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(54) PHOTOGRAPHIC CAMERAS

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a battery tester for photographic cameras and more particular to an arrangement for utilizing camera exposure control and/or light measuring apparatus in conjunction with a lamp for testing a camera battery.

Many modern cameras, both still and movie, utilize one or more batteries for powering the several different operations of the camera such as lens adjustment, shutter adjustment, automatic film advance and rewind, and flash bulb energization. These batteries are often of special design for the respective purposes and are positioned in the cameras so unobtrusively and operate with such effectiveness that they tend to be taken for granted by the user and be forgotten. This performance is, of course, highly desirable from a standpoint of the operator. Unfortunately, the batteries on occasion fail or weaken due to age or use, and when such conditions are not detected by the user, film wastage and picture failures may well result. It is desirable therefore that some means for testing the batteries be provided in the camera. It is particularly important when the battery is powering a small motor for film winding that a predetermined minimum voltage be maintained.

According to the present invention there is provided a camera including scene light measuring means, comprising photosensitive means normally subject to scene light and having a parameter which varies with variation in the intensity of scene light, a galvanometer connected in series with the photosensitive means and responsive to variations in the parameter for providing an

output which is a function of scene light intensity, means for receiving a battery, and battery testing means comprising means connectable in circuit with a received battery and having a luminosity the intensity of which is dependent on the battery voltage and means for effecting illumination of the photosensitive element solely by the luminosity means so that the galvanometer output is indicative of the battery voltage.

Referring to the drawings:—

Figure 1 is a schematic diagram in partial perspective of a camera including a battery testing apparatus according to one embodiment of the present invention;

Figure 2 is a plan of the apparatus of Figure 1 in an operative condition for testing a battery;

Figure 3 is a schematic view in partial perspective of a battery checking arrangement in accordance with a second embodiment of the present invention, a component having the same function as a component in Figure 1 or Figure 2 is identified by the same number with the addition of a prime ';

Figure 4 is a graphical representation of the light emission characteristics of a light-emitting semiconductor device versus voltage between its terminals as a variable resistance in series therewith is varied.

Because photographic cameras are well known, the present description will be directed in particular to elements forming part of or cooperating with the present invention, camera elements not specifically shown or described herein being understood to be selectable from those known in the art.

Referring to Figure 1, a portion of a camera casing 10 is shown in section. A view finder assembly 12 comprising an objective lens 14, an erecting lens assembly 16, a field mask 20 and an eyepiece 22, operates in the usual manner to provide an erect image, to the operator's eye 66, of a scene viewed by the objective lens 14. A lens 24, also in the camera casing 10, also admits scene light into the camera where the light impinges upon a photovoltaic cell 26. The



photovoltaic cell 26 may be only one of the known devices having the property that no external power source is required for its operation and that upon impingement of light onto the photovoltaic cell 26 a current will be generated between its terminals of a magnitude related to the intensity of the impinging light. The photovoltaic cell 26 may be replaced by a photocell, such as a cadmium sulphide cell, and a battery for providing a current that is dependent upon the resistance of the photocell, the resistance of the photocell being related to the intensity of the scene light. The photovoltaic cell 26 is coupled in series with a galvanometer 28 which may be used to control automatic camera diaphragm adjustment or to indicate scene light conditions.

A signal vane 30 is coupled by means known in the art to the galvanometer 28 so that ambient light impinging upon the photovoltaic cell 26 will cause a deflection of the galvanometer 28, resulting in a movement of the signal vane 30 relative to the view finder assembly 12, enabling an operator viewing a scene through the view finder assembly 12 to ensure a satisfactory light level before making an exposure.

The battery 32 to be tested is connected in a normally open circuit with a lamp 34 which is of the tungsten filament type, and also the battery 32 is connected by suitable circuitry to camera components for performance of its normal functions in connection with the operation of the camera (not shown) such as for example film winding. The lamp 34 is connectable in circuit with the battery 32 by means of a switch 36 which is normally in the open condition so that the battery testing apparatus of the present invention does not interfere with the normal operation of the camera.

The battery testing apparatus may be brought into operation by means of a push button assembly 40 which is slidably mounted in one sidewall of the camera casing 10. The push button assembly 40 includes a push button 41 which is external to the camera for manual operation. The push button assembly 40 is normally held in an outward or retracted position by the force of a spring 42 attached to a shield portion 44 of the push button assembly 40 and to a suitable position on the camera casing 10. A spring operating arm 46 on the shield portion 44 is arranged to operate the switch 36 upon depression of the push button 41. While the push button assembly 40 is in the normal retracted position of Figure 1, neither the shield portion 44 nor the operating arm 46 perform any active function.

Referring to Figure 2 in conjunction with Figure 1 for operation of the apparatus to test the battery 32, finger pressure on the push button 41 advances the push button

assembly 40 against the action of the spring 42 as shown by the dotted lines. In the advanced position, the shield portion 44 is inserted between the lens 24 and the photovoltaic cell 26, and the passage of scene light to impinge upon the photovoltaic cell 26 is interrupted. At the same time, the operating arm 46 causes engagement of a switch contact spring 48 with an opposing contact member 50 and closes the path through the tungsten lamp 34 and the battery 32. As shown by the arrows of Fig. 2, the photovoltaic cell 26 is now illuminated only by the light from the tungsten lamp 34, the luminosity of which varies with the voltage of the battery 32. The light incident onto the photovoltaic cell 26 creates a current flow between its terminals and thus a current flow in the galvanometer photovoltaic cell circuit, causing a deflection of the galvanometer 28 by an amount dependent upon the current flowing. The deflection of the galvanometer 28 may be directly related to the power available condition of the battery 32. Since the galvanometer 28 is coupled to the signal vane 30, the deflection of the galvanometer 28 will cause a movement of the signal vane 30 within the field of view of the view finder assembly 12. Lens component 16 produces an image 68 of the signal vane 30 in the field mask 20. The image 68 is erected by the eyepiece 22 as seen by the operator and occupies a position within the field mask 20 related to the deflection of the galvanometer 28; the deflection may be calibrated for battery 32 voltage and may be used as a visual indication of the condition of the battery.

After a battery check has been completed, finger pressure on the push button 41 is removed and the push button assembly 40 is returned to the normal retracted position by the force of the restoring spring 42. The photovoltaic cell 26 is again exposed to ambient light, and the deflection of the galvanometer 28 and the resulting position of the signal vane 30 relative to the view finder assembly 12 are functions of the intensity of the ambient light.

The movement of the signal vane 30 relative to the aperture in the field mask 20 may be calibrated to provide a graduated indication of the battery voltage available and when properly calibrated is capable of detecting a voltage change in the order of .1 volts in a 3 volt battery. The indication provided may be provided by a scale, or by the movement of the signal vane 30 relative to the aperture of the field mask 20 or, as also shown in Fig. 1, at least one aperture may be provided in the periphery of the field mask 20. Since the signal vane 30 is movable relative to the field mask 20, it may be used for blocking scene light through the

aperture 60. Therefore, a second means is available for use as an indication of the level of the battery. When the aperture 60, or any number of apertures 60, is utilized as the indicator, the push button assembly 40 may include a portion designated generally as 62 on a slide arm 63, which is disposed, when the push button assembly 40 is in the normal retracted position, so that the lens component 16 images the portion 62 over the aperture 60 thereby blocking the aperture 60 from use during the normal retracted position of the push button assembly 40.

It is known that the luminosity of a tungsten filament lamp varies with the 3.7 power of applied voltage, which means that small voltage changes result in substantially large luminosity changes. In addition, a spectral shift in energy distribution in the radiated light results as the battery voltage decreases. When the battery voltage is high, the spectral output peak tends towards the blue end of the spectrum, as as the battery voltage decreases the spectral peak approaches the red end of the spectrum. Therefore, by providing a blue filter 64 disposed between a tungsten lamp 34 and the photovoltaic cell 26, the luminosity in the blue range is enhanced and thus the effectiveness of the apparatus.

Referring to Fig. 3, there is shown a second embodiment according to the present invention, where a component performing the same function as a component in Figs. 1 and 2 has the same reference number with the addition of a prime¹.

An arm 71 terminates at one end in a signal vane 30¹ and at the other end in a diaphragm adjusting element 72. The diaphragm adjusting element 72 defines a tapered aperture 73 which is movable relative to a camera lens component 70 as the arm 71 rotates. The lens component 70 is optically aligned with the camera exposure axis (indicated by the arrows A) so that the amount of light admitted to the lens component 70 and thus transmitted along the exposure axis is determined by the position of the arm 71. At the same time that the tapered aperture 73 is movable relative to the lens component 70 the signal vane 30¹ is movable relative to a viewfinder assembly 12¹ to provide a camera operator with an indication of the level of the ambient scene light intensity as previously described.

The battery 32¹ is connectable, for example, to a motor (not shown) as previously described.

The battery 32¹ is also connectable to a light-emitting diode 74 by means of a switch 36¹ and a voltage divider circuit comprising fixed resistors R1, R2, and a variable resistor R3. The light-emitting diode 74 may be any of the known device which emit radiation in a particular portion of the spectrum

when a predetermined voltage is applied across its terminals, and has the property that no light is emitted when the applied voltage is below a particular voltage level, but rises sharply as the voltage is increased above the particular level. One such element may be a diode formed of gallium arsenide phosphide which emits radiation from the green through infrared (5,600 to 9,000 angstroms) range of the spectrum. The diode 74 is conveniently placed in the camera adjacent to the photocell 26¹ so that light emitted from the diode 74 impinges upon the photocell 26¹. The apparatus includes a push button assembly 40¹ having a push button 41¹ accessible from the camera exterior. The push button assembly 40¹ is slidably mounted in the camera housing, being normally held in a retracted inoperative position of Figure 3 by the action of a restoring spring 42¹. The push button assembly 40¹ also includes a light shield 44¹ and a switch actuating arm 46¹.

To utilize the apparatus of the present invention to check the power level of the battery 32¹ the push button assembly 40¹ is moved to its advanced or operative position by finger pressure on push button 41¹ and temporarily held in that position against the restoring force of the spring 42¹. The movement of the push button assembly 40¹ may be lateral relative to the lens 24¹ as shown by the dotted lines of Figure 3 for closing the battery-diode circuit by bringing the actuating arm 46¹ into contact with the switch 36¹ thereby moving a contact 48¹ into engagement with its opposing contact 50¹. The lateral movement also positions the light shield 44¹ between the lens 24¹ and the photocell 26¹ to block the transmission of scene light through the lens 24¹ and onto the photocell 26¹. The photocell 26¹ is then illuminated solely by the light emitted from the diode 74, the intensity of which is governed by the value of the resistance R3 and the power level of the battery 32¹. The light impinging onto the photocell 26¹ produces current flow in the photocell-galvanometer circuit and consequently a deflection of the galvanometer 28¹ which is a function of the power level of the battery.

As pointed out above, the diode 74 has the characteristic that a sudden drop in light emission takes place when the applied forward voltage falls below a particular value. Based upon this characteristic, together with information concerning the output voltage range of the battery 32¹ a suitable selection of the values of the resistors R1, R2, R3 and a variable resistor R4 may be made to regulate the viewing position of the signal vane 30¹ relative to the viewfinder assembly 12¹ and hence field mask 20¹. For example the adjustment may be such that for a diminished but still adequate battery

power level, the signal vane 30¹ may just enter a viewing position of the field mask 20¹. As the battery power level continues to decrease and there is a corresponding decrease in the illumination of the photocell from the diode, the signal vane will move further into the viewing position until the signal vane 30¹ is fully visible to designate a low battery power condition. An accurate and reliable indication of the on-load power level of the battery 32¹ may be made available to the camera user, even though the battery 32 may not have reached an entirely unsatisfactory condition. The signal vane 30¹ may have a preferred position which is normally in the viewing path and movable out of the viewing path depending upon the battery power available.

After completion of the battery test, finger pressure is removed and the push button assembly 40¹ is moved to its retracted position by the influence of the restoring spring 42¹. The diode-battery circuit is again open at the switch 36¹ and the photocell 26¹ is illuminated by scene light as before.

The apparatus as thus described utilizes the diode 74 as a circuit element for providing a battery check by means of the movable signal vane 30¹. However, the diode 74 emits light in the green and yellow range of the spectrum, which makes the diode 74 appropriate for use as a viewable light indicator. Utilizing this fact, and the fact that the diode 74 does not emit light at a voltage below a particular level, the apparatus may be utilized to provide another feature as described in the following paragraph.

The diode 74 may be conveniently placed in relation to the viewfinder assembly 12¹ and to the photocell 26¹ so as to illuminate the photocell 26¹ when emitting light and also to be seen by the eye of an operator. The resistor R3 is in series circuit with the diode 74 and as it is varied affects the light emitted from the diode 74 in the manner shown in Figure 4. Figure 4 represents a logarithmic plot of emitted luminance L against forward applied voltage V₁. The resistor R3 may have an associated pointer movable along a scale between a "bad" indication or a "good" indication as the resistance of resistor R3 is varied. By varying the resistor R3 an operator may determine within certain limits, the expected remaining life of the battery 32¹. The curve of Fig. 4 shows the correspondence between the resistance of the resistor R3 and the light emitted from the diode 74.

By way of explanation, assume the battery 32¹ has a voltage rating of V₁ volts and is capable of supplying current to the circuit for a specified time under the load of resistors R1, R2, and R3.

When the push button assembly 44¹ is operated, the operator observes the light

from the diode 74 through the viewfinder 12¹ and rotates the resistor R3 about a resistance value where the light from the diode 74 becomes bright and then goes out. A battery that is capable of supplying a high output current requires a larger resistance to cause the diode 74 to cease to emit light, thus the pointer on the resistor R3 may show a "good" reading on a scale of the resistor R3. If the battery is incapable of supplying a large current due to age or use, the range of resistance R3 required to vary between the points where the diode 50 is bright and then does not emit light decreases until finally the pointer may indicate a "bad" reading on the scale of the resistor R3.

WHAT WE CLAIM IS:—

1. A camera including scene light measuring means comprising photosensitive means normally subject to scene light and having a parameter which varies with variation in the intensity of scene light, a galvanometer connected in series with the photosensitive means and responsive to variations in the parameter for providing an output which is a function of scene light intensity, means for receiving a battery, and battery testing means comprising means connectable in circuit with a received battery and having a luminosity the intensity of which is dependent on the battery voltage and means for effecting illumination of the photosensitive element solely by the luminosity means so that the galvanometer output is indicative of the battery voltage.

2. A camera according to Claim 1 wherein the means for effecting illumination of the photosensitive element solely by the luminosity means comprises a normally open switch in the circuit of the luminosity means and the battery, and means for closing the switch to cause energization of the luminosity means by the battery, the closing means also being effective to terminate illumination of the photosensitive means by scene light.

3. A camera as claimed in Claim 2 wherein the closing means includes a push button mounted in the camera and movable between an advanced and a normal, retracted position, and a switch closing arm mounted on the push button and effective when the push button is in its advanced position to block access of scene light to the photosensitive element and to close the normally open switch.

4. A camera as claimed in Claim 1, 2 or 3 comprising an optical viewfinder having a field mask, and a signal vane which is coupled to the galvanometer for movement thereby, the movement of the signal vane being viewable through the field mask.

5. A camera as claimed in Claim 4 wherein the field mask has an aperture in



power level, the signal vane 30¹ may just enter a viewing position of the field mask 20¹. As the battery power level continues to decrease and there is a corresponding decrease in the illumination of the photocell from the diode, the signal vane will move further into the viewing position until the signal vane 30¹ is fully visible to designate a low battery power condition. An accurate and reliable indication of the on-load power level of the battery 32¹ may be made available to the camera user, even though the battery 32 may not have reached an entirely unsatisfactory condition. The signal vane 30¹ may have a preferred position which is normally in the viewing path and movable out of the viewing path depending upon the battery power available.

After completion of the battery test, finger pressure is removed and the push button assembly 40¹ is moved to its retracted position by the influence of the restoring spring 42¹. The diode-battery circuit is again open at the switch 36¹ and the photocell 26¹ is illuminated by scene light as before.

The apparatus as thus described utilizes the diode 74 as a circuit element for providing a battery check by means of the movable signal vane 30¹. However, the diode 74 emits light in the green and yellow range of the spectrum, which makes the diode 74 appropriate for use as a viewable light indicator. Utilizing this fact, and the fact that the diode 74 does not emit light at a voltage below a particular level, the apparatus may be utilized to provide another feature as described in the following paragraph.

The diode 74 may be conveniently placed in relation to the viewfinder assembly 12¹ and to the photocell 26¹ so as to illuminate the photocell 26¹ when emitting light and also to be seen by the eye of an operator. The resistor R3 is in series circuit with the diode 74 and as it is varied affects the light emitted from the diode 74 in the manner shown in Figure 4. Figure 4 represents a logarithmic plot of emitted luminance L against forward applied voltage V₁. The resistor R3 may have an associated pointer movable along a scale between a "bad" indication or a "good" indication as the resistance of resistor R3 is varied. By varying the resistor R3 an operator may determine within certain limits, the expected remaining life of the battery 32¹. The curve of Fig. 4 shows the correspondence between the resistance of the resistor R3 and the light emitted from the diode 74.

By way of explanation, assume the battery 32¹ has a voltage rating of V₁ volts and is capable of supplying current to the circuit for a specified time under the load of resistors R1, R2, and R3.

When the push button assembly 44¹ is operated, the operator observes the light

from the diode 74 through the viewfinder 12¹ and rotates the resistor R3 about a resistance value where the light from the diode 74 becomes bright and then goes out. A battery that is capable of supplying a high output current requires a larger resistance to cause the diode 74 to cease to emit light, thus the pointer on the resistor R3 may show a "good" reading on a scale of the resistor R3. If the battery is incapable of supplying a large current due to age or use, the range of resistance R3 required to vary between the points where the diode 50 is bright and then does not emit light decreases until finally the pointer may indicate a "bad" reading on the scale of the resistor R3.

WHAT WE CLAIM IS:—

1. A camera including scene light measuring means comprising photosensitive means normally subject to scene light and having a parameter which varies with variation in the intensity of scene light, a galvanometer connected in series with the photosensitive means and responsive to variations in the parameter for providing an output which is a function of scene light intensity, means for receiving a battery, and battery testing means comprising means connectable in circuit with a received battery and having a luminosity the intensity of which is dependent on the battery voltage and means for effecting illumination of the photosensitive element solely by the luminosity means so that the galvanometer output is indicative of the battery voltage.

2. A camera according to Claim 1 wherein the means for effecting illumination of the photosensitive element solely by the luminosity means comprises a normally open switch in the circuit of the luminosity means and the battery, and means for closing the switch to cause energization of the luminosity means by the battery, the closing means also being effective to terminate illumination of the photosensitive means by scene light.

3. A camera as claimed in Claim 2 wherein the closing means includes a push button mounted in the camera and movable between an advanced and a normal, retracted position, and a switch closing arm mounted on the push button and effective when the push button is in its advanced position to block access of scene light to the photosensitive element and to close the normally open switch.

4. A camera as claimed in Claim 1, 2 or 3 comprising an optical viewfinder having a field mask, and a signal vane which is coupled to the galvanometer for movement thereby, the movement of the signal vane being viewable through the field mask.

5. A camera as claimed in Claim 4 wherein the field mask has an aperture in



the periphery thereof, through which the signal vane is viewable.

- 5 6. A camera as claimed in Claim 3, 4 and 5, wherein the push button is connected to an arm having a light blocking portion which, when the push button is in the normal retracted position, is interposed in the light path between the signal vane and the aperture of the field mask and, when the
10 push button is in the advanced operative position, is removed from said light path.

7. A camera as claimed in any preceding claim wherein the luminosity device comprises a filament lamp.

- 15 8. A camera as claimed in Claim 7, wherein a filter which transmits light in the blue spectral frequency range is positioned in the light path between the filament lamp and the photosensitive element.

- 20 9. A camera according to any one of Claims 1 to 6 wherein the luminosity means comprises a light-emitting semiconductor.

10. A camera as claimed in Claim 9 wherein the light emitting semiconductor has

the property that an applied voltage below a predetermined level produces no emitted light, but an applied voltage above the predetermined level produces emitted light.

11. A camera as claimed in Claim 10, comprising a variable resistor connected in series with the light-emitting semiconductor, so that the applied voltage may be varied by adjustment of the variable resistor, whereby the value of the series resistance where-
35 at the light-emitting semiconductor becomes light-emitting is indicative of the condition of the received battery.

12. A camera as claimed in Claim 9, 10 or 11, wherein the light-emitting semiconductor comprises a light-emitting diode.

13. A camera as hereinbefore described with reference to and as illustrated in Figs. 1 and 2 or Figs. 3 and 4 of the accompanying drawings.

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