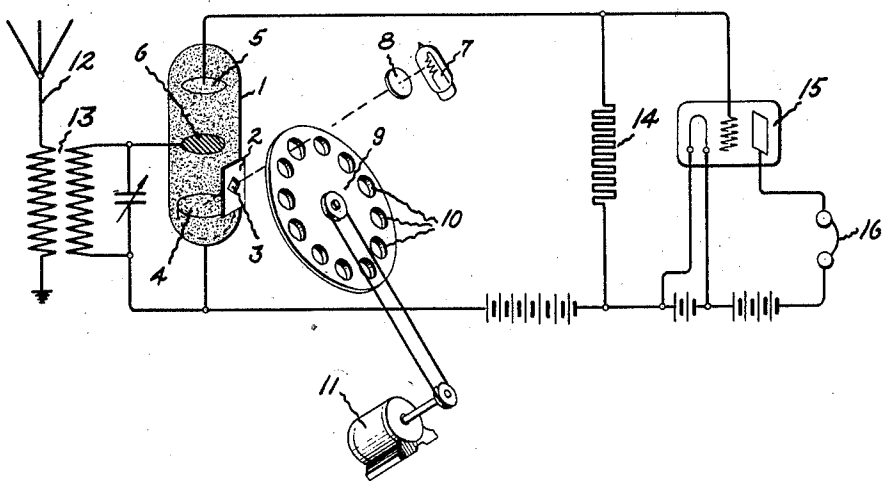
Feb. 7, 1928. 1.658,672

A. G. DAVIS

ELECTRON DISCHARGE APPARATUS

Filed April 2, 1923



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UNITED STATES PATENT OFFICE.

ALBERT G. DAVIS, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRON-DISCHARGE APPARATUS.

Application filed April 2, 1923. Serial No. 629,235.

My present invention relates to electron discharge devices, and more particularly to electron discharge devices of the photo-electric type.

Devices of the photo-electric type have been utilized in the past by producing a variable illumination of the photo-electric cathode whereby the current through the device has been caused to vary in accordance with the variations in the illumination of the cathode. It has also been proposed to provide a constant illumination of the cathode and control the current flowing between cathode and anode in the same manner that the current is controlled in electron discharge devices of the thermionic type.

One of the objects of my invention is to provide an apparatus whereby both of the control methods referred to above may simultaneously be employed to produce various desired results in a much more simple and convenient manner than has heretofore been possible.

A more specific object of my invention is to provide an apparatus for receiving high frequency continuous wave signals which will have the same advantages in so far as selectivity is concerned as the well-known heterodyne system.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof will best be understood by reference to the following description taken in connection with the accompanying drawing in which I have indicated diagrammatically one organization of apparatus whereby my invention may be carried into effect.

As indicated in the drawing, I provide a photo-electric device comprising an evacuated envelope 1 which may be coated with opaque material to prevent the entrance of light, except at a small portion which is covered by a plate 2 having an opening 3 therein through which light may enter and fall upon the cathode 4, which may consist of one of the photo-electric alkaline metals such as sodium, potassium, caesium, etc., or an alloy of two or more such metals. The photo-electric device is also provided with an anode 5 and a discharge controlling member 6 for varying the flow of electrons between the cathode and anode.

As a means for illuminating the cathode in order to produce an emission of electrons therefrom, I have indicated an incandescent lamp 7, the light from which passes through a condensing lens 8 and through the opening 3 in the plate 2. In order to interrupt the illumination from the lamp 7 in a desired manner, I have indicated a disk 9 having openings 10 therein through which the light beam from the lamp 7 may pass. If the disk 9 is rotated by means of the motor 11 the illumination of the cathode and consequently the emission of electrons will be interrupted in a regular manner, the frequency of the interruptions being dependent upon the number of openings in the disk 9, and the speed at which it is rotated. While the use of a disk such as that indicated will produce a complete interruption of the emission of electrons this is not essential as in some cases it may be desirable not completely to interrupt the emission of electrons, but rather to vary the emission in a regular manner between predetermined maximum and minimum values. It is apparent that by suitable modification of the apparatus employed for varying the illumination of the cathode the electron emission from the cathode may be varied in any desired manner.

The apparatus which I have described may be employed for many purposes. I have indicated as one embodiment of my invention its application in a radio receiving system for receiving continuous wave telegraphic signals. Signals received upon the antenna 12 are impressed through the coupling transformer 13 upon a tuned circuit connecting the cathode 4 and discharge controlling member 6 of the photo-electric device. If a uniform illumination of the cathode should be maintained this would cause a current to flow in the circuit between cathode 4 and anode 5 of the photo-electric device which would correspond to the high frequency signaling current received on the antenna. By varying the illumination of the cathode by the apparatus indicated however, the amplitude of the current flowing in the cathode-anode circuit of the photo-electric device may be varied in a desired manner. The disk 9 should preferably be rotated at such a speed that the emission of electrons

will be interrupted at a frequency slightly different from the frequency of the signaling current. The amplitude of the current in the cathode-anode circuit will then vary regularly between maximum and minimum values at a frequency corresponding to the difference in frequency between the signaling current and the frequency of the interruptions. The variable current thus produced gives rise to corresponding potential variations between the terminals of the high resistance 14 which is included in the cathode-anode circuit of the photo-electric device and these potential variations are impressed upon the grid circuit of a thermionic amplifier 15. If the amplitude variations produced in the cathode-anode circuit of the photo-electric device are audible frequency an audible indication will be produced in the telephone receiver 16, which is included in the plate circuit of the amplifier 15. When no signals are impressed upon the discharge controlling member of the photo-electric device the variations in the illumination of the cathode will produce current variations of ultra-audible frequency in the cathode-anode circuit and these currents will not produce any indication in the telephone receiver 16.

While I have shown and described only one embodiment of my invention, it is apparent that my invention is by no means limited to the particular embodiment illustrated, and that many modifications in the type, form and arrangement of the apparatus employed, as well as in the particular utilization thereof may be made without departing from the scope thereof as set forth in the appended claims.

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

1. The combination of a device having a cathode adapted to emit electrons when subjected to the influence of light, an anode and a discharge controlling member, means for impressing an alternating potential on said discharge controlling member, means for illuminating said cathode, and means for regularly cutting off the illumination of said cathode at a radio-frequency having a desired relation to the frequency of the alternating potential impressed upon the discharge controlling member.

2. The combination in a signaling system of an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, and anode and a discharge controlling member, means for impressing signaling potentials on said discharge controlling member, and means for cutting off the illumination of said cathode at a radio-frequency having a desired relation to the frequency of the signaling potential impressed upon the discharge controlling member.

3. The combination of an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, and an anode, means for varying the flow of electrons between said cathode and anode in a regular and predetermined manner, and means for regularly varying the emission of electrons from said cathode at a radio-frequency having a desired relation to the frequency of the variations in the flow of electrons.

4. The combination of an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, and an anode, means for regularly varying the flow of electrons between said cathode and anode in accordance with signals, and means for regularly varying the emission of electrons from said cathode at a radio-frequency having a desired relation to the signaling frequency.

5. The combination of an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, and an anode, means for varying the flow of electrons between said cathode and anode in a regular and predetermined manner, and means for regularly interrupting the illumination of said cathode at a radio-frequency having a desired relation to the frequency of the variations in the flow of electrons.

6. The combination of an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, and an anode, means for regularly varying the flow of electrons between said cathode and anode in accordance with signals, and means for regularly interrupting the illumination of said cathode at a radio-frequency having a desired relation to the signaling frequency.

7. The combination in a signaling system of an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, an anode and a discharge controlling member, means for impressing signaling potentials on said discharge controlling member, and means for regularly varying the emission of electrons from said cathode at a radio-frequency having a desired relation to the frequency of the signaling potential impressed upon the discharge controlling member.

8. The method of operating an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light and an anode, which consists in varying the flow of electrons between the cathode and anode in a regular and predetermined manner and regularly varying the emission of electrons from said cathode at a radio-frequency having a desired relation to the frequency of the variations in the flow of electrons.

9. The method of operating an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light and an anode, which consists in varying the flow of electrons between the cathode and anode in accordance with signals and simultaneously and regularly varying the emission of electrons from the cathode at a radio-frequency having a desired relation to the signaling frequency.

10. The method of operating an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light and an anode, which consists in varying the flow of electrons between the cathode and anode in accordance with signals and simultaneously interrupting the illumination of the cathode at a radio-frequency having a desired relation to the signaling frequency.

11. The method of operating an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light and an anode, which consists in varying the flow of electrons between the cathode and anode in a regular and predetermined manner and regularly varying the emission of electrons from said cathode at a frequency differing slightly from the frequency of the variations in the flow of electrons.

12. The method of operating an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light and an anode, which consists in varying the flow of electrons between the cathode and anode in accordance with signals and simultaneously causing the electron emission from the cathode to vary between minimum and maximum values at a frequency differing slightly from the signaling frequency.

13. The method of operating an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, an anode and a discharge controlling member which consists in applying an alternating potential to the discharge controlling member and simultaneously varying in a predetermined regular manner the illumination of the cathode at a radio-frequency having a desired relation to the frequency of the alternating potential applied to the discharge controlling member.

14. The method of operating an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, an anode and a discharge controlling member which consists in applying an alternating potential to the discharge controlling member and simultaneously and regularly varying the electron emission from the cathode at a frequency differing slightly from the frequency of the alternating potential applied to the discharge controlling member.

15. The method of operating an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, an anode and a discharge controlling member which consists in applying an alternating potential to the discharge controlling member and simultaneously and regularly varying between maximum and minimum values the electron emission from the cathode at a radio-frequency having a desired relation to the frequency of the alternating potential applied to the discharge controlling member.

16. The method of operating an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, an anode and a discharge controlling member which consists in applying a signaling potential to the discharge controlling member and simultaneously and regularly varying between maximum and minimum values the electron emission from the cathode at a frequency differing slightly from the frequency of the signaling potential applied to the discharge controlling member.

17. The method of operating an electron discharge device having a cathode adapted to emit electrons when subjected to the influence of light, an anode and a discharge controlling member which consists in applying a signaling potential to the discharge controlling member and simultaneously and regularly varying between maximum and minimum values the electron emission from the cathode at a radio-frequency having a desired relation to the frequency of the signaling potential applied to the discharge controlling member.

In witness whereof, I have hereunto set my hand this 31st day of March, 1923.

ALBERT G. DAVIS.