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PHOTOSENSITIVE LIGHT CONTROL SYSTEM

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Fig. 1.

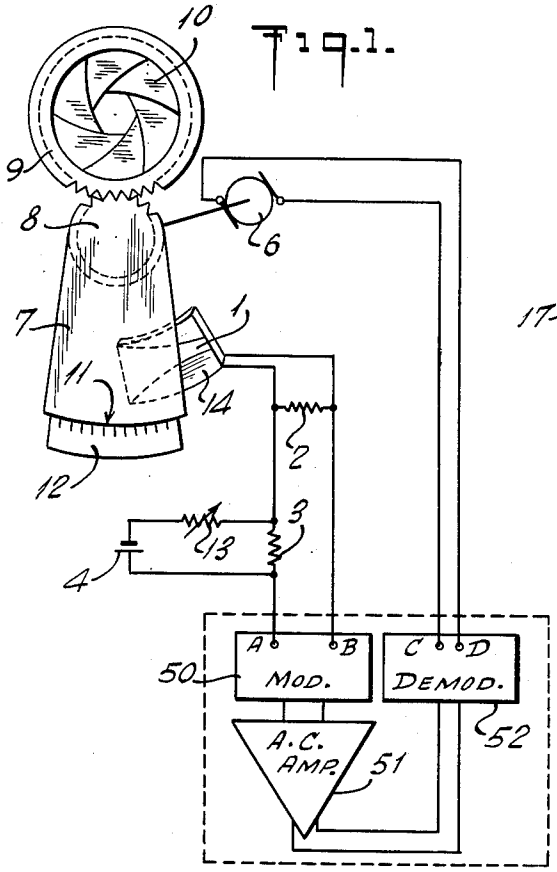


Fig. 3.

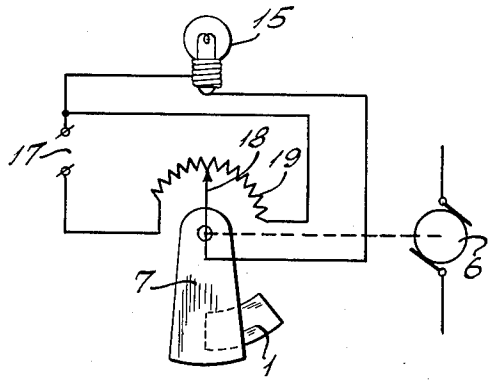


Fig. 4.

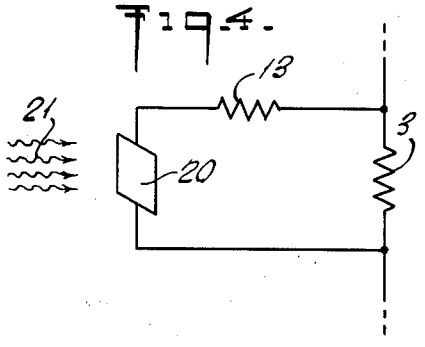
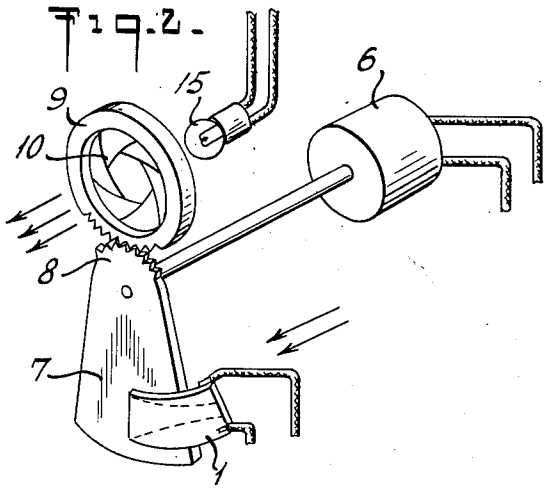


Fig. 2.



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PHOTOSENSITIVE LIGHT CONTROL SYSTEM

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6 Claims. (Cl. 250—217)

The present invention relates to an exposure meter or exposure control apparatus.

Photoelectric exposure meters are known for cameras in which the exposure is controlled in accordance with the light intensity present on a light-responsive element, which supplies a current to a sensitive current meter, whose movable part operates the diaphragm opening. These mechanisms have the shortcoming that, due to the weakness of the current supplied by the light-responsive element, very small forces are available for actuating or setting the diaphragm, so that the latter must be very easily movable and of light weight. This, in turn causes disturbances to occur quite readily. Also, such mechanisms are not sufficiently sensitive.

It is an object of the present invention to overcome the above mentioned disadvantages.

This is accomplished in accordance with the invention by an automatic exposure control device which is constructed as follows. The source of light causing the exposure is combined with a light intensity varying device which is adjustable depending on the light intensity prevailing on a light-responsive element. The adjustment is made by setting to a certain value the voltage drop caused by the light striking the element. The voltage drop is compared with another voltage drop, and the difference, after having been amplified, is fed to an electric motor, which either causes the light-responsive element to be covered by means of an aperture control member, or which causes more light to fall on the light-responsive element, thus making the voltage difference equal to zero, and simultaneously adjusts the light-intensity varying device.

The control mechanism according to the invention consists of a circuit with two resistors arranged in series and a D.C. amplifier, one of the resistors being in parallel with the light-responsive element, the other resistor being in parallel with a source of comparison voltage, the arrangement being such that the resistors are traversed by currents in opposite directions. An electric motor is connected to that terminals of the D.C. amplifier, which motor moves an aperture control member in front of the light-responsive element and thereby re-adjusts the light controlling mechanism.

The invention and its objects and advantages will be fully understood from the following description and the drawings, in which:

FIGURE 1 illustrates schematically the automatic exposure meter according to the invention;

FIGS. 2 and 3 illustrate different embodiments of the invention of FIG. 1; and

FIG. 4 illustrates another reference voltage source which may be employed with the invention.

Referring to the drawings, light-responsive element **1** controls the exposure in accordance with light impinging thereon. In parallel with element **1** there is a resistor **2** which is in series with a second resistor **3** forming a circuit from a point A to a point B.

Parallel to resistor **3** is a constant voltage source **4**, the arrangement being such that the direction of the voltage drop across resistor **3** is opposite to the voltage drop caused by the current of the light-responsive element **1** across resistor **2**. Points A and B are the input terminals

of a D.C. amplifier **5**, whose output terminals are C and D, connected to an electric motor **6**. This motor moves a cover member **7** over element **1**. Rigidly connected with member **7** is a gear wheel **8** which engages with another gear wheel **9**, which in turn is secured to the ring of the iris diaphragm **10** of the camera. Member **7** carries a marker or index **11** which moves over a scale **12** graduated preferably in light values. An equalizing resistor **13**, which may be fixed or adjustable to different values, is connected between the current source **4** and resistor **3**. A light impermeable member **14** is mounted in fixed relationship to light-responsive element **1** to serve as a variable width mask therefor.

The arrangement operates as follows:

When the light-responsive element **1** is lighted, a voltage drop occurs across resistor **2**, which is opposite to the voltage drop across resistor **3**. When the two voltage drops are not equal, the amplifier **5** transmits the difference, in amplified form and with the resulting polarity, to electric motor **6**. The motor then rotates in one direction or the other, depending on the transmitted polarity, in such a manner that the element **1** is further exposed or further covered, depending on whether the drop is smaller in resistor **2** than in resistor **3** or vice versa. When the two voltage drops become equal, the amplifier **5** no longer supplies any current. The motor **6** and the aperture control element **7** are then at rest. Simultaneously with the turning of member **7**, motor **6** turns diaphragm **10** into the position corresponding to the prevailing light, which is done through gears **8** and **9**.

The amplifier considerably increases the sensitivity of the instrument and consequently a sensitive meter is no longer required. Moreover, a structure is obtained which is mechanically much more sturdy.

In order to avoid drift errors, it is desirable to provide the D.C. amplifier **5** with a modulator **50**, an A.C. amplifier **51**, and a demodulator **52**. This type of arrangement is old and well known. In operation, when a differential direct voltage appears on leads A and B, it is converted by modulator **50** into an alternating voltage having a rectangular waveform. This alternating voltage is amplified in amplifier **51** and then re-converted into an amplified direct voltage of the proper polarity by demodulator **52**. The components themselves, and the manner in which they are arranged, are well known in the electrical arts. Circuits useful as such components are described in the following publications: (*a*) Trans. A.J.E.E. 74 (1955) pt. I. pp.141–149, "Switching Transistors Used as Substitute for Mechanical Low-level Choppers," A. P. Kruper; (*b*) Proc. J.E.E. 105 (1958) pp. 258–266, "A Transistor High-Gain-Chopper-Type D.C. Amplifier," G. B. B. Chaplin and A. R. Owens; (*c*) Proc. J.E.E., paper No. 2368 R; May 1957, Milnes, D. Sc.

One advantage of the apparatus of the invention is that the variable masking of element **1** affords the possibility of realizing a desirable functional interdependence of the light intensity on element **1** and the position of diaphragm **10**, by appropriately shaping the aperture cover **7** or light-responsive element **1**, or both members. For the same purpose, the cut-out portion of member **14** can be varied as desired. In a similar manner the characteristic of scale **12**, e.g. linearity, may be accomplished. In known devices this required accurately machined frictional cam drives.

Although an automatic exposure control means for cameras has been described it should be understood that the invention is not limited in its application to cameras. The arrangement according to the invention can also be used for controlling the light intensity caused by a constant light source in dependence on a given variable light intensity of an independent source in such a manner that

between the two intensities there may be effected a desired definite functional relationship. As shown in FIG. 2, light-responsive element 1 is lighted by the independent light source, whereas the light of the constant source 15 is made to enter through diaphragm 10. The remaining components of FIGURE 2 are designated in the same manner as corresponding components of FIGURE 1. As already mentioned, the characteristic of scale 12 may be varied in different ways, so that the light controlled by diaphragm 10 may be controlled in a desired manner by the intensity of the independent source. By appropriate association of the sense of rotation and diaphragm movement the exposure can be increased or decreased with increasing light intensity.

If the light source to be controlled is an artificial source, say an incandescent lamp, the light incidence can be regulated by modifying the intensity of the constant light source instead of by adjustment of the diaphragm 10. For instance, as shown in FIG. 3, this can be done by a potentiometer 18, 19 arranged in the current supply circuit 17 of the lamp 15. This arrangement can be used, according to the invention, e.g. for regulating to a constant value the lighting in a room in dependence on the incoming day light. In that case, the light-responsive element 1 will only be exposed to day light and the electric motor 6 will be connected to actuate the potentiometer or other current controlling means to regulate the intensity of the lamps in the room.

More particularly the invention can be used to make the light from a constant light source equal to the light intensity derived from another source. When the latter intensity changes, this would cause the intensity of the former to change accordingly. The arrangement can also be so made that the light intensity from both sources changes in the same sense, but that the light intensity from the constant source is always somewhat greater than the intensity of the other source, and an arrangement of this type may be called a "light intensifier." As shown in FIGURE 4, the comparison voltage source 4, instead of being a battery, can be a variable source, e.g., a light-responsive element 20 lighted by light of varying intensity from a light source 21. It is evident then, that within the purview of the invention many variations or modifications can be made. For example, the diaphragm 10 could be replaced by equivalent means, such as wedges, crossed polarizers, or the like. Also the gearing between member 7 and the aperture control 9, 10 could be replaced by other mechanisms. The invention, therefore, is not to be construed as limited, except as defined in the following claims.

We claim:

1. Apparatus for controlling the illuminance produced by a light source comprising a light-responsive element connected across a first resistor, a source of reference voltage connected across a second resistor, both of said resistors connected in series to the input of an amplifier in such a way that the voltage drop caused by the light-responsive element across the first resistor opposes the voltage drop caused by the source of reference voltage across the second resistor, the output of said amplifier being connected to an electric motor, two light control means both jointly operated by said motor, the first of said light control means arranged so as to vary only the illuminance to be controlled but not the light impinging upon the light-responsive element, the second light control means arranged so as to change the amount of light impinging upon the light-responsive element.

2. Apparatus according to claim 1, wherein the amplifier comprises a modulator, an alternating-current amplifier and a demodulator.

3. Apparatus according to claim 1, including a mask having a curved outline covering the light-responsive element for exposing a curved portion thereof.

4. Apparatus according to claim 1, wherein the light-responsive element is exposed only to the light source producing the illuminance to be controlled.

5. Apparatus according to claim 1, wherein the light-responsive element is exposed to light from a source other than said source producing the illuminance to be controlled.

6. Apparatus according to claim 1, wherein the reference voltage source includes a light-responsive element exposed to light of variable intensity.

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