

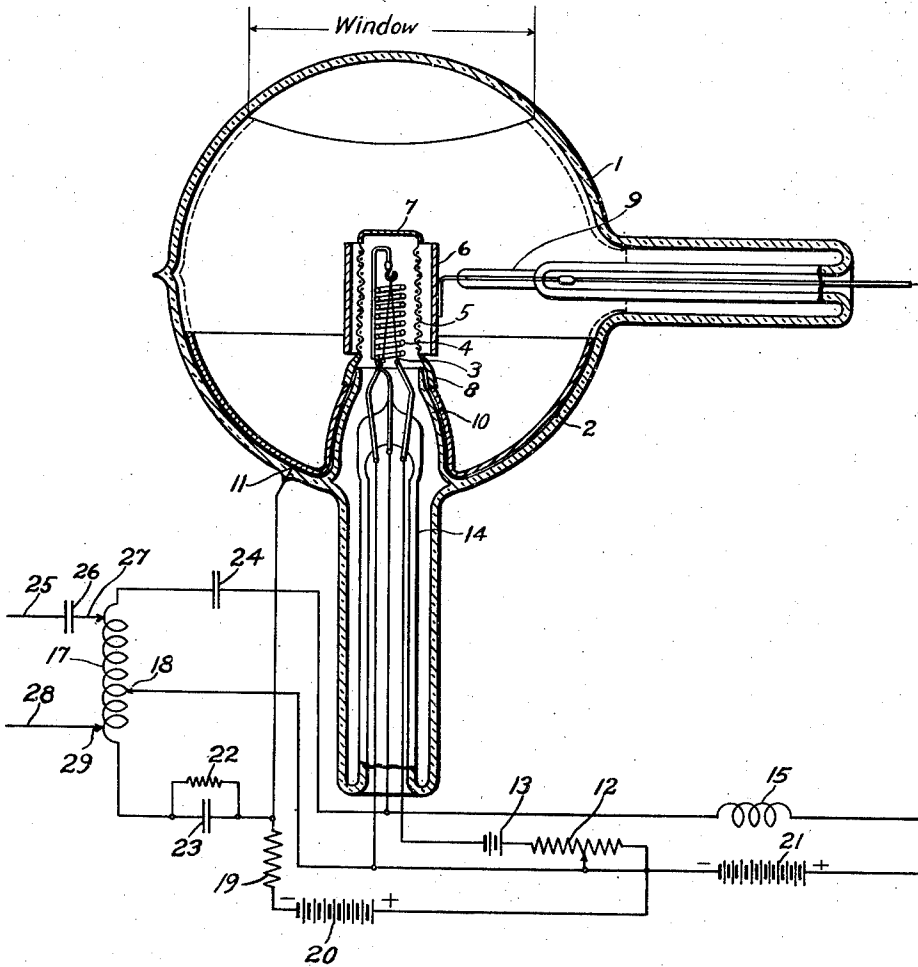
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OSCILLATOR

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OSCILLATOR

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My invention relates, in general, to thermionic devices.

One of the objects of my invention is to provide an improved thermionic oscillator.

Another object of my invention is to provide a light-controlled oscillator.

Another object of my invention is to provide a combined oscillator and modulator.

Another object of my invention is to provide a combined photoelectric cell and oscillator.

Another object of my invention is to provide an oscillator having two control electrodes.

A still further object of my invention is to provide an oscillator having two cathodes.

There are other objects of my invention which, together with the foregoing, will be described in the following detailed specification.

In practicing my invention, I may employ a thermionic tube constructed in a manner substantially similar to the thermionic tubes employed as radio detectors and amplifiers. That is, a tube having a hot cathode, a grid and a cold anode. The construction, of course, may be modified in order to carry out my invention, as will appear subsequently.

The single figure of the drawing is a cross-sectional view of a preferred form of my photoelectric cell, and a diagrammatic view of associated circuits and apparatus.

My improved photoelectric cell comprises a glass bulb 1 having a deposit 2 of conducting material upon a portion of the inner surface of the wall thereof. The deposit may be platinum, or other suitable material, deposited from a solution, or applied in any other desired way.

A filament 3, a grid 4, a second grid 5 and an anode 6 are disposed within the bulb in cooperative relation to each other. The grid 4 may be of the usual helical type employed in thermionic tubes, while the second grid 5 is preferably of finer mesh and is provided with an imperforate cap 7 and a depending skirt 8. The skirt 8 is supported from a reentrant portion 10 of the wall of the bulb and makes electrical contact with the metallic deposit 2.

The anode 6, which is supported from a press 9, and surrounds the filament 3 and the grids 4 and 5, is so shaped that it co-operates with the imperforate cap 7 and the depending skirt 8 to prevent any light emitted by the filament from falling upon the inner surface of the bulb.

The filament 3 and the grid 4 are supported from a plurality of conductors extending through the inner end of a press 14 which is disposed coaxially of the reentrant portion 10 of the bulb.

A photoelectric material, such as potassium, caesium or sodium, is applied to the inner surface of the metallic deposit 2, preferably by distilling it thereon from a small container (not shown), and the material is sensitized by causing an electrical discharge to take place between the anode 6 and the grid 5 in an atmosphere of hydrogen. The resulting chemical action between the hydrogen and the potassium causes a film of potassium hydride to be formed in a colloidal state on the potassium. The potassium hydride is highly active photoelectrically, that is, it emits electrons under the influence of light.

The manner of treatment outlined above, by which a deposit of potassium hydride is placed on the metallic deposit in a colloidal form renders the rate at which the electrons are emitted from ten to twenty times greater than if it were treated by other known means.

It will be understood, of course, that in the foregoing process, the step which involves the deposit of the photoelectric element on the metallic deposit is accomplished as quickly as possible in order that the various elements inside the bulb 1 will not be short-circuited. In addition, the hydrogen is pumped out and replaced with an inert-gas atmosphere at a pressure that will give maximum response of the photoelectric material. When the tube 1 is made, a contact member 11 is placed therein for electrical connection to the metallic and photoelectric deposits.

In order to describe the operation of the photoelectric cell oscillator, it will be understood that certain electrical connections are made in the manner shown in the drawing.

That is, the cathode 3 is connected through a variable resistor 12 to a battery 13. The anode 6 is connected to the filament or cathode 3 through a high-potential battery 21. The first gride 4 is connected through a reactance 15 to the positive terminal of the battery 21, and to one end of a reactor 17 through a condenser 24. The terminal 11 is connected through a resistor 19, battery 20 and second battery 21 to the anode 6. The resistance of the resistor 19 may be of the order of 50 megohms.

One terminal of the reactor 17 is connected through the grid leak 22 and grid condenser 23 to the terminal 11 and then by way of the deposit 2 to the second gride 5. The mid-point of the reactor 17 is connected to the cathode through a contact member 18. A conductor 25 is connected through a condenser 26 and contact member 27 to the one end of the reactor 17. A second conductor 28 is connected to the other end of the reactor 17 by way of the contact member 29. The conductors 25 and 28 comprise the output circuit of my improved oscillator.

It will be seen that the cathode 3, the second grid 5 and the first gride 4 are connected in a circuit that is known as the Hartley oscillating circuit, the positive potential being applied to the grid 4 from the battery 21, causing the said grid to function as an anode. Consequently, if there is sufficient current flow from the cathode 3 to the grid 4, an oscillating current will be delivered over the conductors 25 and 28, the frequency of which is dependent upon the constants of the reactor 17 and the condenser 24. The manner in which this circuit functions will appear more fully hereinafter.

It will be also seen that the negative terminal of the battery 20 is connected to the terminal 11 and that the positive pole of the battery 21 is connected to the anode 6. Inasmuch as the voltage of the batteries 20 and 21 are added together, a high negative potential is placed upon the metallic deposit 2 with respect to the anode 6. A lower positive potential from the battery 21 is also placed upon the grid 4.

It will first be assumed that the photoelectric cell is dark. When the current is passed through the filament or cathode 3, electrons are emitted from the filament. These electrons do not flow to the grid 4 because of the fact that there is a high negative potential existing upon the second grid 5 from the battery 20. The negative potential on the grid 5 need only be sufficient to prevent the amount of current flowing from the cathode 3 to the first anode 4 to be enough to start the circuit into oscillation. Consequently, there is no oscillating current flow in the circuit including the conductors 25 and 28. When the photoelectric cell is illuminated, the photoelectric material begins to emit electrons, the

number of which is proportional to the intensity of light. These electrons flow from the photoelectric material to anode 6 under the influence of the voltage impressed by the batteries 20 and 21 in series.

Immediately upon the flow of current there is a voltage drop across the resistor 19, and the voltage on the grid 5 is reduced to such an extent that the space charge is not so effective to prevent the electrons emitted from the cathode 3 reaching the grid or anode 4. The current flow in the circuit is thus increased. The voltage drop is proportional to the electron flow from the photoelectric material. This, in turn, is proportional to the intensity of light on the photoelectric cell. The voltage drop regulates the space charge which, in turn, controls the number of electrons that reach the grid 4. The electrons reaching the grid 4 thus cause the current to flow through the circuit including the reactor 17. The amount of current is relatively high and causes the cell to break into oscillation, whereby an alternating current is supplied to the conductors 25 and 28, the amplitude of which is governed by the intensity of light falling upon the cell.

The only limit to the amount of current that may be obtained is the amount of heat radiated by the filament, which heat tends to cause the potassium to evaporate. By proper cooling arrangement, a very large current output may be secured.

When the photoelectric cell is darkened, the photoelectric substance does not emit electrons and there is no current flow from the photoelectric material to the anode 6. Consequently, there is no voltage drop across the resistor 19, and a high negative potential is placed on the grid 5 which so controls the space charge that no electrons from the cathode 3 reach the grid 4 or the number that do reach it are not sufficient to cause the tube to oscillate and no oscillating current is delivered to the conductors 23 and 26.

My invention is not limited to the particular arrangement of the apparatus described, but may be variously modified without departing from the spirit and scope thereof, as set forth in the appended claims.

I claim as my invention:

1. In an oscillatory system, a container within which are positioned elements constituting a thermionic amplifier and a light-responsive device, input and output circuits for said amplifier, said circuits being so coupled as to promote the generation of oscillations, and means whereby the amplitude of said oscillations may be controlled by said light-responsive device.

2. An oscillation generator comprising a thermionic tube having an anode, a cathode and a control-electrode, an additional electrode within said tube capable of assuming an electric charge that will prevent the genera-

tion of oscillations, and photoelectric means within said tube for modifying the control exerted by said additional electrode.

3. An oscillation generator including a vacuum tube having three electrodes and circuits associated therewith for causing said electrodes to act respectively as cathode, anode and control electrode, means for impressing a blocking potential upon the control electrode and means including a photoelectric element disposed within said tube for removing said blocking potential.

4. In a light-responsive system, a device comprising a light-sensitive electrode and an anode associated therewith, a thermionic cathode, a plurality of grid-electrodes associated with said cathode, an output circuit associated with said device and so arranged that oscillations tend to develop therein, one of said grids serving as an anode in the generation of said oscillations, means for applying a negative blocking potential to the other of said grids, and connections within said device whereby electronic emission from said light-sensitive electrode to the anode associated therewith renders less negative said blocking potential, whereby the amplitude of oscillations generated depends upon the light impinging on said light-sensitive electrode.

5. In a light-responsive system, a device comprising an evacuated envelope, a thermionic cathode, an anode and two grid-electrodes positioned therein, a light-sensitive substance positioned in said envelope and connected conductively to one of said grids, an output circuit and potential sources associated with said device and so arranged that oscillations tend to develop therein, the other of said grids serving as an anode in the generation of oscillations, means for impressing a negative blocking-potential on said light-sensitive substance with respect to said cathode, and means including said first mentioned anode for rendering said blocking potential less negative when said light sensitive substance is exposed to light.

6. In a light-responsive system, a device comprising an evacuated envelope, a thermionic cathode, an anode, and two grid-electrodes supported therein, a light-sensitive substance positioned in said envelope and conductively connected to one of said grid-electrodes, an output circuit and potential sources associated with the other of said grids and said cathode and so arranged that oscillations tend to develop therein, the last mentioned grid serving as an anode in the generation of said oscillations, said sources of potential being cumulative in impressing a negative blocking potential on said light-sensitive substance with respect to said first mentioned anode, and means whereby the exposure of said light-sensitive substance to light will cause said blocking potential to become less negative.

7. A composite light-sensitive cell and thermionic tube comprising, in combination, an evacuated container having mounted therein a cathode, a plurality of concentric grid-electrodes surrounding said cathode, an anode surrounding said grids, a light-sensitive substance deposited on a portion of the inner surface of said container, and a conductive connection between said light-sensitive substance and one of said grids.

8. A composite light-sensitive cell and thermionic tube comprising, in combination, an evacuated container having mounted therein a cathode, a plurality of grid-electrodes surrounding said cathode, an anode surrounding said grid, a light-sensitive substance deposited on a portion of the inner surface of said container, said anode and one of said grid-electrodes being so shaped and so positioned with respect to said cathode that light therefrom is prevented from reaching said light-sensitive substance, and a conductive connection between the last-mentioned grid-electrode and said light-sensitive substance.

In testimony whereof, I have hereunto subscribed my name this first day of July, 1925.

VLADIMIR K. ZWORYKIN.