

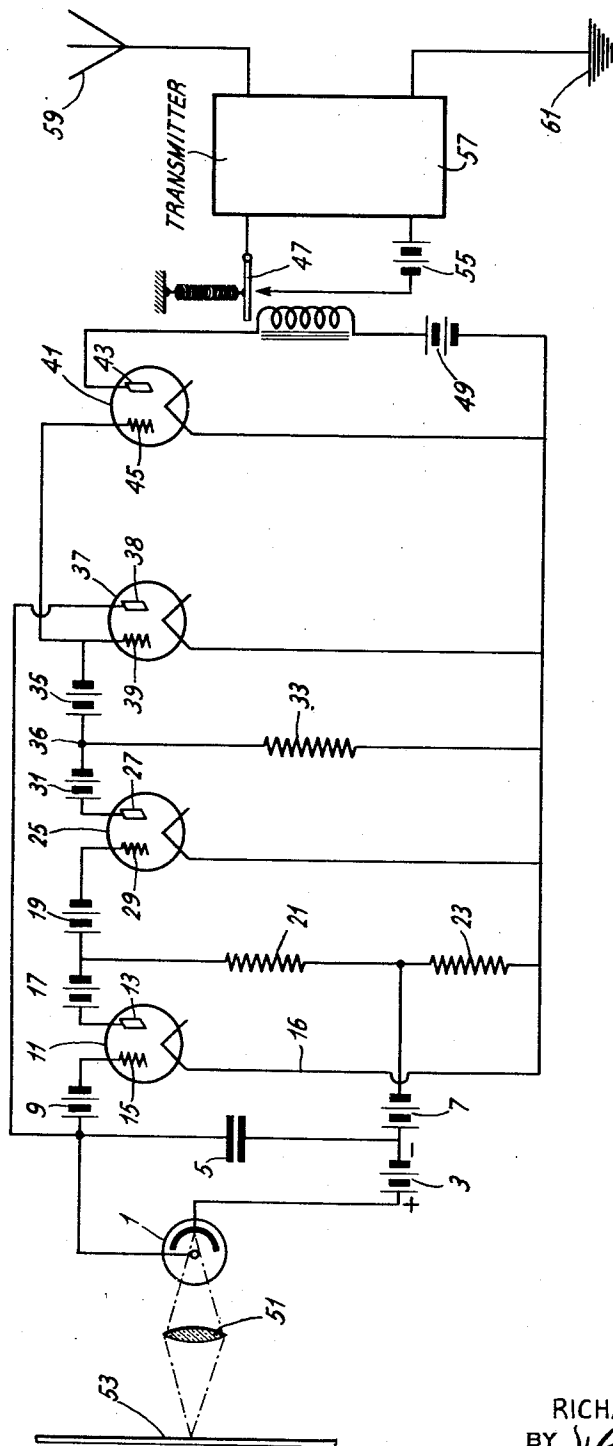
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PHOTOCELL AMPLIFIER

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PHOTOCELL AMPLIFIER

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This invention relates to photocell amplifiers and, in particular, to an integrating type of amplifier, which has an output proportional to the product of intensity of the impinging light on the photocell and the duration of such impingement. The invention in one of its preferred forms finds particular application in facsimile transmission systems wherein it is desired to transmit half-tone pictures or subjects by the so-called "on-off" keying systems. However, the invention is not restricted to the above field but is also directed toward counting systems wherein it is desired to have an indication of units based on the duration of time when light of a predetermined or even variable intensity is either revealed to or masked from a suitable light translating element.

As is well known in the art of picture transmission, over long distance radio circuits or wire communication links or channels, it is extremely desirable to dispense with amplitude modulation and resort to on-off keying, i. e. telegraphic keying. In order to give the effect of half-tones with such a system, it then becomes necessary to resort to some means of time modulation to take the place of amplitude modulation to represent the various tone values of the elemental areas making up the pictures. Thus, to represent in the transmitted signal elemental areas of the subject which are of great density, for example, black or approaching black, the signalling impulses are sent at relatively low frequency, but where the subject matter has a density varying in the direction of white, as for example, between light gray and white, the frequency of the pulses becomes correspondingly greater the more closely complete white is approached. The marking impulses are generally made equal in duration for all values of density, but the spacing of the impulses is made to vary so that time modulation which is introduced by the spacing interval between adjacent signalling impulses controls the transmission. This process can readily be reversed so as to transmit negatives, in which case the marking impulses are made variable with respect to time and all spacing intervals are made equal. In this case, some means of reversing the received signal must be used if a positive picture at the receiver is desired. Such reversing means are well known to the art, but for illustration of the principles of the invention it may be assumed to be accomplished through the use of an extra stage of D. C. amplification, which, as is well known, reverses the polarity of the signal.

It is, accordingly, one object of this invention,

to furnish a photoelectric cell amplifier for use in a facsimile system where it is desired to use "on-off" keying when transmitting half-tone material.

It is a further object of this invention to provide an amplifier for a photoelectric cell which will have an output in accordance with the integrated value of impinging light and time duration of said impingement.

Further objects and advantages of this invention will become evident upon reading the following specification in conjunction with the accompanying drawing wherein the single figure thereof illustrates schematically a photoelectric cell amplifier designed in accordance with this invention.

Referring to the drawing, cooperating with the photosensitive device 1, which may be any conventional type photoelectric cell, is an optical system 51 designed to pick up the light reflected from each elemental area of the subject 53. Connected in series with the electrodes of the photocell 1 is a battery 3 and a condenser 5. When light reflected from the subject 53 falls on the photocell 1, current starts to flow through the condenser 5 and begins to build up a charge therein. A first amplifying tube 11 has its grid 15 and cathode 16 connected so as to amplify the resulting output from the photocell 1 and in the grid lead a biasing source 9 is provided.

As the condenser 5 is charged by light falling in the cell 1, the charge, due to the indicated polarity of the battery 3, will be positive at the point of connection of the condenser 5 and the battery 9, so that the grid 15 of the tube 11 becomes positive with respect to cathode 16. The biasing source for tube 11, indicated by the battery 9 serves to maintain the grid 15 at cut-off potential in the absence of any charge on the condenser 5. As the charge builds up across the condenser 5, the grid 15 is finally carried positive past the cut-off point with respect to cathode potential and plate current begins to flow in the tube 11. This current flows through the resistors 21 and 23 and is provided by the battery 17 which is preferably serially connected with resistors 21 and 23 and the output electrode 13 for the tube 11. The flow of current through the resistors 21 and 23 produces a negative potential on the grid 29 of the cascade connected tube 25. The grid 29 of tube 25 connects with one terminal of resistor 21 and is maintained only slightly negative with respect to the cathode of tube 25 by a biasing source 19. The blocking potential induced on the grid 29 by

the drop in potential through the resistors 21 and 23 cuts off the plate current flowing through the tube 25 so that the grids 39 and 45 of the tubes 37 and 41 respectively both become positive relative to their previous potential.

This is because of the decrease in plate current flow through tube 25 with a resulting decrease in the voltage drop through resistor 33 connected in the output circuit of the tube 25 and in series with the plate voltage supply source 31 therefor which brings the point 36 where the grids 39 and 45 connect with resistor 33 more positive. A battery 35 in series with the grids 39 and 45 of tubes 37 and 41 serves to apply a suitable biasing voltage. During such times as the grid electrode 45 becomes positive due to a decrease in the voltage drop through resistor 33 the bias from battery 35 is overcome and plate current flows through the tube 41 to actuate the relay 47 connected in the tube output circuit. Operation of relay 47 will serve as a means to key a radio transmitter 57, for example.

At the same time the grid 39 of tube 37 also becomes positive and plate current also flows in the tube 37. The plate potential for tube 37, however, is furnished by the condenser 5 of which one terminal is connected with the plate electrode 38 by way of conductor 43. The result is that when tube 37 is positively biased so as to draw plate current, the condenser 5 is discharged. When the condenser 5 is discharged, grid 15 of tube 11 becomes negative, so that plate current ceases to flow in tube 11 and, since there is no longer any potential drop through the resistors 21 and 23 connected in the output circuit, the grid 29 of tube 25 becomes positive. This, in turn, permits plate current to flow in the tube 25 and the resulting potential drop through resistor 33 is impressed on the grids 39 and 45 of tubes 39 and 41 respectively, which cuts-off the plate current and, in turn, restores the relay 47 to its initial position. At the same time the tube 37 is rendered non-conducting so that the condenser 5 may be re-charged by the impinging light on the photocell 1. The process is then repeated cyclically at a rate which is determined by the intensity of the light and the duration of the light's impingement.

It will be readily appreciated that if the intensity of impinging light is great, that greater current will flow through the photocell, and consequently it will take less time to charge the condenser 5. The result of this is that with great intensity of illumination on the photocell 1, the relay 47 is actuated more times per unit interval of time than in the case where the intensity of the light is low. Thus, with low intensity of light considerable time must elapse before sufficient charge builds up on condenser 5 to actuate the grid 15 of the tube 11 and initiate the cycle of operation. It will be appreciated, therefore, that this type of photocell amplifier can readily be used wherever it is desired to have an indication of the integrated product of light intensity and time, since for each cycle of operation, the product of the intensity of illumination and the duration of its existence is the same.

In order that the discharging of the condenser 5 by the tube 37 shall not have a tendency to balance the fluctuations of the potential of the grid 15, a battery 7 is supplied which is connected between the two plate resistors 21 and 23 of the tube 11. To prevent this effect the current established through the plate 38 of the tube 37 and

the condenser 5 is furnished by the battery 7 through the resistance 23, such that the current flowing through the resistance 23 will make the grid 29 of the tube 25 remain negative once the initial impulse has been given by the grid 15 of the tube 11 going positive. This will tend to cause the grid 29 of the tube 25 to remain negative until the discharge of the condenser 5, by the plate 38 of the tube 37 passing sufficient current, overcomes the positive condition that has already been given the grid 15 of the tube 11.

Where it is desired to use the photocell and amplifier, as an illumination integrating device, it is only necessary to replace the relay 47 by a solenoid-operated counter, for example. This counter would then give an indication of the number of illumination-time units and by suitable calibration can be used as an illumination integrating meter. It is, of course, understood that when using the photocell and amplifier as a means of transmitting pictures and the like, that it is not necessary for the relay 47 to key a radio transmitter. It might, for example, be used for communication over telegraph lines by sending out D. C. impulses over the lines or it might be used on wire lines by having the relay 47 key a local oscillator generating a carrier tone.

Still other modifications of this invention may suggest themselves and may be made by those skilled in the art without departure from the scope and spirit of the invention as defined in the appended claims.

What I claim is:

1. A facsimile system comprising in combination, a light translating device, an electric storage element connected with the light translating device and adapted to have stored therein an electrical charge of a magnitude varying in time in accordance with the brilliance of light influencing the light translating element, a thermionic amplifying system connected with said storage element so that the energy output of said system is proportional to the time integrated value of light intensity influencing said light translating device, means for controlling the output of said thermionic amplifying system so that the current flow therethrough takes place whenever the integrated value exceeds a predetermined value, and a relay connected in the output of the said thermionic amplifying system whereby said relay is actuated at a rate proportional to the integrated product of the time and brilliance of the light influencing said light translating element.

2. An indicating system comprising in combination, a light translating device, an electric storage element connected with the light translating device and adapted to have stored therein an electrical charge of a magnitude varying in time in accordance with the brilliance of light influencing the light translating element, a thermionic amplifying device having an input and an output circuit, said input circuit being connected with the light translating element so that the output current flows from said device in accordance with the light intensity influencing said light translating device and is proportional to the electrical charge stored in said storage device, a plurality of thermionic amplifying devices having parallelly connected input circuits connected with the output of said first named thermionic device, means for controlling the output of each of said last named thermionic devices in accordance with the current flow through the output circuit of the first of said thermionic devices, a connection between the output electrode of one of said last

named thermionic devices and said electric storage element whereby said storage element serves as a source of plate voltage for said thermionic device, and an indicator connected in the output
5 of the other of said last named thermionic devices whereby said indicator is actuated at a rate proportional to the integrated product of the time and brilliance of the light influencing said light translating element.

10 3. An energy translating system which comprises a light translating element, an energy storing element connected with the output of said light translating device so that electrical energy is stored therein at a rate in accordance
15 with the brilliance of light impinging upon said light translating device, a thermionic amplifier device having its input circuit connected with the output of said light translating device and in parallel with said electric storage element so
20 that the output current flowing through said device is controlled in accordance with the time integrated value of brilliance of the light impinging upon said light translating device, a second thermionic device having its input circuit connected
25 with the output circuit of said first named thermionic device so that the current flowing

therethrough varies inversely with the current flowing through said first named thermionic device, and a plurality of thermionic devices having
5 parallelly connected input circuits connected with the output of said second named thermionic device so as to have the current flowing there-
through controlled directly in proportion to the current flowing through the first of said thermionic devices, a connection between the output
10 electrode of one of said last named thermionic devices and said electric storage element so that said electric storage element serves as a source of plate current for said thermionic device and is discharged in accordance with the current
15 flowing therethrough, a load circuit connected with the second of said last named thermionic device, and indicating means connected in said load circuit so that indications are produced
20 upon said indicating means in accordance with the current flow in said load circuit and said indications are representative of the product of the brilliance of the light impinging upon said
25 light translating element and the time period during which said light impinges upon said element.

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