

ZOOM CAMERA WITH MOVABLE LIGHT UNIT

The present invention relates to a zoom strobe device having an illumination angle varying mechanism.

A zoom strobe device in which an illumination angle varies in accordance with focal length of a zooming lens is widely used in a zoom lens camera and particularly in a compact camera having a zoom photographing lens system and a separate zoom finder system. In such a zoom strobe device, at least one of a light emitting tube, a reflection shade, and condenser lens constitutes an illumination angle varying member which moves in the optical axis direction to change the illumination angle. The illumination angle varying member is actuated by a cam mechanism.

In a conventional zoom strobe device, since an associated pin provided on the illumination angle varying member is directly engaged in a cam groove of a cam member provided in a cam mechanism, the cam groove must have a large inclination angle to cause a relatively large displacement of the illumination angle varying member by a small displacement of the cam member. However, the large inclination angle of the cam groove may make it impossible to actuate the cam member. This is the reason that the cam member in a conventional zoom strobe device has a long cam groove having a small inclination angle, resulting in an increased displacement of the cam member. This becomes more serious particularly in a camera having a macro function at a TELE extremity in which the zoom lens moves from the TELE extremity to a macro-photographing position, since a relatively large displacement (advance) of the illumination

angle varying member must be caused by a short cam groove to decrease the intensity of the strobe light at the macro-photographing position.

An object of the present invention is to provide a zoom strobe device in which a large displacement of the illumination angle varying member may be caused by a short cam length (cam groove).

According to the present invention, there is provided a zoom strobe device having an illumination angle varying member which is movable in a direction of an optical axis and which is constituted by at least one of a light emitting tube, reflection shade and a condenser lens, the position of said illumination angle varying member being controlled by a cam groove of a cam member which is moved in accordance with a zooming operation, characterised by an intermediate lever which is provided between the cam member and the illumination angle varying member so as to rotate about a pivot, said intermediate lever being provided thereon with an association pin which is engaged in the cam groove of the cam member and an associated portion which is associated with the illumination angle varying member.

Preferably, the distance ℓ_1 between the pivot of the intermediate lever and the association pin is smaller than the distance ℓ_2 between the pivot of the intermediate lever and the associated portion ($\ell_1 < \ell_2$).

Thus, a large displacement of the illumination angle varying member in the optical axis direction can be caused by a small movement of the cam member when ℓ_2 is larger than ℓ_1 ($\ell_1 < \ell_2$). Namely, an increased axial component of the movement

of the cam groove is transmitted to the illumination angle varying member, and accordingly the illumination angle varying member can be smoothly actuated by a small displacement of the cam member, thus resulting in a realization of a small and compact zoom strobe device.

Conveniently, the device further comprises a light emitting block which is formed by the light emitting tube and the reflection shade integral therewith.

The illumination angle varying member may be constituted by the light emitting block. In this case, the light emitting block is preferably provided on its upper portion with a pair of hanging rails which extend outwardly from the light emitting block in parallel with the optical axis direction and which have stepped engagement portions.

Preferably, the device further comprises a strobe housing in which the light emitting block is housed, said strobe housing being provided with guide slots in which the corresponding hanging rails are slidably fitted and supporting surfaces which engage with the stepped portions.

The intermediate lever may be pivoted to the wall portion of the strobe housing that has the guide slots.

Moreover, said cam member may be made of a cam plate which is reciprocally moved in a direction perpendicular to, and not intersecting, the optical axis.

In a preferred embodiment, the device further comprises a strobe finder housing which has a pair of vertical walls, a bottom wall which connects the lower portions of the vertical walls, and an upper wall which extends from the upper portion

of one of the vertical walls in the direction opposite to the bottom wall in parallel with the bottom wall, said vertical walls and said bottom wall defining a chamber in which a zoom finder device can be held, said light emitting block being supported by the upper wall so as to move in the optical axis direction.

According to another aspect of the invention, there is provided a camera comprising a zoom strobe device comprising an illumination angle varying member which is movable in a direction of an optical axis and which is constituted by at least one of a light emitting tube, a reflection shade and a condenser lens, the position of said illumination angle varying member being controlled by a strobe cam groove of a cam member which is moved in accordance with a zooming operation, characterized by an intermediate lever which is provided between the cam member and the illumination angle varying member so as to rotate about a pivot, said intermediate lever being provided thereon with an association pin which is engaged in the strobe cam groove of the cam member and an associated portion which is associated with the illumination angle varying member.

Conveniently, at least one movable lens is provided with a further association pin, the position of which lens is controlled by the direct engagement of the pin in a finder cam groove formed in the cam member.

Preferably, the distance l_1 between the pivot of the intermediate lever and the association pin is smaller than the distance l_2 between the pivot of the intermediate lever and the associated portion ($l_1 < l_2$).

The device may further comprise a light emitting block which is formed by the light emitting tube and the reflection shade integral therewith, the illumination angle varying member being constituted by the light emitting block.

An example of the present invention will be described below in detail, by way of illustration only, with reference to the accompanying drawings, in which:

Figure 1 is an exploded perspective view of a main portion of a zoom strobe device embodying an aspect of the present invention;

Fig. 2 is a view similar to Fig. 1, in association with a finder device;

Fig. 3 is a partial sectional view taken along the line III-III in Fig. 2; and

Figs. 4, 5 and 6 are plan views of the zoom strobe device shown in Fig. 1 showing positional relationships of components thereof show in WIDE extremity, TELE extremity and macro photographing range, respectively.

A zoom strobe device 10 of an embodiment of the present invention is supported by a strobe finder housing 11 together with a zoom finder device 30. Note that a zoom photographing lens is, as is well known, separately provided and is not shown in the drawings.

The strobe finder housing 11 has a pair of vertical walls 11a and 11b, a bottom wall 11c which connects the vertical walls 11a and 11b at the lower portion thereof, and an upper wall 11d horizontally and outwardly extending from the upper end of the vertical wall 11b. The vertical walls 11a and 11b and the bottom

wall 11c define a chamber 12 in which the zoom finder device 30 is provided. The zoom strobe device 10 is received in a space defined by the vertical walls 11a and 11b and the upper wall 11d.

A first movable lens frame 31 which holds a first lens L1 and a second movable lens frame 32 which holds a second lens L2 are located in this order in the chamber 12 which viewed from front. Both the frames 31 and 32 are supported so as to move in the optical axis direction. In addition, third, fourth and fifth lenses L3, L4 and L5 are immovably located in the chamber 12 to the rear of the second lens L2. The upper portions of the third, fourth and fifth lenses L3, L4 and L5 are covered by a finder cover 33. The first and second movable lens frames 31 and 32 are provided, on their upper portions, with association pins 31a and 32a, respectively.

The upper wall 11d of the strobe finder housing 11 has a pair of guide slots 13 formed therein, which extend in parallel with the optical axis. Each of the guide slots 13 has a rear through hole portion 13a and a stepped portion which is formed by a lower portion having a decreased width to define a supporting surface 13b located anterior to the through hole portion 13a, as shown in Figs. 4-6.

The zoom strobe device 10 has a fixed condenser lens (Fresnel lens) 14 and a light emitting block 15 which serves as an illumination angle varying member in the illustrated embodiment. The light emitting block 15 has a xenon tube (light emitting tube) 15a and a reflection shade 15b integral therewith. The light emitting block 15 is provided on its upper

surface with a pair of hanging rails 16 which extend rearwardly from the light emitting block 15 in parallel with the optical axis and are adapted to be fitted in the corresponding guide slots 13. The hanging rails 16 have stepped portions 16a which can be engaged by the supporting surfaces 13b. One of the hanging rails 16 remote from the zoom finder device 30 has an association pin 16b projecting from the upper surface thereof.

Upon assembling the light emitting block 15 onto the upper wall 11d of the finder strobe housing 11d, the hanging rails 16 are inserted into the through hole portions 13a of the associated guide slots and are then moved forward, so that the stepped portions 16a engage onto the supporting surfaces 13b.

The positions of the light emitting block 15 and the first and second movable lens frames 31 and 32 of the zoom finder device 30 are controlled by cam grooves 20, 21 and 22 formed on a cam plate 18. The cam plate 18 is supported on a supporting plate 19 which is secured to the strobe finder housing 11 so as to move linearly in the right and left hand directions (lateral directions). The cam plate 18 has a movement restricting groove 18a formed therein which extends laterally, so that a pair of guide pins 19a secured to the supporting plate 19 can extend therethrough. The supporting plate 19 has a projection 19b which is formed by cutting the plate on the opposite side to the groove 18a to prevent upward displacement... (floating) of the cam plate 18, so that the cam plate 18 can be reciprocally moved in a lateral direction perpendicular to, and not intersecting, the optical axis.

The cam plate 18 has a rack 18b which is provided on a downwardly bent rear portion of the cam plate and which is engaged by a terminal gear 23a of a drive mechanism 23. Consequently, the forward and reverse rotations of the terminal gear 23a cause the cam plate 18 to move right and left. The drive mechanism 23 is driven in association with the zooming operation of a zoom photographing optical system (not shown) to correspond the zoom photographing range to the finder field of view and the strobe illumination angle.

The association pins 31a and 32a of the first and second movable lens frames 31 and 32 are directly engaged in the corresponding cam grooves 21 and 22 of the cam plate 18. Accordingly, when the cam plate 18 moves right and left, the first movable lens frame 31 (first lens L1) and the second movable lens frame 32 (second lens L2) are moved in the optical axis direction in accordance with the profiles of the cam grooves 21 and 22 to change the finder field of view.

The association pin 16b is functionally engaged with the cam groove 20 through an intermediate lever 24. The intermediate lever 24 is pivoted to the upper wall 11d of the strobe finder housing 11 by means of a shaft (pivot) 25. The intermediate lever 24 has an association pin 26 which is fitted in the cam groove 20 and a bifurcated association portion 27 in which the association pin 16b of the light emitting block 15 is engaged. The association pin 26 and the bifurcated association portion 27 are located on the opposite sides of the shaft 25. The distances ℓ_1 and ℓ_2 between the association pin 26 and the shaft 25 and between the bifurcated association portion 27 and the

shaft 25 are $l_1 < l_2$, so that when the intermediate lever 24 is rotated by the association pin 26, the movement of the association pin is proportionally increased and transmitted to the bifurcated association portion 27, and hence the light emitting block 15.

Each of the cam grooves 20, 21 and 22 has lens accommodating section $\delta 1$, zooming section $\delta 2$ and macro section $\delta 3$, as shown in Fig. 1 (only those of the cam groove 20 are shown in Fig. 1). It is necessary for the zooming section $\delta 2$ to cause a larger forward displacement M (Fig. 1) of the light emitting block 15 within a small displacement range of the cam groove 20, i.e. the macro section $\delta 3$ (corresponding to a small axial distance m ($< M$) in Fig. 1) to decrease the intensity of the strobe light when the zoom lens is moved from the TELE extremity to the macro photographing position. In this case, the WIDE extremity is located on the lens accommodating section side $\delta 1$. The above discussion also applies to the cam grooves 21 and 22.

The zoom strobe device of the present invention operates as follows.

When the cam plate 18 moves right or left, the first movable lens frame 31 and the second movable lens frame 32 move directly in accordance with the profiles of the cam grooves 21 and 22 to correspond the finder field of view to the zoom photographing range. On the other hand, the light emitting block 15 is moved in the optical axis direction via the intermediate lever 24 while enlarging the axial component of the displacement of the cam groove 20. Thus, the association pin 26 provided on

the intermediate lever 24 is fitted in the cam groove 20, and the association pin 16b of the light emitting block 15 is associated with the bifurcated association portion 27 of the intermediate lever 24. Furthermore, the distance ℓ_1 between the association pin 26 and the shaft 25 is different from the distance ℓ_2 between the bifurcated association portion 27 and the shaft 25 ($\ell_1 < \ell_2$). Accordingly, when the association pin 26 moves in the optical axis direction by the distance m (Fig. 1), the light emitting block 15 moves in the opposite direction by the distance $M = (\ell_2 / \ell_1) \cdot m$. Therefore, even if the distance m is reduced, that is, even if the axial displacement m within the macro section δ_3 of the cam groove 20 is reduced to decrease the inclination angle θ thereof, the necessary displacement of the light emitting block 15 can be provided. In other words, if the inclination angle θ is set, so that the cam plate 18 can be actuated with a small drive force, and if the lengths ℓ_1 and ℓ_2 are determined in accordance with the inclination angle θ , the necessary axial displacement of the light emitting block 15 can be readily ensured.

As can be seen from the foregoing, with the present invention, in a zoom strobe device in which the illumination angle varying member is moved in the optical axis direction with the help of the cam groove, since the rotatable intermediate lever which has thereon the association pin engaging in the cam groove and the association portion associated with the illumination angle varying member is provided between the illumination angle varying member and the cam groove, the enlarged axial component of the displacement of the cam groove

is transmitted to the illumination angle varying member by properly selecting the ratio of the distance between the pivot shaft of the intermediate lever and the association pin and the distance between the pivot shaft of the intermediate lever and the association portion. As a result, a smaller displacement of the cam member can actuate the illumination angle varying member, thus resulting in a smooth operation and a smaller zoom strobe device.

CLAIMS

1. A zoom strobe device having an illumination angle varying member which is movable in a direction of an optical axis and which is constituted by at least one of a light emitting tube, reflection shade and a condenser lens, the position of said illumination angle varying member being controlled by a cam groove of a cam member which is moved in accordance with a zooming operation, characterised by an intermediate lever which is provided between the cam member and the illumination angle varying member so as to rotate about a pivot, said intermediate lever being provided thereon with an association pin which is engaged in the cam groove of the cam member and an associated portion which is associated with the illumination angle varying member.
2. A zoom strobe device according to Claim 1, wherein the distance ℓ_1 between the pivot of the intermediate lever and the association pin is smaller than the distance ℓ_2 between the pivot of the intermediate lever and the associated portion ($\ell_1 < \ell_2$).
3. A zoom strobe device according to either of Claims 1 or 2 further comprising a light emitting block which is formed by the light emitting tube and the reflection shade integral therewith.
4. A zoom strobe device according to either of Claims 1 or 2 wherein the illumination angle varying member is constituted



by the light emitting block.

5. A zoom strobe device according to Claim 4, wherein the light emitting block is provided on its upper portion with a pair of hanging rails which extend outwardly from the light emitting block in parallel with the optical axis direction and which have stepped engagement portions.

6. A zoom strobe device according to Claim 5, further comprising a strobe housing in which the light emitting block is housed, said strobe housing being provided with guide slots in which the corresponding hanging rails are slidably fitted and supporting surfaces which engage with the stepped portions.

7. A zoom strobe device according to Claim 6, wherein said intermediate lever is pivoted to the wall portion of the strobe housing that has the guide slots.

8. A zoom strobe device according to Claim 7, wherein said cam member is made of a cam plate which is reciprocally moved in a direction perpendicular to, and not intersecting, the optical axis.

9. A zoom strobe device according to any preceding Claim further comprising a strobe finder housing which has a pair of vertical walls, a bottom wall which connects the lower portions of the vertical walls, and an upper wall which extends from the upper portion of one of the vertical walls in the direction



opposite to the bottom wall in parallel with the bottom wall, said vertical walls and said bottom wall defining a chamber in which a zoom finder device can be held, said light emitting block being supported by the upper wall so as to move in the optical axis direction.

10. A camera comprising a zoom strobe device comprising an illumination angle varying member which is movable in a direction of an optical axis and which is constituted by at least one of a light emitting tube, a reflection shade and a condenser lens, the position of said illumination angle varying member being controlled by a strobe cam groove of a cam member which is moved in accordance with a zooming operation, characterised by an intermediate lever which is provided between the cam member and the illumination angle varying member so as to rotate about a pivot, said intermediate lever being provided thereon with an association pin which is engaged in the strobe cam groove of the cam member and an associated portion which is associated with the illumination angle varying member.

11. A camera according to Claim 10 comprising at least one movable lens provided with a further association pin, the position of which lens is controlled by the direct engagement of the pin in a finder cam groove formed in the cam member.

12. A camera according to Claim 10 wherein the distance ℓ_1 between the pivot of the intermediate lever and the association pin is smaller than the distance ℓ_2 between the pivot of the



intermediate lever and the associated portion
($l_1 < l_2$).

13. A camera according to any of Claims 10 to 12 further comprising a light emitting block which is formed by the light emitting tube and the reflection shade integral therewith.

14. A camera according to Claim 13 wherein the illumination angle varying member is constituted by the light emitting block.

15. A zoom strobe device substantially as hereinbefore set forth, with reference to, and/or as illustrated in, Figures 1 to 5 of the accompanying drawings.
