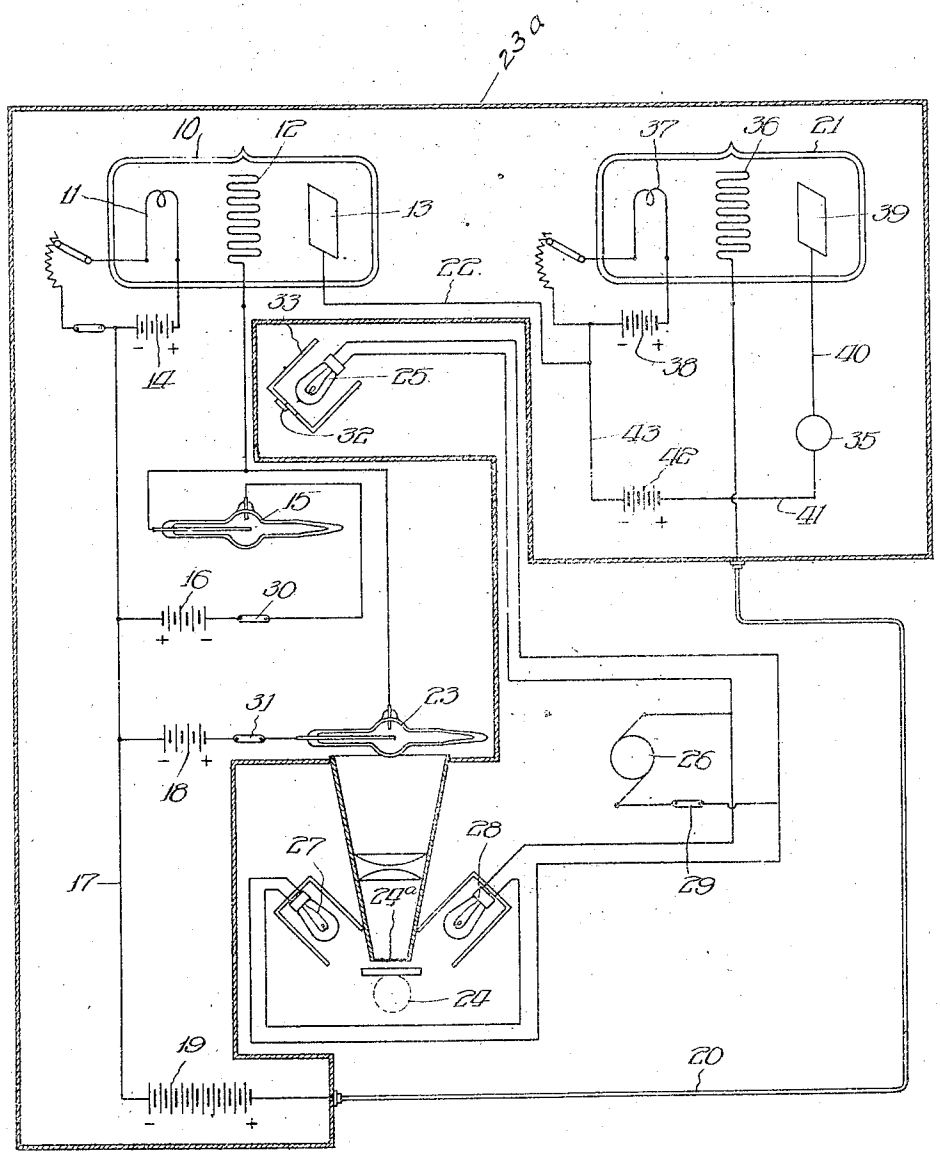
Sept. 8, 1925. 1,552,679

V. C. CRITES

PHOTOMETRIC DEVICE

Filed Jan. 9, 1920



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UNITED STATES PATENT OFFICE.

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PHOTOMETRIC DEVICE.

Application filed January 9, 1920. Serial No. 350,407.

To all whom it may concern:

Be it known that I, VIRGIL C. CRITES, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Photometric Devices, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to photometric devices, together with means for the amplification of variations in such devices.

In my Patent No. 1,379,172, patented May 24, 1921, I set forth a system including an electron discharge tube and a pair of photo-electric cells so arranged that the current variations of one of said photo-electric cell is amplified by the electron discharge tube. My present invention concerns itself with the provision of means to secure a second amplification.

My invention concerns itself with the amplification of the variations of an electron discharge tube by a second electron discharge tube in such manner that the second electron discharge tube need not be brought into resonance with the first.

I will explain one form which my invention may take more in detail by referring to the accompanying drawing illustrating diagrammatically a system arranged in accordance with my invention.

Referring more particularly to the drawing, I show an electron discharge tube 10 having the filament 11, grid 12 and plate 13. A suitable battery 14 serves to energize the filament 11 thereby to place the tube 10 in condition for establishing an electronic stream such energization being sufficient to bring about a saturated condition in said tube. A photo-electric cell 15 has one of its terminals connected to the grid 12 and its remaining terminal connected with a battery 16, whose free terminal is connected with a conductor 17 forming part of the external circuit of the tube 10. This conductor 17, as readily apparent from the illustration, is connected to one terminal of the filament 11 and therefore to one terminal of the battery 14. It will be noted that the conductor 17 is associated with the negative terminal of the battery 14, the positive terminal of the battery 16, the negative terminal of the battery 18 and the negative terminal of the battery 19.

Although definite voltages are not absolutely required, I have found in practice that in the particular arrangement of apparatus with a given particular size of photo-electric cell and electron discharge tube, that I get good results if the voltage of the battery 14 is about six volts, the voltage of the batteries 16 and 18 each one hundred and twenty volts and the voltage of the battery 19 about three hundred and fifty volts.

The external circuit of the electron discharge tube 10 extends by way of the conductor 17 through the battery 19, conductor 20, to a second electron discharge tube 21, conductor 22, back to the plate 13 of the tube 10.

I provide a second photo-electric cell 23 which, as seen from the drawing, I connect to the electron discharge tube 10 in a manner reverse to the connection of the photo-electric cell 15. The photo-electric cell 23 has certain apparatus which will be presently explained whereby objects, such as the object 24, and which objects are of different color or light effect, affect the photo-electric cell 23 in proportion to their lighting effect so that the electrical variations in said photo-electric cell 23 are in accordance with the color or other lighting effect of successive objects 24 that are placed within the range of the photo-electric cell 23.

Cell 15 is unsensitized so that its characteristics remain constant under the influence of the steady light source 25, while cell 23 is sensitized so as to make it more sensitive and more readily responsive to slight changes in light. It is therefore more delicate.

In one form of application of my improved device, I have utilized it for determining the color of cigars placed within the range of the cell 23, such a cigar being diagrammatically indicated as the object 24 in the drawing.

A screen 24ª placed between the object 24 and the cell 23 is of such characteristics that it prevents the 60 cycle Hertzian waves (due to the use of 60 cycle current in the lamps 27 and 28) from influencing the cell 23.

A lead shell 23ª surrounds all of the cells and tubes to prevent their being influenced by external disturbances.

The photo-electric cell 15 is under the influence of a source of light 25, which source of light receives its current from any suitable source of current such as indicated at 26. The illumination of the objects 24 is brought about by suitable sources of light 27 and 28, also connected to the same source of current 26. I prefer to have the lamp or source of light 25 of two hundred and fifty volts and the lamps 27 and 28 of one hundred and twenty-five volts each, if the primary source of current 26 is a two hundred and fifty volt system. The photo-electric cell 15 is designed for the purpose of controlling the residual condition of the tube 10, as will be presently explained. For this reason the photo-electric cell 15 is for a certain adjustment to be continually illuminated by the lamp 25.

Now it may be that there is a variation in the impressed pressure from the source 26 so that there would be variations in the lighting effect of the lamp 25. This might tend to impair the correctness of the variations of the system if it were not that the variations in lighting effect of the lamp 25 will be the same as that of the lamps 27 and 28 so that if the lighting effect of the lamp 25 is lowered, the lighting effect of the lamps 27 and 28 upon the object 24 is correspondingly lowered so that the indications of the system are independent of any normal variations in the source of pressure of the circuit supplied by the generator 26.

The cell 15 which acts as a resistance has its light sensitive coating distilled and deposited on the silver coating which in turn has been distilled and deposited on the glass. After the distillation has taken place the bulb is highly evacuated and filled to a very low pressure with an inert gas. The pressure of the gas is so chosen that the tube will operate at the required voltage.

The cell 23 which photometers the light value of the cigars is constructed much the same with the exception that after the distillation of the light sensitive material the bulb is highly evacuated and chemically pure hydrogen is introduced and a sufficient potential is applied across the terminals to cause a glow discharge to take place. Just what the action that takes place in the tube really is, in the presence of the hydrogen, is not known. It is thought that a hydrate of the alkali metal is produced, or that the metal enters a colloidal state. It results however in an interaction between the metal film and the gas which makes the cell very sensitive.

I have explained the general arrangement of the electrical connections of the various devices constituting the system. It will be noted that the variations in current flow of the cell 23 are suitably amplified by the electron discharge tube 10 so that they are susceptible of accurate measurement.

In the operation of the system as thus connected up, I first connect into the circuit the battery 14 to energize the filament 11 and thereby establish a residual flow of current through the electron discharge tube and its external circuit, which as before explained includes the conductors 17, 20 and 22. I then cause an illumination of the lamps 25, 27 and 28, suitable switches 29, 30 and 31 being provided for this purpose and for controlling the circuits through the photo-electric cells. I then connect the photo-electric cell 15 into the circuit and so adjust the current strength that there is no longer any residual flow through the electron discharge tube 10. This result may be brought about by varying the position of the plate 32 which controls the degree of opening through the housing 33 surrounding the lamp 25. I then connect the photo-electric cell 23 into the circuit and cause it to become operative by placing an object 24 within its optical range.

The structure by virtue of which the lighting or color effect of the object 24 alone influences the readings or actuations of the photo-electric cells 23 are more clearly set forth in my said co-pending application, it being sufficient to indicate here that a photo-electric cell 23 is actuated by the amount of light coming from the object 24.

The variations in the photo-electric cell 23 actuate an indicating instrument 35, as will presently appear. The conductor 20 which forms part of the external circuit of the tube 10 is connected to the grid 36 of the second tube 21 and the conductor 22 is connected to the filament 37 of the same tube. A battery 38 energizes the filament 37. A plate 39 also forms part of the tube 21 and this is connected directly to the indicating instrument 35, the external circuit of the said tube 21 extending then from the plate 39 by way of conductor 40, indicating instrument 35, conductor 41, battery 42, and conductor 43 to the filament 37. I prefer the tube 21 to be very highly evacuated and the battery 42 of sufficiently low potential that the primary or residual flow as evidenced in the measuring instrument 35 will hardly indicate its presence. The battery 38 is preferably of about six volts and battery 42 is preferably of about fifty volts strength. The tube 21 is thus connected into the circuit to amplify the electrical variations of the tube 10. It will be noted that the tube 21 is directly connected with the external circuit of the tube 10, there being no transformer interposed between the two, and the connection being such that it is not necessary to bring the two tubes into resonance.

I find that the variations in the external circuit of the tube 21 relative to the variations in the tube 10 follow substantially a straight line equation. This provides a very simple and effective method of giving us a straight line amplification and also provides a very simple and effective method of obtaining a multiple amplification without the necessity of bringing the various tubes into resonance.

From what has been thus described the nature of my invention will be readily apparent, and it will also be apparent that my invention is not limited to the specific arrangement as herein disclosed.

I claim the following:—

1. A system of the character described, comprising an electron discharge tube having a plate and a grid, a photo-electric cell connected to said tube whereby the variations of current in said cell are amplified by said tube, a further photo-electric cell to control the residual electric condition of said tube, said cells being reversely connected with said tube, and a second similar electron discharge tube directly connected into the circuit of said first aforesaid electron discharge tube, to thereby amplify the electrical variations of said first aforesaid tube having a plate and a grid, the plates of said tubes being connected together and the grids of said tubes being connected together.

2. A system of the character described, comprising an electron discharge tube having a plate and a grid, a photo-electric cell connected to said tube whereby the variations of current in said cell are amplified by said tube, a further photo-electric cell to control the residual electric condition of said tube, and a second similar electron discharge tube directly connected into the circuit of said first aforesaid electron discharge tube to thereby amplify the electrical variations of said first aforesaid tube having a plate and a grid, the plates of said tubes being connected together and the grids of said tubes being connected together.

3. A system of the character described, comprising an electron discharge tube having a plate and a grid, a photo-electric cell connected to the grid of said tube, whereby the variations of current in said cell are amplified by said tube, and a second similar electron discharge tube directly connected into the circuit of said first aforesaid electron discharge tube to thereby amplify the electrical variations of said first aforesaid tube having a plate and a grid, the plates of said tubes being connected together and the grids of said tubes being connected together, the plates of said tubes being unconnected with the grids of said tubes.

4. A system of the character described, comprising an electron discharge tube having a plate and a grid, means for energizing said tube, means for causing variations of the electrical conditions in said tube, and a second similar electron discharge tube directly connected to the said first aforesaid electron discharge tube to amplify the electrical variations in said first aforesaid electron discharge tube having a plate and a grid, the plates of said tubes being connected together and the grids of said tubes being connected together, the plates of said tubes being unconnected with the grids of said tubes.

In witness whereof, I hereunto subscribe my name this 20th day of December, A. D. 1919.

VIRGIL C. CRITES.