battery 18 through a resistor 19. The cathode 13 is connected to the grid 14 through an adjustable resistor 20, a battery 21 and an adjustable resistor 22, and to the auxiliary electrode 16 through the resistor 20 and a battery 23.

In initiating the operation of the pressure control apparatus, the resistors 20 and 22 may be adjusted to a position where no discharge of electrons is produced between the cathode 13 and anode 15 when the gas within the receptacle 1 is at its normal pressure. When this is done, the pressure control apparatus will be practically inactive until a change in the pressure of the gas occurs. If a slight decrease in the pressure of the gas occurs, however, the current transmitted through the auxiliary anode 16 will decrease, thus decreasing the voltage drop across the resistor 20 and causing a higher positive potential to be produced at the grid 14. When this occurs, electrons will be discharged between the cathode 13 and the anode 15 and gas will be liberated at the anode 15 due to the fact that it is subjected to bombardment by the electrons. The liberation of the gas at the anode 15 will, of course, tend to restore the pressure of the gas to its normal value. As the pressure of the gas approaches its normal value, the potential of the grid 14 is gradually reduced to zero and the pressure control apparatus is eventually rendered inactive for the reason that the voltage of the battery 21 is neutralized by the potential drop across the resistor 20. Any reduction in the pressure of the gas below its normal value thus immediately brings into operation an influence tending to restore it to its normal value and the pressure of the ionizable medium is maintained within very narrow limits. Either change in the operating pressure of the device or change in the rate at which the pressure is restored to a desired value may be controlled by adjustments of the resistors 20 and 22.

The embodiment of the invention illustrated and described herein has been selected for the purpose of clearly setting forth the principles involved. It will be apparent, however, that this embodiment may be modified in many ways to adapt it to the different conditions encountered in its use.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. The combination of an electron discharge device comprising a receptacle, operating and control circuits for said device, a translating device connected in said operating circuit, energy storage means located within said receptacle and arranged to be connected in said control circuit, a source of current for energizing said operating circuit in accordance with the potential drop across said energy storage means, and an ionizable medium within said receptacle having its pressure regulated to cause said translating device to be operated at a predetermined time after the supply of energy to said energy storage means is initiated.

2. The combination of an electron discharge device comprising a receptacle, operating and control circuits for said device, a translating device connected in said operating circuit, energy storage means located within said receptacle and arranged to be connected in said control circuit, a source of current for energizing said operating circuit when the energy stored in said energy storage means has assumed a predetermined value, and an ionizable medium having its pressure regulated to cause said translating device to be operated at a predetermined time after the supply of energy to said energy storage means is initiated.

3. The combination of an electron discharge device comprising a receptacle, operating and control circuits for said device, energy storage means located within said receptacle and arranged to be connected in said control circuit, a translating device arranged to be connected in said operating circuit, a source of current for operating said translating device when the energy stored in said energy storage means has assumed a predetermined value, and an ionizable medium of sufficient density to control the rate of change in the amount of the energy stored in said energy storage means, whereby operation of said translating device is produced at a predetermined time interval after initiating the change in the amount of said stored energy.

4. The combination of an electron discharge device comprising a receptacle, operating and control circuits for said device, energy storage means located within said receptacle and arranged to be connected in said control circuit, a source of current for energizing said operating circuit in accordance with the potential drop across said energy storage means, an ionizable medium

within said receptacle of sufficient density to control the rate of variation in said potential drop, and means for adjusting and automatically maintaining the value of the pressure of said medium at a predetermined value.

5. The combination of an electron discharge device, operating and control circuits for said device, a translating device connected in said operating circuit, an insulated grid arranged to be connected in said control circuit, a source of current for energizing said operating circuit in accordance with the potential at the outer surface of the insulation of said grid, and a gas having its pressure regulated to cause said translating device to be operated at a predetermined time after the supply of energy to said energy storage means is initiated.

6. The combination of an electron discharge device, operating and control circuits, for said device, an insulated grid arranged to be connected in said control circuit, a source of current for energizing said operating circuit in accordance with the potential at the outer surface of the insulation of said grid, a gas of sufficient density to control the rate of change in the value of said potential, and electron discharge means for automatically maintaining the pressure of said gas at a predetermined value.

7. An electron discharge device comprising a receptacle, a cathode, an anode, a translating device connected between said cathode and anode, an insulated grid interposed between said cathode and anode, and an ionizable medium having its pressure regulated to cause said translating device to be operated at a predetermined time after the supply of energy to said energy storage means is initiated.

In witness whereof, I have hereunto set my hand this 25 day of November, 1924.

FRIEDRICH WILHELM MEYER.