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"CAMERA MECHANISM"

The present invention relates to a camera mechanism having both a lens shutter and a focal-plane shutter.

5 Cameras having a lens shutter only and cameras having a focal-plane shutter only are respectively well-known.

10 A camera having a lens shutter only is very suitable for flash photography because of the shape of the shutter aperture. On the other hand, a camera having a focal-plane shutter can be used with replaceable lenses because of the light-blocking construction of the camera. Also, the latter camera permits high-speed time control because of the manner of the operation. In an attempt to utilize the features of both types of cameras mentioned above, an  
15 interchangeable lens having a lens shutter operating alone has been proposed inside a camera equipped with a focal-plane shutter. However, the shutter operates alone only on an interchangeable lens. It has separate control portions for the focal-plane shutter and the  
20 lens shutter, respectively. Therefore, it has numerous duplicated parts.

25 According, therefore, to the present invention, there is provided a camera mechanism comprising a lens shutter for effecting a programmed exposure operation and a diaphragm-adjusting operation; a focal-plane shutter; a selector means for selecting whether the lens shutter is operated in a lens shutter mode, in which the lens shutter is operated as a programmed shutter, or is

operated in a focal-plane shutter mode in which the shutter speed is controlled by the focal-plane shutter and the aperture is controlled by the lens shutter respectively; a first driving means including a motor for controlling the programmed exposure value and/or the aperture value of the lens shutter; an actuating member which is driven by the motor and has first control means for controlling the programmed exposure value in response to rotation of the motor in one angular direction, the actuating member having second control means for controlling the aperture value in response to rotation of the motor in the opposite angular direction; a second driving means for controlling the time for which the focal-plane shutter is operated; and a sequential control means for controlling the timing at which the first and second driving means are operated.

Preferably, the first and second control means respectively comprise first and second cams on the said actuating member, the latter being rotatably mounted.

Each of the said cams is preferably engageable with a portion of an opening and closing lever which is adapted to effect opening and closing movement of shutter blades of the lens shutter.

Means may, if desired, be provided for adjusting the manner in which in operation the opening and closing lever is moved by the said cams.

The second cam may have portions thereof lying on circles drawn about the centre of rotation of the actuating member.

The invention also comprises a camera provided with a camera mechanism as set forth above.

The invention is illustrated, merely by way of example in the accompanying drawings, in which:-

Figure 1 is a diagrammatic cross-sectional view of

a camera provided with a camera mechanism according to the present invention,

Figure 2 is a block diagram illustrating the operation of the camera mechanism of Figure 1;

5        Figures 3 and 4 are graphs illustrating the operation of the camera mechanism of Figure 1;

Figure 5 is a block diagram similar to Figure 2 but showing another embodiment of a camera mechanism according to the present invention;

10        Figure 6 is a graph illustrating the operation of the camera mechanism shown in Figure 5;

Figure 7 is a plan view of the main portion of a lens shutter forming part of the camera mechanism of Figure 1; and

15        Figures 8 and 9 are plan views of parts of further embodiments of such a lens shutter.

Terms such as "clockwise" and "counter-clockwise", as used in the description below, are to be understood to refer to directions as seen in the drawings.

20        In Figure 1 there is shown a camera having a body 1 within which is mounted a camera mechanism according to the present invention. The camera mechanism comprises a lens 2 which is mounted in a lens barrel 3 carried by the body 1 of the camera. An image of a subject to be  
25        photographed is focused by the lens 2 onto a photosensitive material F (hereinafter referred to as the film) disposed behind means 4 defining the field of view.

30        A viewfinder 5 for examining the field of view is mounted on the top of the camera body 1. A light-occluding cylinder 6, which shields the film F against light coming from regions other than the lens 2, is mounted in the front portion of the camera body 1. A shutter release 7 for operating the camera is mounted on

the upper surface of the camera body 1.

A lens shutter 8 for opening and closing the lens aperture is disposed behind the lens 2. The shutter 8 has blades 8a which normally close the lens opening.

5 A stepper motor 9 is disposed inside the lens barrel 3 and actuates the shutter blades 8a in response to an output signal from a first driving means D1, the blades 8a acting also as a diaphragm.

10 An electronic circuit 10 that controls the stepper motor 9 comprises the first driving means D1, a second driving means D2, a sequential control circuit SC (Figure 2) which controls the timing at which the first and second driving means D1, D2 and hence the timing at which the lens shutter 8 and a focal-plane shutter 11  
15 are operated, and a photometric circuit (not shown). The photometric circuit includes photocells (not shown) for measuring the brightness of the subject. Since all of these components, however, are well-known, they are not described in detail herein.

20 The focal-plane shutter 11 comprises a first blind 13 and a second blind 14 both of which are carried by a base 12 mounted in the camera body 1. When two electromagnets (not shown) are successively energized by the second driving means D2 of the electronic circuit  
25 10, the blinds 13, 14 operate at a desired interval to control the exposure time.

The focal-plane shutter 11 is cocked by known means when the film F is fed. When a multiple exposure operation is performed, the shutter 11 is cocked  
30 independently of the transport of the film F.

A selector means 15 is mounted on the top of the camera body 1 to determine whether the focal-plane shutter 11 or the lens shutter 8 is used in taking a photograph.

Figure 2 is a block diagram illustrating the operation of the structure described above. The selector means 15 determines whether the focal-plane shutter 11 or the lens shutter 8 is actuated. In response to a signal from the selector means 15, the sequential control circuit SC drives the first driving means D1 and the second driving means D2 at a predetermined timing to actuate the focal-plane shutter 11 and the lens shutter 8 sequentially.

The manner in which the shutters 8, 11 are actuated is next described by referring to Figures 3 and 4. In each of these figures, the exposure value at the field of view 4 or the position of the field of view is plotted against the elapsed time.

Figure 3 is a graph illustrating the operation when a lens shutter mode is established by the selector means 15. In this mode, the exposure operation is performed by the lens shutter 8. When the shutter release 7 shown in Figure 1 is depressed for photography, the sequential control circuit SC first causes the second driving means D2 to produce an output signal. This moves the first blind 13 of the focal-plane shutter 11 from one end P1 of the field of view to the other end P2 thereof to open the field of view 4.

Then, the sequential control circuit SC instructs the first driving means D1 to deliver an output signal for actuating the lens shutter 8. The film F is exposed to an amount of light corresponding to a region Q1. At this time, the lens shutter 8 performs a programmed exposure operation in which the aperture and the time are selected according to the brightness of the subject.

Subsequently, the sequential control circuit SC causes the second driving means D2 to produce an output signal. The second blind 14 of the focal-plane shutter

11 is moved from one end P1 to the other end P2 thereof, thus closing the field of view 4.

Upon completion of the operation of the focal-plane shutter 11, the sequential control circuit SC produces an output signal to wind up the film F until the next frame appears. The sequential control circuit SC, moreover, drives a motor (not shown) to cock the focal-plane shutter 11.

By these operations, the photography in the lens shutter mode is completed.

Figure 4 is a graph illustrating the operation when a focal-plane shutter mode is established by the selector means 15. In this mode, the exposure operation is performed by the focal-plane shutter 11.

When the shutter release 7 shown in Figure 1 is depressed to take photographs, the sequential control circuit SC first causes the first driving means D1 to deliver an output signal, which opens the lens shutter 8 to a desired aperture d1. Thus, the lens aperture is opened.

Then, the sequential control circuit SC orders the second driving means D2 to produce an output signal. The first blind 13 and the second blind 14 of the focal-plane shutter 11 are successively actuated to expose the film F. At this time, the blinds 13 and 14 operate at an interval  $t$  which provides an appropriate amount of exposure in combination with the aperture value d1 of the lens shutter 8 according to the brightness of the subject.

Thereafter, the sequential control circuit SC causes the first driving means D1 to produce an output signal to close the lens shutter 8.

Upon completion of the operation of the lens shutter 8, the sequential control circuit SC delivers an

output signal to wind up the film F until the next frame appears. At the same time, it drives the motor (not shown) to cock the focal-plane shutter 11.

By these operations, the photography in the focal-plane shutter mode is completed.

Figure 5 is a block diagram similar to Figure 2 but showing another embodiment in which blades are mounted in a diaphragm device 8F of the lens shutter 8 to achieve the aperture value  $d_1$  of Figure 4. Figure 6 is a graph illustrating the operation of the Figure 5 construction.

Specifically, in the embodiment illustrated in Figure 5, the sequential control circuit SC causes the first driving means D1 to fully open shutter blades 8T of the lens shutter 8 to the value of  $d$ . The diaphragm device 8F is so operated that the given aperture value  $d_1$  is established.

The lens shutter 8 shown in Figure 2 can be replaced with the lens shutter shown in Figure 5 with similar utility.

Figure 7 shows the main portion of the lens shutter 8 of Figure 1. The lens shutter 8 has a base 80 on which various components are disposed.

More specifically, an actuating member 18 has teeth 18a with which the stepper motor 9 is in mesh by way of an idler gear 9a. The motor 9 rotates the actuating member 18 around the shutter aperture. The actuating member 18 has a first cam 18b controlling the programmed exposure value of the shutter, a second cam 18c controlling the aperture value, and shoulder portions 18d, 18e. The shoulder portions 18d, 18e are engageable with a fixed pin 80a to limit the range of the angular movement of the actuating member 18.

An opening and closing lever 19 is rotatably

mounted on a shaft or pin 19a. A spring 19b urges the opening and closing lever 19 counter-clockwise. The lever 19 has a pin 19c which is engageable with the cams 18b, 18c of the actuating member 18, and a pin 19d which protrudes downwards. The pin 19d engages with the shutter blades 8a.

The shutter blades 8a are so mounted that they can rotate around a downwardly protruding portion of the shaft 19a and around a shaft 20. Normally, the blades 8a are in the illustrated position and close the shutter aperture. The blades 8a are actuated by the pin 19d. As is well known in the art, they have an edge portion 8a1 acting also as a diaphragm.

The manner in which the lens shutter 8 shown in Figure 7 operates in the lens shutter mode is next described. First, the first driving means D1 rotates the stepper motor 9 in a forward direction. In the embodiment of Figure 7, the motor is rotated clockwise so that the actuating member 18 rotates clockwise at a constant velocity around the shutter aperture. At this time, the pin 19c follows the second cam 18c. The opening and closing lever 19 is thus rotated counter-clockwise by the spring 19b. The pin 19d then actuates the shutter blades 8a. The edge portion 8a1 serves also as the diaphragm. Thus, the shutter aperture is gradually opened. During this process, when a known photometric circuit (not shown) senses that the time set for the exposure value (Q1 in Figure 3) appropriate for the subject has elapsed, the sequential control means SC causes the first driving means D1 to reverse the stepper motor 9. The actuating member 18 then rotates counter-clockwise. The first cam 18b pushes the pin 19c upwards to actuate the opening and closing lever 19. Then, the pin 19d drives the shutter blades 8a to close the

shutter aperture. Thus, the programmed exposure operation is completed.

5 The manner in which the lens shutter 8 operates in the focal-plane shutter mode is next described. The components are essentially identical in operation to the lens shutter mode described above and so the operation is not described in detail. In the focal-plane shutter mode, the shutter blades 8a provide the aperture d1 shown in Figure 4. Only the method of providing this aperture is next described.

10 In particular, the sequential control means SC causes the first driving means D1 to reverse the stepper motor 9. Therefore, the actuating member 18 turns counter-clockwise. The pin 19c follows the second cam 18c so that the opening and closing lever 19 is rotated counter-clockwise. Then, the shutter blades 8a are rotated. The edge portion 8a1 forms the given aperture size (d1 in Figure 4). The stepper motor 9 then comes to a halt. Subsequently, the process is the same as the process in the focal-plane shutter mode. Finally, the stepper motor 9 rotates in a forward direction to close the shutter aperture.

The profiles of the first cam 18b and the second cam 18c of the actuating member 18 are now described.

25 Since the first cam 18b corresponds to the programmed exposure, the shutter blades 8a are so operated that an aperture corresponding to the combination of the exposure and the elapsed time is formed. For this purpose, the first cam 18b is designed to shift the pin 19c a long distance per unit angular movement of the actuating member 18.

30 The second cam 18c corresponds to the aperture size d1 and so the stepper motor 9 provides the aperture value d1 and comes to a halt. The amount of movement of

the shutter blades 8a is determined according to the angular position of the stopped motor. The second cam 18c is designed to shift the pin 19c a short distance per unit angular movement of the actuating member 18.

That is, the inclined surface of the second cam 18c is less steep than the inclined surface of the first cam 18b.

Figure 8 shows a second embodiment of an actuating member 18 having the first cam 18b and the second cam 18c. The second cam 18c has portions lying on circles drawn about the centre of rotation, corresponding to the aperture value d1. Consequently, if an error in the angular position of the stepper motor 9 and errors associated with other components build up, the aperture value is not affected.

Figure 9 shows a third embodiment of the first cam 18b and the second cam 18c. Pins 19e and 19c which can be actuated by the first cam 18b and the second cam 18c, respectively, are mounted on the opening and closing lever 19. The pins 19e, 19c are somewhat loosely mounted in the opening and closing lever 19 so as to be rotatable. Further, portions of the pins 19e, 19c which engage the opening and closing lever 19 and the portions thereof which engage the cams 18b, 18c are eccentric with respect to each other.

Hence, the pins 19c and 19e can be adjusted separately. Adjustment of one of the pins 19c, 19e does not affect the adjustment of the other.

In the structure shown in Figure 5, a second cam differing in shape from the actuating member 18 may be formed on the diaphragm device 8F. The shutter blades 8a are in this case opened so that the diaphragm device 8F may provide the aperture value.

In the above embodiments, an electrical stepper

motor 9 is used. It can, however, be replaced by another motor, such as an ultrasonic motor or a DC motor, as long as it can be reversed.

5       The invention is also applicable to a single-lens reflex camera, in which case suitable cams may be formed on the actuating member 18 of the single-lens reflex camera. The shutter blades 8a which are normally open are once closed. Then, an exposure operation may be performed.

10       As will be appreciated from the above description, the first and second cams which are formed on the actuating member 18 permit the programmed exposure value and the aperture value to be accurately controlled.



### CLAIMS

1. A camera mechanism comprising a lens shutter for effecting a programmed exposure operation and a diaphragm-adjusting operation; a focal-plane shutter; a selector means for selecting whether the lens shutter is operated in a lens shutter mode, in which the lens shutter is operated as a programmed shutter, or is operated in a focal-plane shutter mode in which the shutter speed is controlled by the focal-plane shutter and the aperture is controlled by the lens shutter respectively; a first driving means including a motor for controlling the programmed exposure value and/or the aperture value of the lens shutter; an actuating member which is driven by the motor and has first control means for controlling the programmed exposure value in response to rotation of the motor in one angular direction, the actuating member having second control means for controlling the aperture value in response to rotation of the motor in the opposite angular direction; a second driving means for controlling the time for which the focal-plane shutter is operated; and a sequential control means for controlling the timing at which the first and second driving means are operated.

2. A camera mechanism as claimed in claim 1 in which the first and second control means respectively comprise first and second cams on the said actuating member, the latter being rotatably mounted.

3. A camera mechanism as claimed in claim 2 in which each of said cams is engageable with a portion of



an opening and closing lever which is adapted to effect opening and closing movement of shutter blades of the lens shutter.

4. A camera as claimed in claim 3 in which means are provided for adjusting the manner in which in operation the opening and closing lever is moved by the said cams.

5. A camera mechanism as claimed in any of claims 2-4 in which the second cam has portions thereof lying on circles drawn about the centre of rotation of the actuating member.

6. A camera mechanism substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

7. A camera provided with a camera mechanism as claimed in any preceding claim.

8. A camera having a lens shutter for performing a programmed exposure operation and a diaphragm-adjusting operation and a focal-plane shutter,

said camera comprising:

a selector means for establishing either a lens shutter mode in which the lens shutter is operated as a programmed shutter or a focal-plane shutter mode in which the shutter speed is controlled by the focal-plane shutter and the aperture is controlled by the lens shutter, respectively;

a first driving means including an electric motor for controlling either the programmed exposure value of the lens shutter and/or the aperture value;

an actuating member which is driven by the motor and has a first cam controlling the programmed exposure value in response to forward reciprocating rotation of the motor and a second cam controlling the aperture value in response to reverse reciprocating rotation of



the motor;

a second driving means controlling the time for which the focal-plane shutter is operated; and

a sequential control means controlling the timing at which said first and second driving means are operated.

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