Dec. 20, 1960 M. H. DIEPEVEEN 2,965,815

ADJUSTABLE ELECTRONIC TIMING DEVICE

Filed July 5, 1957

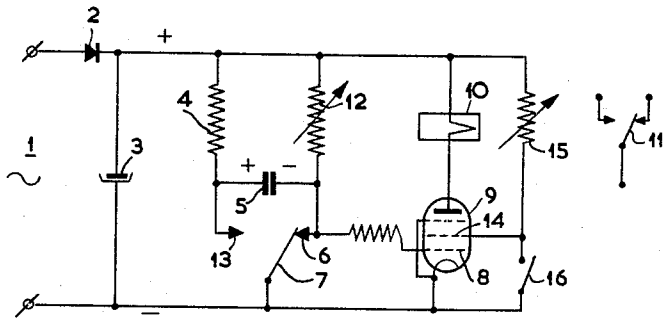

FIG.1

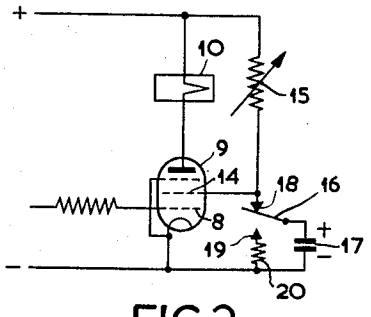

FIG.2

INVENTOR

MAURITS HENDRIK DIEPEVEEN

BY Frank P. Lipari

AGENT

United States Patent Office 2,965,815 Patented Dec. 20, 1960

2,965,815

ADJUSTABLE ELECTRONIC TIMING DEVICE

Maurits Hendrik Diepeveen, Garden Grove, Calif., assignor to North American Philips Company, Inc., New York, N.Y., a corporation of Delaware

Filed July 5, 1957, Ser. No. 670,172

Claims priority, application Netherlands July 11, 1956

2 Claims. (Cl. 317—142)

The present invention relates to an adjustable timing circuit. More particularly, the invention relates to an adjustable electronic timing circuit arrangement which includes a controllable high-vacuum valve, a relay included in the anode circuit of this valve and a capacitor which is charged through a resistor and one end of which is connected to the control grid of the valve.

It is an object of the present invention to provide an improved and simple timing circuit of this kind.

According to the invention, the relay, which has two contacts, is energized in the conductive condition of the valve, the capacitor being charged through the resistor and one contact so that the end of the capacitor which is connected to the control grid, is negatively charged from a source of direct current which also provides the supply voltage for the valve. The said contact also connects the control grid to the valve cathode, the relay being de-energized when the current through the valve is decreased, so that the said contact is opened and the capacitor, through a second contact and a second resistor, is reversely charged from the direct voltage source to a value at which the valve, by means of the grid voltage, again passes the larger current and the relay is energized, so that the initial condition is again obtained.

An advantage of the timing arrangement in accordance with the invention over the said known device consists in that the valve can be replaced by other valves of different type without the chosen switching period being appreciably affected. This is due to the fact that the capacitor is reversely charged and the valve, for example, switches at the instant at which the voltage across the capacitor passes through zero, which is comparatively sharply defined in the discharge-charge curve of the capacitor. The switching time remains constant, even when the valve ages. In contradistinction thereto, in the known arrangement, the discharge curve of the capacitor asymptotically approximates the point at which the valve switches, and this obviously is far less critical, so that variations in the grid bias due to ageing of the valve can cause a variation of the switching time.

Preferably, the second resistor is adjustable, so that the switching time also is adjustable. In addition, the relay is provided with at least one contact for transmitting the period of time during which the relay is de-energized.

In order that the invention may be readily carried into effect, it will now be described more fully with reference to the accompanying drawing, wherein:

Fig. 1 is a schematic diagram of an embodiment of the timing arrangement of the present invention; and

Fig. 2 is a modification of the embodiment of Fig. 1.

In Fig. 1, a rectifier 2 and a smoothing capacitor 3 are connected to an alternating voltage supply 1. The rectifier 2 is also connected to a resistor 4, a capacitor 5 and, through a contact 6 and a contact member 7, to the other terminal of the alternating current supply. The contact 6 is also connected to the control grid 8 of a high-vacuum valve 9. The anode circuit of the valve 9 includes a relay 10 which operates the contact member 7 and a second contact member 11 for switching a load into circuit and out of circuit respectively. To the positive terminal of the rectifier there is also connected a second adjustable resistor 12, the other end of which is connected to the capacitor 5, the other end of which is connected to a second contact 13. The valve 9 has a screen grid 14 which is connected, through a suitable resistor 15, to the anode voltage supply and, through a switch 16, to the cathode of the valve.

It is assumed that, in the condition shown, the valve 9 is conducting, so that the relay 10 is energized. Consequently, the capacitor 5 is charged so that its right-hand side, which is connected to the control grid 8, is negative. Due to the position of the member 7, the control grid 8 is at cathode potential and the valve remains conducting. When the switch 16 is closed for a short period of time, the current through the valve 9 is decreased so that the relay 10 is de-energized and the contact members 7 and 11 are changed over. Consequently, the full negative voltage of the capacitor 5 is applied to the grid circuit of the valve 9 so that the relay 10 remains de-energized. However, gradually the capacitor 5 is reversely charged through the resistor 12, the contact 13 and the contact member 7, so that at a certain instant the control grid 8 has such a potential applied to it that the current through the valve 9 again energizes the relay 10 and the contact members 7 and 11 are again changed over, so that the initial condition is restored.

The switching time is adjustable by variation of the resistor 12. This time is $0.6955\ R_{12}C_5$.

The valve 9 can be correctly adjusted by means of the resistor 15. Preferably, the value of the resistor 15 is equal to the direct current resistance of the valve 9 and the winding of the relay 10.

The circuit arrangement of the present invention is not only simple, but has the advantage of being independent of the supply voltage, since the capacitor 5 is reversely charged from negative to positive, so that, with a high supply voltage, the capacitor is reversely charged in the same period of time. Another advantage resulting from the fact that the capacitor 5 is reversely charged, is that there is no need for a second negative voltage for the control grid 8 or for the use of a separate gas or vapor filled controllable valve.

The switch 16 must be closed for a short period of time only, since, if it is permanently closed, the valve 9 cannot again become conductive when the voltage across the capacitor 5 passes through zero. In order to prevent injudicious operation of the switch 16, it may be designed in the form shown in Fig. 2. The switch 16 is connected, through a capacitor 17, to the negative terminal and has two contacts 18 and 19, the contact 19 being connected to the negative terminal through a resistor 20. Normally, the switch is in the position shown and the capacitor 17 is charged to the voltage of the screen grid 14. Consequently, the valve 9 is conductive. If, now, the switch 16 is connected to the contact 19, the valve 9 remains conductive, however, the capacitor 17 is discharged through the resistor 20. When the switch 16 is again brought into contact with the contact 18, the voltage at the screen grid 14 decreases to zero value and the tube becomes non-conducting for a short period of time. At this instant, the switch 7 is changed over, the circuit arrangement operating further in the manner described with reference to Fig. 1.

The timing arrangement may be used in photography, resistance welding, chemical processes, switching of traffic lights, and the like, particularly if the switch 16 is replaced, for example, by a rotating drum controller or by some other automatic switching device.

What is claimed is:

1. A timing circuit arrangement comprising an electron discharge device having an anode, a cathode, a control grid and a screen grid, a relay having an energizing winding connected in series circuit arrangement with said anode, switching means connected between said control grid and said cathode, said switching means having a first terminal point connected to said cathode, second and third terminal points and a switching arm adapted to electrically connect said first point to one of said second and third points in response to the energized condition of said winding, a capacitor having one terminal connected to said second terminal point and to said control grid and having the opposite terminal thereof connected to said third terminal point, a source of direct current having a positive pole and a negative pole, means connecting said negative pole of said source to said first terminal point, a first impedance interconnecting said second terminal point and said positive pole of said source, a second impedance interconnecting said third terminal point and said positive pole of said source, said impedances forming with said capacitor a first circuit for charging said capacitor in one direction and a second circuit for charging said capacitor in the opposite direction respectively upon actuation of said switching means, means connecting said positive pole of said source to the relay end of said series circuit arrangement, auxiliary switching means having a first auxiliary terminal point, a second auxiliary terminal point connected to said screen grid, a third auxiliary terminal point connected to said cathode and an auxiliary switching arm adapted to electrically connect said first auxiliary point to one of said second and third points, and an auxiliary capacitor having one terminal connected to said first auxiliary terminal and having the opposite terminal thereof connected to said third auxiliary terminal point and to said cathode.

2. A timing circuit arrangement comprising an electron discharge device having an anode, a cathode, a control grid and a screen grid, a relay having an energizing winding connected in series circuit arrangement with said anode, switching means connected between said control grid and said cathode, said switching means having a first terminal point connected to said cathode, second and third terminal points and a switching arm adapted to electrically connect said first point to one of said second and third points in response to the energized condition of said winding, a capacitor having one terminal connected to said second terminal point and to said control grid and having the opposite terminal thereof connected to said third terminal point, a source of direct current having a positive pole and a negative pole, means connecting said negative pole of said source to said first terminal point, a first impedance interconnecting said second terminal point and said positive pole of said source, said first impedance having a variable impedance value, and a second impedance interconnecting said third terminal point and said positive pole of said source, said impedances forming with said capacitor a first circuit for charging said capacitor in one direction and a second circuit for charging said capacitor in the opposite direction respectively upon actuation of said switching means, means connecting said positive pole of said source to the relay end of said series circuit arrangement, auxiliary switching means having a first auxiliary terminal point, a second auxiliary terminal point connected to said screen grid, a third auxiliary terminal point connected to said cathode and an auxiliary switching arm adapted to electrically connect said first auxiliary point to one of said second and third points, and an auxiliary capacitor having one terminal connected to said first auxiliary terminal and having the opposite terminal thereof connected to said third auxiliary terminal point and to said cathode.

References Cited in the file of this patent

UNITED STATES PATENTS

2,559,508	Meier	July 3, 1951
2,818,532	Aitel	Dec. 31, 1957
2,835,849	Biedermann et al.	May 20, 1958

FOREIGN PATENTS

678,535	Great Britain	Sept. 3, 1952