

Interchangeable Photographic Objective having
an improved rotation control mechanism
for the diaphragm operating ring

The present invention relates to an interchangeable objective provided with a diaphragm operating ring which is rotatable between a rotation range for diaphragm presetting and a position for automatic diaphragm regulation, and, more particularly, to a
5 rotation control mechanism for the diaphragm operating ring used for changeover between the said rotatable range for diaphragm presetting and the said position for automatic diaphragm regulation.

A photographic camera of automatic exposure control type has
10 conventionally adopted either the diaphragm priority mode in which the diaphragm value is preset on the objective by the user and the shutter speed for appropriate exposure is automatically regulated in the camera body, or the shutter speed priority mode in which conversely, the shutter speed is manually preset on the camera
15 body by the user and the lens aperture for appropriate exposure is automatically regulated, or the programmed mode in which a combination of diaphragm value and shutter speed is automatically regulated for appropriate exposure.

20 An interchangeable objective used with a photographic camera adopting these three modes of automatic exposure control function, or different exposure control functions, must include a diaphragm operating ring provided with a rotation range for manually pre-setting the diaphragm value in said diaphragm priority mode
25 (Manual, referred to hereinafter as M-range) and a position for automatic diaphragm regulation (Auto, referred to hereinafter as A-position) for both said shutter speed priority mode and said programmed mode, since information on whether the diaphragm operating ring occupies the M-range or the A-position must be
30 transferred to the camera body in view of the fact that different exposure control mechanisms are activated depending on the M-range and the A-position.

Any unintentional change-over between the M-range and the A-position must reliably be avoided and, in consequence, suitable change-over locking mechanism and unlocking mechanism have been necessary. However, the structure for the connection between the lens barrel and the camera body has inconveniently made it difficult to obtain a large rotation angle for change-over between one end of the M-range and the A-position. This has given rise to various problems with respect not only to the strength but also to the degree of freedom for design. Particularly in an objective of a relatively large diameter, the rotation angle within the M-range must be large, but the rotation angle of a diaphragm information transferring lever which is rotatable together with the diaphragm operating ring is restricted by the pawl angle of the mount ring, so that the mechanism must be sometimes realized at the cost of the strength of the change-over locking mechanism.

These problems will now be considered in detail with respect to Figs. 1 to 3 of the accompanying drawings which show a typical known construction. A mount ring 2 is integrally connected by screws 3 to a mount support ring 1 so that this mount ring 2 is detachably engaged into a mount ring 4 provided on the camera body B.

A diaphragm operating ring 5 is rotatably mounted around the outer periphery of the mount support ring 1, and a diaphragm rotating ring 6 adapted to be rotated integrally with this diaphragm operating ring 5 is rotatably supported between said mount support ring 1 and the mount ring 2. The diaphragm rotating ring 6 is provided with a diaphragm information transferring lever 7 projecting from a part of said diaphragm rotating ring 6 and this diaphragm information transferring lever 7 extends through a circular arcuate notch 8 in the mount ring 2 towards the camera body B and engages with a diaphragm information receiving lever 9 provided within the camera body. The diaphragm information receiving lever 9 is operatively associated with a variable resistor (not shown) forming part of an automatic exposure control circuit and generates an electric signal corres-

ponding to the angular position of the diaphragm operating ring 5. As shown in Fig. 1, information is given to the camera body as to whether the diaphragm information transferring lever 7 lies within the M-range or at the A-position, and what diaphragm value is
5 taken by said diaphragm information transferring lever 7 within the M-range.

Referring to Fig. 3 showing by way of example the well known change-over mechanism for changing over between the M-range and the A-position, the mount support ring 1 is provided at a position
10 corresponding to one rotational end of the M-range (e.g., the minimum lens aperture) and at a position corresponding to the A-position with radially extending rotation control pins 10, 11, respectively, which are retractable and outwardly biased by compression coiled springs 10a, 11a, respectively. The diaphragm
15 operating ring 5 is provided in its inner surface with a locking groove 12 adapted to receive these rotation control pins 10, 11, and supports an unlocking button 13 adapted for inwardly displacing these pins 10, 11 against the biasing effect of said compression coiled springs 10a, 11a. Reference numeral 14 designates a
20 tapered flank allowing rotation of the diaphragm operating ring 5 within the M-range.

With such known change-over mechanism, it has been possible to ensure good operation without any problems so long as the interchangeable objective actually mounted on the camera body is
25 such one which permits a distance ℓ between the two rotation control pins 10, 11, or in other words the rotation angle for changeover between the M-range and the A-position to be sufficiently large. However, with an interchangeable objective requiring said distance ℓ to be small, the mechanism has only been
30 realized at the cost of various problems, such as insufficient strength of the rotation control pins 10, 11 and a restricted degree of freedom for the design.

In accordance with the invention there is provided

an interchangeable objective comprising a mount support ring for attachment to a camera body, a diaphragm, a diaphragm operating ring supported by the mount support ring and having a diaphragm presetting rotation range for manually presetting the diaphragm position in which in use the diaphragm position can be automatically regulated from an attached camera body, two rotation control members provided at angular positions corresponding to one end of the diaphragm presetting rotation range and to the automatic diaphragm regulation position respectively, the rotation control members being biased to project radially outwardly, locking groove means on the diaphragm operating ring adapted to receive the rotation control members selectively in dependence upon the rotary position of the ring, and an unlocking member adapted to bear against the rotation control members when received in the locking groove to displace them out of the locking groove against their biasing force, characterised in that the two rotation control members are relatively spaced from each other in the direction of the optical axis, and the unlocking member has a portion of sufficient extent in the said direction to be capable of unlocking a rotation control member in either of the two spaced axial positions.

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

Fig. 1 (described above) is a rear view of the barrel of a photographic objective showing by way of example how the M-range and the A-position of the diaphragm operating ring are arranged;

5 Fig. 2 (described above) is a section taken along the line II - II in Fig. 1, showing the objective's barrel of Fig. 1 as mounted onto the camera body;

Fig. 3 (described above) is a section showing an important part of the well known mechanism for change-over between the M-range and the A-position;

10 Fig. 4 is a section showing the corresponding part of a first objective embodying the present invention;

Fig. 5 is a partial view of the diaphragm operating ring as seen in the direction of the arrow $\bar{V}$ in Fig. 4;

15 Fig. 6 is a front view showing the essential part of the diaphragm operating ring;

Fig. 7 is a partial view of the diaphragm operating ring as seen in the direction of the arrow VII in Fig. 6;

20 Figs. 8 to 10 show the diaphragm operating ring in the lens barrel as held at the minimum lens aperture position within the M-range, of which Fig. 8 is a section of the essential part, Fig. 9 is a partial view as seen in the direction of the arrow IX in Fig. 8 and Fig. 10 is a section taken along the line X - X in Fig. 8;

25 Figs 11 to 13 show the diaphragm operating ring held at the A-position, of which Fig. 11 is a cross-section of the essential part, Fig. 12 is a partial view as seen in the direction of the arrow XII in Fig. 11 and Fig. 13 is a section taken along the line XIII - XIII in Fig. 11;

30 Fig. 14 is a section showing the essential part of another embodiment of the present invention;

Fig. 15 is a partial view as seen in the direction of the arrow XV in Fig. 14;

Fig. 16 is a section showing the essential part of a further embodiment of the present invention;

35 Figs. 17 and 18 are frontal sections showing the essential part of another interchangeable objective embodying the present invention;

Figs. 19 and 20 are sections taken along lines XIX - XIX and XX - XX in Fig. 17, respectively;

Fig. 21 is a perspective view showing one of the rotation arresting members;

5 Figs. 22a to 22f are frontal sections showing the essential part of the control mechanism in different states of operation;

Figs. 23a to 23c are side sections showing said essential part;

10 Figs. 24a and 24b are views as seen in the direction of arrow XXIV in Figs. 22b and 22e, respectively;

Fig. 25 is a perspective view showing another embodiment of the rotation arresting members; and

15 Fig. 26 is a perspective view showing another embodiment of the locking groove of the diaphragm operating ring and the rotation arresting members.

In the first place, a procedure for determining the rotation angle for change-over between the M-range and the A-position and reasons why this angle should be relatively small will be explained on the basis of specific numerical data.

20 The rotation range of the diaphragm information transferring lever 7 is limited by an angle (θ_k in Fig. 1) defined between each pair of adjacent pawls 2a formed in the mount ring 2.

This angle θ_k depends on the following factors:

- (1) The number of pawls 2a formed in the mount ring 2
25 The number of points necessary for definition of a plane is three and the number of pawls also is preferably three. Thus, it is assumed here that three pawls are formed in this embodiment.
- (2) The positions of the pawls 2a in the mount ring 2
30 Positioning of these three pawls 2a at regular intervals should be avoided so as to permit the mount ring 2 to be received in the mount ring of the camera body only at a particular angular position. However, putting these pawls all on one side might bring the optical
35 axes of the objective and the camera body out of mutual alignment. To meet these mutually contradictory requirements, the pawls 2a are arranged at intervals of

130°, 115°, and 115°.

(3) The operating angle for mounting or detaching of objective and the angular dimensions of the pawls

The operating angle for mounting the objective onto the camera body depends on the intervals at which the pawls 2a are arranged. When the angular dimensions of each pawl on the objective corresponds to the angular dimension of each pawl on the camera body, the angular dimension of the pawl must be less than one half of said 115°.

Accordingly, the operating angle for mounting or detaching the objective will be more than one half of 115°, for example, 60°. Typically the angular dimension of every pawl will be 50° with an allowance of 5° for mounting the objective onto the camera body.

(4) The angular dimension θ_k of the notch formed between the pawls 2a

It is preferred that the diaphragm information transferring lever 7 is rotatable within a range which is as wide as possible, so that the notch 8 is formed between those pair of pawls 2a which are separated by the interval of 130°. The angle θ_k therefore corresponds to the interval of the pawls minus the pawl angle, i.e., $130^\circ - 50^\circ = 80^\circ$.

The diaphragm information transferring lever 7 has its rotatable range of 75° with allowance of 2.5° (circumference length of 1mm with a radius of 23mm) towards the maximum lens aperture and the A-position, respectively. Within such range, the angle θ_k over which the diaphragm information transferring lever 7 can be rotated from the minimum lens aperture in the M-range to the A-position depends further upon a factor as mentioned in the following paragraph.

(5) The angle θ_1 of the diaphragm information transferring lever 7 itself

The diaphragm information transferring lever must have sufficient strength for exact transfer of diaphragm

information. When such requirement is satisfied by a transferring lever having a circumferential length of 4mm with a radius of 23mm, the angle θ_j is obtained by.

$$\theta_j = \frac{4 \times 360^\circ}{23 \times 2 \times \pi} \approx 10^\circ$$

- (6) The number of steps n from the maximum lens aperture to the minimum lens aperture within the M-range

The exposure control circuit in the camera body receives the diaphragm information within the M-range as a number of steps from the maximum lens aperture to the actually-used diaphragm value (e.g. five steps when the maximum lens aperture is 1.4 and the actually-used diaphragm value is 8). There are 9.5 steps for an objective having a maximum lens aperture of 1.2 and a minimum lens aperture of 32, so that such objective must be able to deal with a range extending up to 10 steps, i.e., $n = 10$.

- (7) The rotation angle θ_M of the diaphragm information transferring lever 7 per unit diaphragm value

As the minimum unit of diaphragm information, 1/3 step must be reliably transferred to the exposure control circuit. Assumed that this requirement is satisfied with a circumferential displacement of the variable resistor by 1mm, said variable resistor having a radius of 28mm, the rotation angle $1/3\theta_M$ corresponding to 1/3 step is obtained by:

$$1/3\theta_M = \frac{1 \times 360^\circ}{28 \times 2 \times \pi} \approx 2^\circ$$

Accordingly, the rotation angle θ_M of the diaphragm information transferring lever itself per unit diaphragm value is about 6° .

- (8) The rotation angle θ_A of the Diaphragm information transferring lever 7 from the minimum lens aperture to the A-position within the M-range

$$\theta_A = 75^\circ - \theta_j - n\theta_M$$

This gives:

$$\theta_A = 75^\circ - 10^\circ - 10 \times 6^\circ = 5^\circ$$

5 Thus the rotation angle θ_A is limited to an angle as small as 5° . Assuming that, in the known mechanism as shown in Fig. 3, the rotation control pins 10, 11 are formed with holes 10b, 11b respectively having diameters of 1.5mm to receive the compression coiled
10 springs 10a, 11a, respectively, said pins 10, 11 must have diameters of at least 2mm. With the diaphragm operating ring 5 having an inner diameter of 28mm, and holes 10c, 11c adapted to receive the pins 10, 11, respectively, which are 3mm deep, the distance l
15 between said holes 10c and 11c is obtained by

$$l = \frac{(28 - 3) \times 2 \times \pi}{360^\circ} \times 5 - 2 = 0.2\text{mm}$$

20 when θ_A is 5° . So long as θ_A is limited to 5° , the distance between the holes 10c and 11c is as small as 0.2mm at the narrowest position and, in consequence, there is a danger that these holes 10c, 11c formed in the mount support ring 1 might be destroyed, for
25 example, as the user violently rotates the diaphragm operating ring 5 when the objective is mounted onto the camera body.

In accordance with the present invention, the two rotation control pins 10, 11 are spaced from each other in the direction
30 of the optical axis, as seen in Figs 4 and 5, so as to give the mount support ring 1 sufficient strength even when the angle θ_A is small as above mentioned. Specifically, the mount support ring 1 is provided at positions circumferentially spaced from each other by an angular distance corresponding to the rotation
35 angle for change-over between the M-range and the A-position set as above mentioned and by a distance S in the direction of the optical axis with two radial pin guide holes 10c, 11c adapted to receive the associated rotation control pins 10, 11

which are, in turn, outwardly biased under action of the compression coiled springs 10a, 11a, respectively.

5 The diaphragm operating ring 5 is provided along its inner peripheral surface with a locking groove 15 extending in the direction of the optical axis to receive said rotation control pins 10, 11. The mount support ring 1 is a non-rotatable member adapted for rotatable support of the diaphragm operating ring 5. The locking groove 15 is separated by a circumferential relief groove 16, which is necessary for machining, into a groove portion 10 15a and a groove portion 15b adapted to receive said rotation control pin 10 and said rotation control pin 11, respectively. There is formed a guide hole 18 radially extending through the diaphragm operating ring 5 at a cross area of said locking groove 15 and said relief groove 16 for slidably guiding an unlocking 15 button 17, which is, in turn, provided at the bottom with an extension plate 17a extending transverse to the unlocking button over the two rotation control pins and lying within the locking groove so that the plate 17a may bear against the heads of said two rotation control pins 10, 11, respectively.

20 The rotation control pins 10, 11 serve, in the same manner as has previously been mentioned in reference with the known embodiment, to hold the diaphragm operating ring 5 against one rotational end (the minimum lens aperture) in the M-range when the pin 10 is received in the locking groove portion 15a and to 25 hold said diaphragm operating ring at the A-position when the other pin 11 is received in the locking groove portion 15b. Said locking groove portion 15a is formed with a tapered flank 19 allowing rotation of the diaphragm operating ring 5 towards the maximum lens aperture of the M-range.

30 As shown in Figure 4 there is provided a click-stop mechanism 20 between the diaphragm operating ring 5 and the mount support ring 1. In this mechanism, the diaphragm operating ring 5 is provided in the inner peripheral surface with click-grooves 21a corresponding to diaphragm value graduations other than 35 the minimum lens aperture, a click-groove 21b corresponding to the minimum lens aperture and a click-groove 21c corresponding to the A-position graduation, while the mount support ring 1 is provided

with a click-ball 23 adapted to be received in these click-grooves under a biasing effect of a compression coiled spring 22. It will be understood that the rotation control pin 10 is received in the locking groove 15 when the click-ball 23 is received in the click-groove 21b and the rotation control pin 11 is received in the same click-groove when said click-ball is received in the click-groove 21c. The mechanism in which the lens aperture is adjusted by rotation of the diaphragm operating ring 5 is well known and such mechanism is not therefore described in detail.

With the interchangeable objective constructed as has been described above, the change-over between the M-range and the A-position can be achieved by depression of the unlocking button 17. Such change-over between the M-range and the A-position never occurs so long as said unlocking button 17 is not depressed. When the diaphragm operating ring 5 is rotated to the minimum lens aperture within the M-range, the rotation control pin 10 is received in the locking groove 15 (more strictly the groove portion 15a), as seen in Figs 8 to 10, and thereby said diaphragm operating ring 5 is prevented from being further rotated. For rotational adjustment to the A-position, the unlocking button 17 is depressed so as to retract the rotation control pin 10 out of the locking groove 15a and then the diaphragm operating ring may be rotated to the A-position. Now the rotation control pin 11 is received in the locking groove 15 (more strictly the groove portion 15b) and thereby the diaphragm operating ring is prevented from rotating toward the M-range (as seen in Figs. 11 to 13). Rotation from the A-position to the M-range also can be achieved by a similar operation.

‡ The rotation control pins 10, 11 are spaced from each other in the direction of the optical axis, so that the mount support ring 1 maintains the desired strength even when there is available a considerably small rotation angle for change-over between the M-range and the A-position. Assuming that such rotation angle θ_A for change-over is 5° and the rotation control pins 10, 11 having diameters of 2mm are centrally spaced from each other by 3mm in the direction of the optical axis, while the diaphragm operating ring 5 has its inner diameter of 28mm and the pin guide holes 10c, 11c are 3mm deep, the minimum acceptable dimension $2'$ between

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these guide holes 10c, 11c is obtained by:

$$L' = \sqrt{\left\{ \frac{(28 - 3) \times 2 \times \pi}{360} \times 5 \right\}^2 + 3^2} - 2 = 1.7\text{mm}$$

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This value is sufficient to maintain the desired strength of the mount support ring 1.

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The embodiment as has been described hereinafter adopts formation of the tapered flank 19 on the diaphragm operating ring 5 and, for convenience in machining such tapered flank 19, there is provided the circumferential relief groove 16. However, said circumferential relief groove is not necessary, as seen in Figs. 14 and 15, when the diaphragm operating ring 5 comprises a moulded synthetic resin or a die cast piece.

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The two rotation control pins used for change-over of the diaphragm operating ring between the M-range and the A-position are spaced from each other in the direction of the optical axis. In this way the supporting member for the diaphragm operating ring, i.e., the mount support ring can maintain a necessary strength even when the rotation angle for change-over is relatively small. Furthermore, the distance between these two rotation control pins as measured in the direction of the optical axis can be adjusted for every objective in consideration of factors such as the length of the diaphragm operating ring as measured in the direction of the optical axis and the degree of freedom for design inclusive of dimensioning of the M-range is effectively improved.

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Biasing of the rotation control pins 10, 11 may be achieved also, instead of by the compression coiled springs, by leaf springs 29, 30 fixed at one end by respective pins 27, 28 on the inner peripheral surface of the support ring 1 so that free ends of said leaf springs 29, 30 depress lower end surfaces of the rotation control pins 10, 11 inserted into associated through-holes 25, 26 formed in the support ring 1, as seen in Fig. 16.

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Referring to Figs. 17 to 20, reference numeral 31 designates a mount support ring, and reference numeral 32 designates

a diaphragm operating ring rotatably supported by said mount support ring 31. A mount 33 by which the objective is attached to the camera body is fixed to the mount support ring 31. The diaphragm operating ring 32 is provided in its inner peripheral surface with an interlocking groove 34 into which an interlocking pin 36 fixed on a diaphragm rotating ring 35 is engaged so that said diaphragm rotating ring 35 may be rotated together with said diaphragm operating ring 32. This diaphragm rotating ring 35 is rotatably supported along the inner peripheral surface of the mount support ring 31 and is integrally provided with a diaphragm information transferring lever 38 projecting through a notch 32 formed in the mount 33 toward the camera body. Said diaphragm information transferring lever 38 is adapted to transfer information as to whether said diaphragm information transferring lever 38 occupies the M-range or the A-position of the diaphragm operating ring 32 to the camera body. The diaphragm rotating ring 35 is rotated to activate the diaphragm mechanism of known type and thereby to preset a desired diaphragm value. Such diaphragm mechanism of known art is not shown or described in detail.

The rotation angle of the diaphragm operating ring 32 is restricted by the circumferential length of the interlocking groove 39 formed in the mount support ring 31, into which said interlocking pin 36 is inserted. Namely, both the M-range and the A-position are arranged within an angle θ of the interlocking groove 39. In this embodiment, the M-range is arranged to cover an angle θ_1 and the A-position is arranged to be spaced by an angle θ_2 from one rotational end of said M-range (e.g., the minimum lens aperture position).

The diaphragm operating ring 32 is provided in its inner periphery with an angular extent corresponding to said M-range with a plurality of click-grooves 40 the number of which depends on the number of diaphragm value steps. The mount support ring 31 is formed with a guide hole 42 for a click ball 41 adapted to be received by said click-grooves 40 and a leaf spring 43 is fixed at one end by a screw 44 to the mount support ring 31 so as to bias said click ball 41 toward the click-grooves 40.

Two leaf springs 51M, 51A serving as rotation arresting members are secured at one end by respective screws 53, 54 to the mount support ring 31 in leaf spring receiving grooves 50M, 50A which are formed offset in the direction of the optical axis. The diaphragm operating ring 32 is provided with a locking groove 55 and an unlocking member (button) 56 projecting outwardly from the upper boundary of this locking groove 55.

The rotation arresting members 51M, 51A respectively comprise, as one of them is shown in Fig. 21, leaf springs formed at one end with respective fixing holes 57M, 57A and at their other end with respective arresting surfaces 58M, 58A. These rotation arresting members 51M, 51A are secured to the mount supporting ring 31 in a symmetrical relationship so that said arresting surfaces 58M, 58A cross one another as seen in a front view. The rotation arresting member 51M has its arresting surface 58M bearing against one of side walls (M-locking side wall) 55M circumferentially defining the locking groove 55 of the diaphragm operating ring 32, as shown in Figure 17, to arrest further rotation of said diaphragm operating ring 32 toward the A-position, when the diaphragm operating ring 32 has been rotated to the minimum lens aperture position within the M-range. Accordingly, this arresting member may be referred to as to rotation arresting member 51M for M.

The other rotation arresting member 51A has its arresting surface 58A bearing against the other of the side walls (A-locking side wall) 55A circumferentially defining the locking groove 55 of the diaphragm operating ring 32, as shown in Figure 18, to arrest further rotation of said diaphragm operating ring 32 toward the M-range, when said diaphragm operating ring 32 has been rotated to the A-position. Accordingly, this arresting member may be referred to as the rotation arresting member 51A for A.

Said unlocking member 56 is engageable with the outer surfaces of these two rotation arresting members 51M, 51A and depression of this unlocking member permits said both rotation arresting members to be displaced out of the locking groove 55 under an effect of elastic deformation.

Thus the diaphragm operating ring 32 of the interchangeable objective of Figs. 17 to 24 is controlled in the following manner. Within the M-range, at the first place, both rotation arresting members 51M, 51A for M and A, respectively, are forcibly deflected by the inner surface of the diaphragm operating ring 32 inwardly, as shown in Fig. 22a, unless said diaphragm operating ring 32 is rotated to the minimum lens aperture position. In consequence, these arresting members are never received by the locking groove 55 and the diaphragm operating ring 32 is freely rotatable in the directions of both arrows R and L.

When the diaphragm operating ring 32 has been rotated in the direction as indicated by the arrow L (Figs 22a, b, c) to the minimum lens aperture position, the arresting surface 58M of the rotation arresting member 51M for M bears against the M-locking side wall 55M of the locking groove 55 and thereby to arrest further rotation of the diaphragm operating ring 32 in the direction of the arrow L or towards the A-position, as shown in Fig. 22b, Fig. 23a and Fig. 24a. Now the diaphragm operating ring 32 is freely rotatable toward the maximum lens aperture position (i.e., upon rotation in this direction, the end of the locking groove 55 depresses the arresting member 51M downward).

To rotate the diaphragm operating ring 32 to the A-position, the unlocking member 56 may be depressed to disengage the arresting surface 58M of the rotation arresting member 51M for M from the M-locking side wall 55M, as seen in Figs. 22c and 23b, and from such a state the diaphragm operating ring 32 may be rotated in the direction of the arrow L or towards the A-position. When the diaphragm operating ring 32 has been rotated to the A-position, the arresting surface 58A of the rotation arresting member 51A for A is engaged with the A-locking side wall 55A of the locking groove 55, as seen in Figs. 22e, 23c and 24b, and thereby to arrest further rotation of the diaphragm operating ring 32 in the direction of the arrow R or towards the M-range. The rotation in the direction of the arrow L is arrested by the interlocking pin 36 fixed on the diaphragm rotating ring 35 being engaged with one end 39A of the interlocking groove 39 formed in the support ring 31 (Fig. 18).

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To bring the diaphragm operating ring 32 back to the M-range, the unlocking member 56 may be depressed to displace the rotation arresting member 51A for A inwardly, as shown in Fig. 22f, and thereby to disengage the arresting surface 58A from the A-locking side wall 55A. From this state, the diaphragm operating ring 32 may be rotated toward the M-range. In the embodiment as has been described hereinabove, the two rotation arresting members 51M, 51A are located in the leaf spring grooves 50M, 50A, respectively, and there is provided between both these leaf spring grooves 50M, 50A a land (position control surface) 52 adapted to control the maximum displacement of the unlocking member 56. As a result, smooth operation is ensured without extreme deformation of the rotation arresting members 51M, 51A.

Fig. 25 shows another embodiment of the rotation arresting members 51M, 51A. According to this embodiment, both rotation arresting members 51M, 51A for M and A, respectively, are integrated as a single piece comprising a single leaf spring material and there is provided between both arresting members a common surface for position control 52. The locking groove 55 formed in the diaphragm operating ring 32 comprises, as seen from Fig. 26, a combination of two locking grooves 55(1), 55(2) of triangular cross-sections respectively including M-locking side wall 55M and A-locking side wall 55A. In this embodiment, the rotation arresting members 51M, 51A may be formed from a linear leaf spring material and forward ends of the respective rotation arresting members 51M, 51A may be formed as arresting surfaces 58M, 58A. It should be noted here that the mount support ring 31 is a non-rotatable member adapted for rotatable support of the diaphragm operating ring 32.

It will be understood from the foregoing description of Figures 17 to 26 that change-over of the diaphragm operating ring between the M-range and the A-position is accomplished by using two rotation arresting members comprising leaf springs for M-range and A-position, respectively, and the opposite side walls circumferentially defining the locking groove of the diaphragm operating ring, which may be disengageably engaged with said both rotation arresting members. These both rotation arresting members are offset in the direction of the optical axis. Nevertheless

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they are displaceable by depression of the single unlocking member. Thus, it is possible to reduce the rotation angle for change-over between the M-range and the A-position by suitably arranging the positions of the respective leaf springs serving as rotation
5 arresting members so that the freedom degree of design may be improved and the desired strength may be maintained. Furthermore, the change-over between the M-range and the A-position can be achieved merely by depressing the single unlocking member with a high manoeuvrability.



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CLAIMS

1. An interchangeable objective comprising a mount support ring for attachment to a camera body, a diaphragm, a diaphragm operating ring supported by the mount support ring and having a diaphragm presetting rotation range for manually presetting the diaphragm
5 within the said range and an automatic diaphragm regulation position in which in use the diaphragm position can be automatically regulated from an attached camera body, two rotation control members provided at angular positions corresponding to one end of the diaphragm presetting rotation range and to the
10 automatic diaphragm regulation position respectively, the rotation control members being biased to project radially outwardly, locking groove means on the diaphragm operating ring adapted to receive the rotation control members selectively in dependence upon the rotary position of the ring, and an unlocking member
15 adapted to bear against the rotation control members when received in the locking groove to displace them out of the locking groove against their biasing force, characterised in that the two rotation control members are relatively spaced from each other in the direction of the optical axis, and the unlocking member has a
20 portion of sufficient extent in the said direction to be capable of unlocking a rotation control member in either of the two spaced axial positions.
2. An objective according to claim 1, in which the rotation
25 control members comprise radially extending pins.
3. An objective, according to claim 2, in which the pins are biased by coiled springs.
- 30 4. An objective according to claim 2, in which the pins are biased by leaf springs.
5. An objective according to claim 1, in which the rotation control members comprise leaf springs.

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6. An objective according to claim 5, in which the leaf springs are capable of engaging respective opposed sides of the locking groove.
 - 5 7. An objective according to claim 5 or 6, including a position control surface between the two leaf springs which is adapted to regulate the maximum depression of the unlocking member.
 8. An objective according to claim 7, in which the leaf springs and position control members are formed from a unitary element.
 - 10 9. An interchangeable objective substantially as herein described with reference to and as shown in Figs. 4 to 15 of the drawings.
 10. An interchangeable objective substantially as herein described with reference to and as shown in Figs. 17 to 26 of the drawings.
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