

SPECIFICATION

Photographic Camera having an Exposure Indicator

The invention relates to photographic cameras having indicators for determining if the camera is adjusted for prevailing scene light conditions to provide an acceptably exposed photograph. More particularly, the invention provides apparatus which takes into account the exposure latitude of the film being utilized in determining whether the camera is set for such an exposure.

Cameras are known in the art having exposure control circuits that deflect a movable member such as a needle in relation to the amount of light present and the speed of the film being used. The light is sensed by a photoconductive device, and the film speed value is typically provided by manual adjustment of a multi-position switch. The camera further includes a reference mark mechanically coupled to the aperture and/or shutter control mechanism, the mark being located in proximity to the needle. The camera operator views the deflecting needle and the reference mark and manually adjusts the aperture and/or shutter mechanism until the needle and reference mark coincide. With such an adjustment, an exposure may be obtained that produces a quality photograph.

There are other cameras that provide for correct camera adjustment by use of a balancing circuit, such as a Wheatstone bridge, one arm of the bridge including a photocell, and a second or reference arm including electrical elements having values which are functionally related to the shutter speed and/or aperture size at which the camera is set. When a balanced electrical condition is achieved between the arms, the camera is considered to be correctly adjusted.

A disadvantage of these kinds of cameras is that one particular film speed value is used to determine if they are correctly set. This is, in many cases, an unnecessarily limiting constraint. With many negative films, it is common to expect that acceptable photographs may be achieved even though the film is overexposed or underexposed from what might be considered an "optimum" exposure. With some films of this type, for example, they may be overexposed up to the equivalent of three exposure values, or underexposed the equivalent of as much as two exposure values, yet an acceptable photograph will be produced. One camera setting will suffice for many normally encountered scene conditions. A camera using certain negative film may be set for an exposure appropriate for overcast or open shade conditions and still acceptably accommodate exposure conditions ranging from bright indoor daylight scenes to summer sunlight scenes. In effect, there exists, instead of a discrete "optimum" exposure, a "window", constituting a range of exposures, appropriate for the film being utilized, that produces satisfactory photographs. As long as the camera is adjusted to produce an exposure within this "window", the camera

operator may make photographs without concern for certain departures from the "optimum" exposure. Therefore, it is apparent that the prior art cameras discussed above for indicating the appropriateness of camera settings are unnecessarily restricted.

United States Patent No's. 3,678,827 and 3,852,777, both of which are assigned to the assignee of the present invention, disclose cameras which include low-light signal mechanisms controlled in accordance with the underexposure latitude of films in the cameras. The '777 patent discloses an automatic exposure control apparatus for a camera that takes into account underexposure latitude to determine if a suitable exposure may be made in dim light conditions without increasing exposure time beyond a predetermined unacceptable limit. When a light level is detected that would be considered as requiring an excessively long exposure time to achieve an "optimum" exposure level, the exposure control causes an exposure to be effected, without increasing exposure time to this excessive time, which is less than "optimum" but is within the limits of the underexposure latitude of the film. In doing so, a low-light indicator is inhibited when underexposure latitude is taken into account.

The apparatus disclosed in both the '827 and '777 patents permits the low-light capability of the cameras to be expanded. However, such apparatus does not utilize overexposure latitude of photographic films to expand a camera's apparent usefulness for making acceptable exposures of very bright scenes.

It is an object of the present invention to provide a camera wherein film exposure latitude including both underexposure latitude and overexposure latitude is taken into account.

According to the present invention there is provided a photographic camera having an exposure indicator and comprising a computer having inputs relates to film speed, film over- and under-exposure latitudes, and scene brightness, for computing a range of exposure values which would produce an acceptably exposed photograph, and comparator means for determining if the exposure value at which the camera is set lies within the range of exposure values and for operating the indicator in accordance with such determination.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 illustrates the exposure indicator of a camera of the present invention in block diagram form;

Figure 2 illustrates apparatus by which a camera may sense automatically film speed and film exposure latitudes information of a film utilized therein;

Figure 3 is a schematic diagram of a binary sensing circuit for use with the apparatus of Figure 2;

Figure 4 is a block diagram of a presently

preferred embodiment of apparatus constituting an exposure indicator of a camera of the present invention; and

Figure 5 is a simplified flow chart of a computer program for use with the apparatus of Figure 4.

As photographic cameras and film cartridges are well known, the present description will be directed in particular to elements forming part of, or cooperating more directly with the indicator apparatus of a camera in accordance with the present invention. It is to be understood that camera elements and cartridge element not specifically shown or described may take various forms well known to those skilled in the art

Figure 1 is a block diagram, denoted generally 10, for illustrating the exposure indicator of the present invention. Film data-retrieval apparatus 12, described in detail hereinafter, provides data corresponding to the film speed and exposure latitudes of the film being used and provides this data to an interface unit 14.

The term "film speed" as used herein means the sensitivity of a given film to light, and is related to an exposure which produces a given film density. This sensitivity may be indicated by an American National Standards Institutes (ANSI) number.

The term "film exposure latitude" as used herein is a range of exposure values within which a given film will produce a negative or positive of satisfactory quality. Film exposure latitude may be represented by an upper exposure value number and a lower exposure value number.

The term "exposure value" (EV) as used herein means the amount of light reaching the film. Exposure values are represented by a scale of successive whole numbers, each number being equivalent to half the light of the next lower number, and twice the light of the next higher number. Any given exposure value covers a range of aperture shutter-speed combinations that yield the same exposure. For instance, the exposure value 13 gives a range of aperture/shutter-speed combinations of f/4 at 1/500 second to f/32 at 1/8 second. A scale from 2 to 18 is sufficient for all normal photographic purposes since it represents exposure from 1 second at f/2 to 1/500 second at f/200, a range of over 1:60,000. For additional information pertaining to exposure values, reference is made to *The Focal Encyclopedia of Photography*, Revised Desk Edition, published by McGraw-Hill, 1969.

A light-level sensing circuit 15 serves to provide to the interface unit 14 data relating to the brightness of the scene to be photographed. An aperture control mechanism 16 and a shutter control mechanism 17 provide information to the interface unit 14 regarding the aperture size and shutter speed, respectively, at which the camera is adjusted. The mechanism 16 establishes aperture size and regulating an adjustable diaphragm 18, and the mechanism 17 controls shutter speed by adjusting a shutter 19. The interface unit 14 transfers this aperture size and

shutter speed information together with the scene brightness data, and film speed and exposure latitudes data, to a computer, denoted generally 20, which is preferably a microprocessor.

The microprocessor 20 computes an exposure value based on scene brightness and film speed. The microprocessor then uses such computed exposure value to compute a range of exposure values corresponding to the film exposure latitudes; such range has one boundary defined by a lower acceptable exposure value, denoted X, and a second boundary defined by an upper acceptable exposure value, denoted Y.

The microprocessor 20 further computes an anticipated exposure value (AEV) based on the camera's aperture size and shutter speed, and determines whether such AEV is within the computed exposure value range, in other words, whether an exposure will be effected which will produce an image of satisfactory quality. To accomplish this, the AEV is compared to the range established by exposure values X and Y. If the AEV is outside this range, an indicator 21 is activated to convey this fact to an operator of the camera (indicated by numeral 22). This indication signals the operator to adjust the camera to produce a new AEV to attempt to bring the AEV within the boundary exposures X and Y. If this occurs, the indicator 21 is deactivated to signal that the camera is set to effect a proper exposure.

The diaphragm 18 and the shutter 19 may be any of a number of well-known mechanisms which regulate the amount of light and the duration of light, respectively, that impinges on a film. For example, the shutter 19 may be of the type disclosed in U.S. Patent No. 3,906,525 issued to H. Ettischer on September 16, 1975. Such a shutter includes a single blade movable for sequentially uncovering and covering an exposure aperture. A restraining member, responsive to a manually settable shutter-speed setting member, is adjustably located in the path of the shutter for regulating the speed at which the shutter blade moves across the exposure aperture thereby to control the duration of an exposure interval.

Referring now to Figure 2, there is shown an arrangement constituting film data-retrieval apparatus 12 for receiving film speed and film exposure latitudes information automatically. A portion 30 of a camera body defines an arcuate film chamber 32 in which there is placed a cylindrical film cartridge 34. An extension 36 extends tangentially from the top surface as viewed in Figure 2 of the cartridge 34, and includes, at its open end, and elongate rectangular slot 37 through which the film 38 can be fed, by means not shown, from the cartridge. The film 38 is located in a film exposure plane 40 for exposing to impinging scene light by being biased against a film gate 42, only a portion of which is shown in Figure 2.

The cartridge 34 includes an inner conductive sheathing 44 surrounded by an insulating overcoat 46. Formed axially of the cartridge 34 in the overcoat 46 are a series of spaced apertures 48,

which expose the underlying conductive sheathing 44 to form a series of metallic contacts 50. The pattern formed by contacts 50 constitutes a binary representation of film speed and film exposure latitude, as described in detail hereinafter.

Other forms of the contacts 50 may be utilized, for example, small metallic contact blocks which may be secured directly onto the overcoat 46 by means of a suitable adhesive. It should also be apparent that the invention is not dependent on the particular form of cartridge 34 and will be equally useful with other forms, for example, flat-pack cartridges, or the well known 126 and 110 size cartridges, or the like.

Film data-retrieval apparatus 12 includes a series of spaced electrical contact pins 52 (individually numbered 52A to 52H) which extend through apertures 53 formed in an interior camera wall 54, which defines a portion of the film chamber 32. A series of biasing elements 56, for example, small coil springs, is lodged between a second interior wall 58 and the pins 52, as shown, and is provided to force the pins into good electrical contact with the cartridge 34. The pins 52 are spaced relative to one another so that each will be aligned with a possible corresponding contact 50 on the cartridge 34. A stop member 57 is attached to each pin 52 to retain the pins in their respective apertures 53 against the bias force of the springs 56. To maintain the springs 56 aligned with their respective pins 52, the other ends of the springs are embedded in the wall 58 as shown by the numeral 59.

Referring now to Figure 3, there is shown an electronic circuit, denoted generally 60, for detecting the presence of a contact 50, shown by solid line in Figure 2. Circuit 60 serves to sense a change between two stable states of electrical conduction and operates as an inverter circuit, as follows: When its base electrode voltage, V_b , is at a low level, e.g. state 0, transistor 61 does not conduct, and so no current flows from the supply voltage V_{cc} through resistor 62 to electrical ground. As a result there is no voltage drop across resistor 62, and the output voltage, V_{out} , is at a high level or state 1 which is essentially that of the supply voltage V_{cc} . When V_b is at a high level, transistor 61 conducts. When a collector current flows, there is a substantial voltage drop across resistor 62. As a result, V_{out} drops almost to ground potential, or state 0. In other words, when V_b is low, V_{out} is high, and when V_b is high, V_{out} is low.

To sense the presence of a contact 50, circuit 60 includes a double pole switch mechanism 63 connected between the emitter electrode 61A and the base electrode 61B of the transistor. One pole of switch 63 is formed from one of the pins 52, specifically pin 52A, which is connected through electrical ground to emitter electrode 61A. The other pole is formed from a selected one of the other pins 52, pin 52B in this example,

which is connected to the base electrode 61B.

The conductive sheath 44 is the element by which the two poles of the switch 63 may be electrically connected. If the apertures 48 are formed in the overcoat 46 in alignment with the pins 52A and 52B, such pins mutually contact the conductive sheath 44 to form a closed circuit, thereby effectively short circuiting the base-emitter junction of the transistor 61. Alternatively, if there is no aperture 48 under the pin 52B, the switch 63 remains open since the pins 52A and 52B will not be electrically connected by means of the sheath 44.

When voltage is applied to the circuit 60, it operates as follows: If the switch 63 is open indicating the absence of a contact 50 under the pin 52B, the transistor 61 conducts and V_{out} is at a low level, e.g. state 0. If, however, the switch 63 is closed, indicating a contact 50 is present under the pin 52B (and, of course, pin 52A), the transistor 61 does not conduct. In that condition, V_{out} is at a state 1. Therefore, the circuit 60 distinguishes between the presence and absence of the contacts 50 on the cartridge 34 when a voltage is applied to the circuit.

It will now be obvious to those skilled in the art that a similar circuit 60 would be provided for each of the pins 52 (other than the grounding pin) to determine the presence or absence of a respective contact 50 aligned with the respective pin 52B to 52H. In each circuit, the pin 52A would serve the purpose of a common grounding connection.

Film speed, and film exposure latitudes as represented by an overexposure latitude value and an underexposure latitude value, are encoded in binary form on the cartridge 34. By providing that each contact 50 represents the binary equivalent of "1" or "0" ("1" when the contact 50 or aperture 48 is present and "0" when the contact or aperture is absent), the contacts are grouped together to form a binary word having a magnitude which represents film speed, and film exposure latitude. In the case of representing any of 7 film speeds, three contacts 50 are required. For example, the following selection of film speeds may be represented in binary form:

	Film Speed (ANSI) (uncoded cartridge)	Contacts "bits"
	25	000
	64	001
	80	010
	100	011
	125	101
	160	110
	400	111

If, for example, the upper exposure latitude were to be represented by any of four possible amounts of overexposure, two contacts 50 would be required. For example:

Upper Exposure Latitude
(Number of exposure values)

Contacts "bits"

1/2	00
1	01
2	10
3	11

Two additional contacts could be devoted for any of four possible amounts of underexposure to represent the lower or underexposure latitude.

- 10 It will be apparent that other formats are equally useful for encoding film information. For example, a "combination code" is disclosed in a co-pending U. S. Patent Application, Serial No. 905689, filed 15th May 1978. Such a
- 15 "combination code" represents a particular combination of a variety of film characteristics including film speed.

- Referring now to Figure 4, there is illustrated a camera apparatus which, in accordance with the
- 20 teachings of this invention, utilizes film exposure latitude in the determination of whether or not the camera is set for prevailing light conditions to provide an acceptably exposed photograph. Such apparatus includes a microprocessor, generally
- 25 denoted 70, which performs functions identical to that of the processing unit 20 in the simplified block diagram of Figure 1. The microprocessor 70 includes a group of general purpose registers 71 for receiving data. The data provided to registers
- 30 71 is used by an arithmetic logic unit 72 to perform exposure value calculations. The microprocessor 70 includes other basic components such as address buffers for retrieving program instructions, accumulators for handling
- 35 frequently manipulated data, and input/output buffers for transferring data into and out of the microprocessor. Such components are illustrated as collectively performed by control circuits 73. A
- 40 clocking circuit 74, shown schematically as a crystal, is provided for timing to regulate sequentially the operation of the microprocessor 70. Further descriptive material relating to microprocessors is widely available, for example,
- 45 *Microprocessors and Microcomputers*, by B. Soucek, (Wiley, 1976).

- The microprocessor 70 is effectively controlled by a manually operable input control switch 78. In a preferred embodiment, the control switch 78 is actuated in a response to initial movement of an
- 50 operator-controlled shutter release button (not shown), such initial movement occurring prior to the shutter 19 being opened to commence an exposure interval. Actuation of the switch 78 commences a series of operations performed by
- 55 the microprocessor 70 under the management of the control circuits 73.

- Film data-retrieval apparatus 12, discussed previously and illustrated in block form in Figure 1, includes a digital control circuit 80 for applying
- 60 both voltage signals to the electrical contact pin 52, and for receiving signals relating to the information encoded on the cartridge 34. For this purpose, the circuit 80 includes a plurality of the

- modified inverter circuits 60 shown schematically in Figure 3 and previously discussed. A binary word is generated by the circuit 80 in accordance with the pattern of the contacts 50 under the respective pins 52. Such word represents the film speed and the exposure latitudes of the film in
- 70 cartridge 34, and is transferred to the interface unit 14 by the circuit 80.

- The interface unit 14, discussed previously and illustrated in block form in Figure 1, includes a loading switch 81 and a data storage register 82
- 75 which is settable in accordance with received input data provided by the film data retrieval apparatus 12. The switch 81 serves as a gate for transferring digital signals temporarily stored in the storage register 82, along data transfer lines
- 80 83 to the register 71 in the microprocessor 70.

- Data produced by the light-level sensing circuit 15 and the aperture control and shutter control mechanism 16 and 17, respectively, are in the form of electrical signals, the amplitudes of which
- 85 are proportional to the respective parameters to which the signals relate. For example, the data provided by the light-level sensing circuit 15 is formed by means of a photo-resistive element 84. As is known in the art, such an element has an
- 90 electrical resistance inversely proportional to the intensity of impinging light. When such element is in series with a resistor having a fixed predetermined value, the combination of the photoresistor and resistor forms a voltage divider circuit.
- 95 Accordingly, the voltage signal produced across the photoresistor has an amplitude which is proportional to scene light intensity or brightness.

- The electrical signals relating to aperture size and shutter speed may be produced by means of
- 100 variable resistors, included within voltage divider circuits associated with the aperture control and shutter control mechanism 16 and 17, respectively. For example, the adjustable diaphragm 18 may provide for varying a camera
- 105 taking lens aperture between f-stop settings of approximately f/8 or less to f/22, and a shutter speed setting member may provide for shutter speeds ranging from 1/30 second to about 1/300 second or less. The aforementioned variable
- 110 resistors have electrical resistances proportional to the aperture size and shutter open time. Voltage signals are produced across such resistors having amplitudes related to these resistances. Accordingly, electrical signals are
- 115 produced representing exposure information such as shutter speed and aperture size.

- Camera apparatus for producing electrical signals relating to camera exposure information are well known in the photographic art. For
- 120 example, U.S. Pat. No. 4,048,644 discloses a block diagram representing an electrical circuit which produces electrical signals relating to scene brightness, aperture size and shutter speed.

- As the microprocessor 70 processes digital information, an analogue to digital (A/D) converter
- 125 86 is provided to convert the analogue signals relating to scene brightness produced by the circuit 15, and aperture size and shutter speed

data produced by the mechanism 16 and 17, respectively, to digital signals. The converter 86 then serves to transfer such digital signals to the storage register 82 of the interface unit 14.

5 A read-only memory program storage unit 94 is connected to the microprocessor 70 for supplying microprocessor program instructions to permit the microprocessor to determine whether or not the camera is adjusted for prevailing light conditions so as to produce an acceptably exposed photograph. A computer program for providing such instructions and for use with apparatus constituting the exposure indicator of the present invention is illustrated in abbreviated form by the program flow chart of Figure 5.

The flow chart of Figure 5 is divided into five primary sections, denoted by even reference numerals 100 to 108. The section 100 of the program uses data relating to film speed provided by the retrieval apparatus 12, the scene brightness produced by the circuit 15 to determine an exposure value (EV) for the film employed.

The program section 102 produces an anticipated exposure value (AEV). The AEV represents a discrete exposure value which would be produced utilizing the aperture size and shutter speed as indicated by the mechanisms 16 and 17, respectively.

30 The program 104 constitutes program means which uses the film exposure latitudes data provided by the film data-retrieval apparatus 12 and the EV produced by the program section 100 to compute an acceptable upper exposure value and an acceptable lower exposure value for the film employed. The program section 104 further compares the AEV produced by program section 102, to the calculated acceptable upper and acceptable lower exposure values to determine if such AEV is within the exposure latitude of the film. If the AEV lies outside the range defined by such upper and lower exposure values, the indicator 21, shown in Figures 1 and 4 is activated or energized by means of a command from the program section 106. Accordingly, a signal is provided to a camera operator, for example, by a lamp in the camera viewfinder (not shown), that the camera exposure parameters need to be varied in order to obtain an exposure which is within the film exposure latitude. In the illustrated example, this would be done by adjusting the size of the lens aperture, or adjusting shutter speed, or both.

If, on the other hand, it were determined in the program section 104 that the AEV is between the upper and lower limits of the computed acceptable exposure range, the program section 108 is employed to issue an appropriate command to the indicator 21 so that the camera operator is apprised that the camera is adjusted for an acceptable exposure for the prevailing scene light conditions and the film being employed.

In operation, a film cartridge 34 having film information including film speed and exposure

latitudes coded in binary form is inserted into the film-receiving chamber 32 of the camera. Upon initial movement of a camera shutter release button (not shown) and prior to the shutter 19 being opened, the control switch 78 is actuated to permit the following sequence of operations to take place:— The digital control circuit 80 applies voltage signals to each of the pins 52B to 52H. If an associated contact 50 is absent, the respective switch mechanism 63 is in its open position, and the output, V_{out} , is a low-level voltage corresponding to state 0, i.e. a binary 0. Of course, if the contact 50 is present, the respective switch mechanism 63 is closed and the output V_{out} is a high-level signal representative of a state 1 or binary 1. After each pin 52 receives its input voltage signal, a binary signal is produced representing the film speed and the film exposure latitudes data coded on the cartridge 34. The binary control circuit 80 serves to transfer this signal to the storage register 82. Upon execution of the proper instruction by the microprocessor 70 as provided by the program storage 94, the loading switch 81 delivers this binary signal from the storage registers 82 along the data lines 83 to the general purpose registers 71, where the data is temporarily stored for subsequent processing.

Data corresponding to scene brightness is developed in analogue form by the photoresistive element 84 and converted into digital format by A/D converter 86. This digital luminance data is also transferred by instruction from the microprocessor 70 on the lines 83 to the registers 71. Similarly, digital representations of the aperture size and shutter speed are transferred along the lines 83 on command from the microprocessor 70 and are stored in the registers 71.

With data relating to the film being utilized and camera exposure data loaded into the microprocessor 70, the arithmetic logic unit 72 undertakes the sequence of logic mentioned previously in connection with the program flow chart of Figure 5.

EV and AEV may be expressed by the following:

$$AEV = \log_2 A^2/T \quad (1)$$

$$EV = \log_2 \frac{LS}{K} \quad (2)$$

where A=f-number of camera lens
T=exposure-time interval (seconds)
S=arithmetic film speed
L=scene luminance (foot lamberts)
K=exposure level constant

The constant K may be expressed as:
120 $K = 3.33 \pm 0.5$ for 35 mm film, 16 mm movie film and larger sizes.
 $K = 4.2 \pm 0.6$ for 8 mm and Super 8 films and 110 size films.

For a further detailed discussion of the exposure level constant K, reference is made to *Photometry and Radiometry for Engineers*, by Allen Stimson, published by John Wiley & Sons.

- Arithmetic logic unit 72 computes the range of exposure values acceptable for the film. Firstly, equation (2) is solved for EV, using the scene luminance and film speed data. Then, using the film over- and under-exposure latitudes data, the range of acceptable exposure values is computed. This range is represented at one end by the aforementioned upper acceptable exposure value Y, which corresponds to the sum of EV and the film overexposure latitude, and at the other end by lower acceptable exposure value X, which is equal to EV minus the film underexposure latitude.

- This exposure value range permits a determination of whether the lens f-number and shutter speed at which the camera is set is appropriate for the scene luminance and film employed to produce an acceptably exposed photograph. This determination is done by solving equation (1) for AEV. If the AEV is found to be outside the computed range of acceptable exposure values, the control circuits 73 provide a signal to activate a current driver 96. With the current driver 96 activated, the indicator 21 is energized to provide a warning signal to the camera operator. This signal is an indication to the operator to adjust either the diaphragm 18 by means of the diaphragm control 16, or to adjust the shutter 19 by means of the shutter control 17. When the control switch 78 is again actuated, the entire sequence is re-initiated. Such sequence continues until the AEV is within the range defined by the upper and lower scene exposure values. At that time, the indicator 21 will not be energized at the end of the sequence.

- The teachings of this invention may also be used to employ an arrangement for indicating whether the range of capabilities of the camera would permit the camera to be set or adjusted to achieve a proper exposure for the film utilized. Such an arrangement proceeds from a recognition that a variety of combinations of shutter speeds and aperture sizes may be employed to produce a range of exposure values. Such a range would be bounded at one end by an exposure value for the combination of the fastest shutter speed and smallest lens aperture, and would be bounded at the other end by an exposure value for the combination of the slowest shutter speed and largest lens aperture. The former constitutes a high exposure value and relates to the least amount of light passed through the camera lens to the film, and the latter is a low exposure value and relates to the greatest amount of light passed through. With information relating to the least and the greatest amount of light that the camera exposure control is capable of passing through, a determination may be made, which takes into account film exposure latitude, as to whether or not the subject brightness is such so as to provide an acceptably

exposed photograph upon the exposure control apparatus being adjusted.

A camera exposure value range (EVR_c) may be expressed as follows:

$$EVR_c = \log_2 \frac{A_{MAX}^2}{T_{MIN}} - \log_2 \frac{A_{MIN}^2}{T_{MAX}} \quad (3)$$

For instance, a camera having a shutter-speed range from 1/30 to 1/500 second and a range of apertures from f/2.8 /16 can provide a range of exposure values from 8 to 17.

- An exposure value range for the camera and film combination (EVR_{cf}) may be expressed as the sum of the exposure value range for the camera and the exposure latitude of the film employed:

$$EVR_{cf} = EVR_c + \text{film exposure latitudes} \quad (4).$$

- To determine if the camera is adjustable to provide an acceptably exposed photograph requires that an exposure value as provided by equation (2), falls within the exposure value range for the camera and film, as provided by equation (4). If this is the case, the range of capabilities of the camera would be adequate to produce a proper exposure of the scene. Of course, if the exposed value provided by equation (2) falls within EVR_{cf} , it would be necessary to determine, as described in detail hereinbefore, whether or not the particular combination of aperture size and shutter speed at which the camera is set produces an AEV that is within the range of acceptable film exposure values.

- Two indicators 21, may be provided, one indicator would be to signal that AEV is higher than the upper acceptable exposure value, the second indicator would be for signaling that AEV is less than the lower acceptable exposure value.

- Two indicators would serve to remove any ambiguity from the camera operator as to which direction either the lens aperture size or shutter speed would have to be changed in order to bring the computed AEV within the computed exposure value range of the film employed.

- Whether one or two indicators 21 are provided, the latter preferably would be located in the camera viewfinder. This location ensures that the photographer will have easy access to any indicator signal without having to move the camera out of a picture-taking position.

- Although the invention has been described in connection with the sensing of contacts on a film cartridge, this description has only been by way of a preferred example. Instead of encoding the film exposure latitude and film speed on the cartridge, the information may be provided to the microprocessor in other manners, e.g. by manually adjustable dials on the body of the camera.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations

and modifications can be effected within the scope of the invention as defined in the appended claims.

Claims

- 5 1. A photographic camera having an exposure indicator and comprising a computer having inputs related to film speed, film over- and under-exposure latitudes, and scene brightness, for computing a range of exposure values which
- 10 would produce an acceptably exposed photograph, and comparator means for determining if the exposure value at which the camera is set lies within the range of exposure values and for operating the indicator in
- 15 accordance with such determination.
2. A camera as claimed in Claim 1 having means for sensing the speed of a film inserted therein and the under- and over-exposure latitudes thereof and for providing the sensed information,
- 20 in binary form, to the computer.
3. A camera as claimed in Claim 1 or 2 arranged to receive a film cartridge having information of film speed and film exposure latitudes represented thereon in binary form, the
- 25 camera comprising reading means for reading such binary information and for feeding the same to the input of the computer.
4. A camera as claimed in Claim 1, 2 or 3 wherein means are provided for sensing the scene
- 30 brightness, the aperture value and the shutter speed setting of the camera and for providing electrical signals in analogue form representative thereof, the camera comprising an analogue-to-digital converter for converting the signals to

- 35 digital form and for feeding the digital signals to storage registers of the computer.

5. A camera as claimed in Claim 4 comprising an aperture control mechanism for varying the lens aperture of the camera and for providing an
- 40 analogue signal representative thereof, and a shutter control mechanism for varying the shutter speed of the camera and for providing an analogue signal representative thereof.

6. A camera as claimed in any preceding Claim
- 45 wherein the exposure indicator is visible in a viewfinder of the camera.

7. A camera as claimed in any preceding Claim wherein the exposure indicator comprises first
- 50 means for indicating that the camera is set to an exposure value which is too high to produce an acceptably exposed photograph and second means for indicating that the camera is set to an exposure value which is too low to produce an acceptably exposed photograph.

8. A camera as claimed in any preceding Claim wherein the exposure indicator is arranged to
- 55 indicate whether it is within the camera's capability to produce an acceptably exposed photograph taking into account the film speed, scene brightness, film over- and under-exposure latitudes and the range of the camera's exposure parameters.

9. A photographic camera having an exposure indicator for indicating to an operator of the
- 65 camera whether the camera is set to provide an acceptably exposed photograph, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

and modifications can be effected within the scope of the invention as defined in the appended claims.

Claims

- 5 1. A photographic camera having an exposure indicator and comprising a computer having inputs related to film speed, film over- and under-exposure latitudes, and scene brightness, for computing a range of exposure values which
- 10 would produce an acceptably exposed photograph, and comparator means for determining if the exposure value at which the camera is set lies within the range of exposure values and for operating the indicator in
- 15 accordance with such determination.
2. A camera as claimed in Claim 1 having means for sensing the speed of a film inserted therein and the under- and over-exposure latitudes thereof and for providing the sensed information,
- 20 in binary form, to the computer.
3. A camera as claimed in Claim 1 or 2 arranged to receive a film cartridge having information of film speed and film exposure latitudes represented thereon in binary form, the
- 25 camera comprising reading means for reading such binary information and for feeding the same to the input of the computer.
4. A camera as claimed in Claim 1, 2 or 3 wherein means are provided for sensing the scene
- 30 brightness, the aperture value and the shutter speed setting of the camera and for providing electrical signals in analogue form representative thereof, the camera comprising an analogue-to-digital converter for converting the signals to

35 digital form and for feeding the digital signals to storage registers of the computer.

5. A camera as claimed in Claim 4 comprising an aperture control mechanism for varying the lens aperture of the camera and for providing an
- 40 analogue signal representative thereof, and a shutter control mechanism for varying the shutter speed of the camera and for providing an analogue signal representative thereof.

6. A camera as claimed in any preceding Claim

- 45 wherein the exposure indicator is visible in a viewfinder of the camera.

7. A camera as claimed in any preceding Claim wherein the exposure indicator comprises first means for indicating that the camera is set to an exposure value which is too high to produce an acceptably exposed photograph and second means for indicating that the camera is set to an exposure value which is too low to produce an acceptably exposed photograph.

8. A camera as claimed in any preceding Claim wherein the exposure indicator is arranged to indicate whether it is within the camera's capability to produce an acceptably exposed photograph taking into account the film speed, scene brightness, film over- and under-exposure latitudes and the range of the camera's exposure parameters.

9. A photographic camera having an exposure indicator for indicating to an operator of the camera whether the camera is set to provide an acceptably exposed photograph, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

