Jan. 30, 1968 F. W. R. STARP 3,366,024

DIAPHRAGM ACTUATING MECHANISM

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Fig. 1

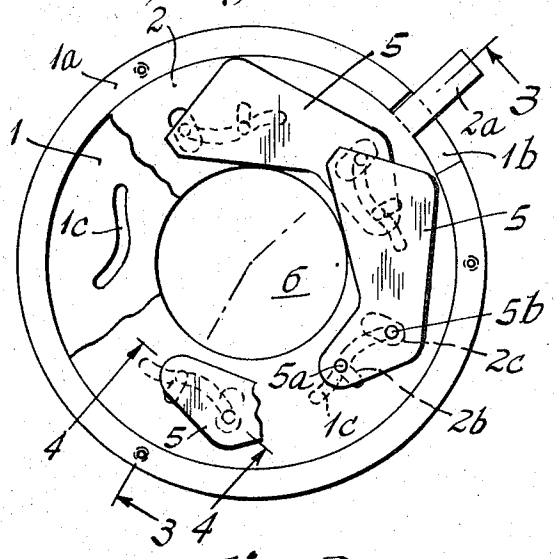


Fig. 2

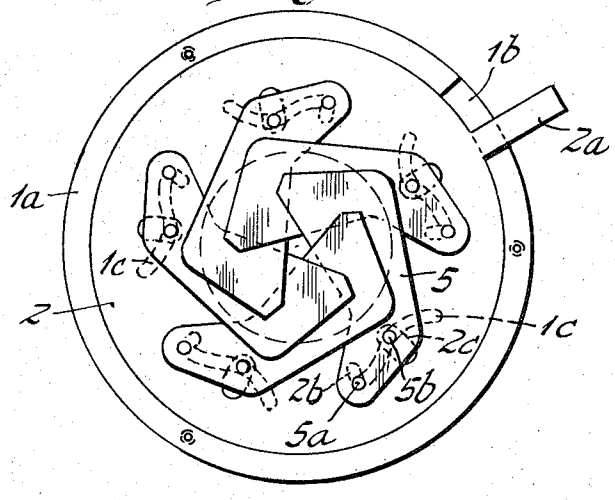
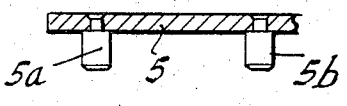


Fig. 3



Fig. 4



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Fig. 5

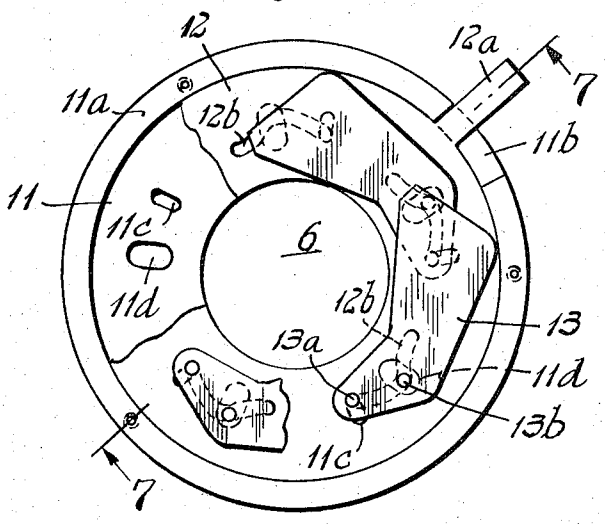


Fig. 6

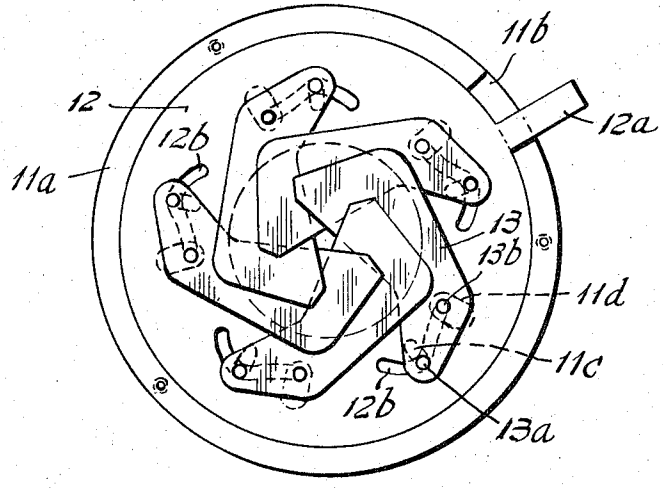
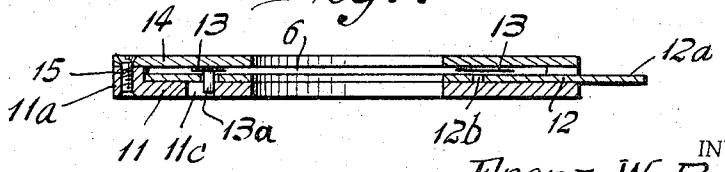


Fig. 7



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DIAPHRAGM ACTUATING MECHANISM

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7 Claims. (Cl. 95—64)

The present invention relates to a lens diaphragm actuating mechanism by means of which a plurality of diaphragm blades, or lamellae, are pivoted about moving points between maximum and minimum diaphragm aperture settings by means of a setting ring which is obliged to move through only a relatively small operating angle, the blades being so arranged that, in spite of being set by a small movement of the setting ring, they operate with a relatively low moment of adjustment.

In diaphragms of the general type of this invention, cams have been provided with different slopes for setting the diaphragm blades. In the positions of these blades corresponding to the largest values of the diaphragm apertures, for example from "2.8" to "4," the blades have to travel a comparatively long distance, and the operating cams therefore have comparatively steep slopes, reaching almost the limit of being self-arresting. As a result the forces required for moving the diaphragm blades must be relatively large.

The present invention solves the problem of permitting relatively large movement of the diaphragm blades with relatively small movement of the control, or setting, member and with relatively small torque on the setting member and on the blades by providing two adjusting pins for each of the blades. These pins extend through guide slots, of which there is at least one, or one section, for each diaphragm blade. In addition the pins extend through more or less radially extending slots. The radially extending slots are in one member and the guide slots are in another member and relative rotational movement of one of these members with respect to the other causes the two pins for each blade to move in such a way as to pivot the blade inwardly or outwardly, depending on the direction of the relative motion of the one member. The blades thus have no fixed pivot axle and the two movable pivot points may be relatively far apart, which tends to reduce the force required to pivot the blades while at the same time the floating pivot point of each of the blades permits full movement of the blades between maximum and minimum aperture settings with only a relatively small motion of one of the setting members with respect to the other.

Considered in greater detail, the invention provides guide slots arranged in a ring which is firmly connected to the diaphragm housing while radial slots are provided in a diaphragm setting ring. The ring in which the guide slots are formed may comprise the bottom of the diaphragm housing.

In another embodiment of the invention, a variant of the foregoing arrangement is set forth in which the radial slots are formed in a ring firmly connected in the diaphragm housing whereas the guide slots are arranged in the ring that is used as the diaphragm setting member. In this case it is advantageous to have the ring in which the radial slots are formed also be the bottom of the diaphragm housing.

In order to provide for freedom of choice of the arrangement of the guide slots, it is possible that these slots may be formed either as a single slot or as two slots for each diaphragm blade.

The invention is described hereinafter with respect to the drawings in which:

FIG. 1 is a plan view of a diaphragm housing with its cover removed and with parts broken away to show a diaphragm setting ring and two diaphragm blades in their open position, the guide slots by which the blades are set being arranged in the bottom of the housing and being in the form of continuous slots;

FIG. 2 shows the housing of FIG. 1 with the cover removed and the diaphragm blades set to the position corresponding to the smallest diaphragm aperture;

FIG. 3 shows a cross-sectional view of the diaphragm housing of FIG. 1 along the line 3—3 of FIG. 1;

FIG. 4 is an enlarged cross-sectional view of a diaphragm blade along the line 4—4 of FIG. 1;

FIG. 5 is another embodiment of the invention corresponding to FIG. 1 but with a modification of the control members;

FIG. 6 shows the apparatus of FIG. 5 with the diaphragm blades set for the smallest aperture; and

FIG. 7 is a cross-sectional view of the housing of FIG. 5 along the line 7—7.

FIGS. 1 to 3 show the bottom **1** of a housing for a lens diaphragm having an edge **1***a* for concentrically guiding a diaphragm setting ring **2**. A cover **3** is attached to the edge **1***a* by means of several machine screws **4**. The diaphragm housing may be built into a shutter housing of a photographic camera in accordance with known forms of construction, although the shutter housing is not shown for reasons of clarity. Several diaphragm blades **5**, each rotatably mounted, are associated with the diaphragm setting ring **2**.

As may be seen in the drawings, the adjusting movements of the diaphragm blades **5** are effected by turning the diaphragm setting ring **2** which has an arm **2***a* provided for this purpose. This arm may be operatively connected to a manually operable diaphragm member, or control, on the camera shutter or to a sensing slide of an automatic exposure system built into the camera. The arm **2***a* extends through an opening **1***b* in the edge **1***a* of the housing bottom **1**. The circumferential dimension of this opening is determined by the movement of the arm necessary for setting the range of diaphragm values, for example, values from "2.8" to "22."

Each of the blades **5** is connected to the diaphragm setting ring **2** and to the housing **1** by a pair of adjusting pins **5***a* and **5***b*, which engage in separate slots, one for each diaphragm blade, **1***c* formed in the bottom of the housing **1**. While the slots shown are in the form of an elongated S, these slots may also be developed as two individual slots. The curvature of each of the slots **1***c* is calculated to transform the rotary motion of the diaphragm setting ring **2** and its arm **2***a* with respect to the motion of the diaphragm blades **5** into a linear relationship. In order to transmit the rotary movement of the adjusting ring **2** to the blades **5**, one of the two adjusting pins **5***a* and **5***b*, and preferably pin **5***a*, fits into a slot **2***b* in the ring. The latter slot extends approximately radially with respect to the center of the diaphragm. The second pin **5***b* of each blade **5** extends through a slot **2***c* which is large enough so that it merely serves as a passage for the pinion and does not interfere with the motion thereof.

In FIG. 1, the blades **5**, of which only two of the five actually included in a preferred embodiment, are shown, and these blades are in positions corresponding to the full diaphragm aperture **6**. When the blades are so positioned, the arm **2***a* engages one end of the opening **1***b* while the adjusting pins **5***a* and **5***b* occupy the positions shown in the guide slots **1***c*. The arm **2***a* may be rotated

to rotate the diaphragm ring either manually or by means of engagement with a sensing slide of an automatic exposure system, as stated hereinabove. This rotation causes the pins **5***a* to move radially outwardly in the slots **2***b* as these pins, together with the pins **5***b* traverse the guide slots **1***c*. The engagement of the pins **5***a* and **5***b* into the individual diaphragm blades **5** causes these blades **5** to pivot inwardly toward the center of the diaphragm aperture **6** until the diaphragm aperture reaches its smallest value as shown in FIG. 2. This figure shows all of the diaphragm blades and thus the contour of the smallest diaphragm aperture can be made out quite clearly. When the diaphragm blades reach the position of smallest aperture, the arm **2***a* reaches the other end of the opening **1***b* within which this arm is constrained.

In the embodiment shown in FIGS. 5 to 7, the arrangement of the slots is reversed from the arrangement in FIGS. 1 to 3. In FIGS. 5 to 7 the bottom of the diaphragm housing is indicated by reference numeral **11** and is provided with an edge **11***a*. A diaphragm setting ring **12**, the motion of which is guided and constrained by the bottom **11** and the edge **11***a*, has an arm **12***a* which extends through an opening **11***b* in the edge. The diaphragm blades, of which there are five in the embodiment of FIGS. 5 to 7, although only two are shown for the sake of clarity, are associated with the diaphragm setting ring **12** to be controlled thereby. Several guide slots **12***b*, one for each of the blades, are arranged in the diaphragm setting ring **12** and, just as in the embodiment of FIGS. 1 to 3, these guide slots may be arranged so that there are two for each of the blades rather than one as shown. The position of each of the blades **13** is controlled by a pair of adjusting pins **13***a* and **13***b* which extend into the guide slots **12***b*. Each adjusting pin **13***a* extends into a substantially radially extending slot **11***c* in the bottom **11** of the diaphragm housing. In addition, another slot **11***d* is formed in the bottom **11** adjacent to each of the blades **13**, and a second adjusting pin **13***b* extends through the slot **11***d*. As in the earlier embodiment, the slot **11***d* is large enough so that it does not obstruct the motion of the adjusting pin **13***b* during the setting of the diaphragm blades **13**. Because of the arrangement of a slot **11***d* for each of the adjusting pins **13***b*, the latter can be made just as long as each of the adjusting pins **13***a*, which prevents the pins **13***b* from being removed from engagement with the guide slot **12***b*. The slots **11***d* may be dispensed with if the dimensions of the adjusting pins **13***b* are shortened accordingly. In the embodiment shown in FIGS. 5 to 7 the guide slot **12***b* is so shaped that the motion of the diaphragm blades **13** is made relatively linear. A cover **14** fixed by means of screws **15** to the edge **11***a* of the bottom **11** is provided for the axial guiding of the diaphragm setting ring **12** and the blades **13**. The function of the diaphragm shown in FIGS. 5 to 7 is similar to that of the arrangement of FIGS. 1 to 4, so that no special explanation is deemed to be necessary.

What is claimed is:

1. Diaphragm control apparatus comprising: a plurality of diaphragm blades; a first ring; a second ring concentric with said first ring, at least one of said rings being rotatable with respect to the other; a guide slot in said first ring; a substantially radial slot in said second ring; a first pin attached to each of said diaphragm blades and extending through both of said slots; and a second pin attached to each of said blades and extending into said guide slot to be engaged thereby.

2. The apparatus of claim **1** comprising a diaphragm housing and in which said first ring is fixedly connected to said housing and said second ring moves with respect to said first ring.

3. The apparatus of claim **2** in which said first ring comprises the bottom of said housing.

4. The apparatus of claim **1** comprising a diaphragm housing and in which said second ring is fixedly connected to said housing.

5. The apparatus of claim **4** in which said second ring comprises the bottom of said housing.

6. Diaphragm control apparatus comprising: a plurality of diaphragm blades; a first ring; a second ring concentric with said first ring, at least one of said rings being rotatable with respect to the other; a separate guide slot in said first ring for each of said blades; a separate radial slot in said second ring for each of said blades; a plurality of first pins, each of said first pins being attached to one of said diaphragm blades and extending through one of said radial slots and one of said guide slots; a plurality of second pins, each of said second pins being attached to one of said diaphragm blades and extending into the same guide slot as the first pin of the same blade, whereby relative rotation of one of said rings with respect to the other of said rings forces both pins of each of said blades to move along the respective one of said slots to pivot said blades.

7. Diaphragm control apparatus comprising: a plurality of diaphragm blades; a first ring; a second ring concentric with said first ring, at least one of said rings being rotatable with respect to the other; a plurality of first and second guide slots in said first ring arranged so that there is one first and one second guide slot for each of said diaphragm blades; a plurality of substantially radial slots in said second ring, the number of said radial slots being equal to the number of said blades; a plurality of first pins, one of said first pins being attached to each of said diaphragm blades and extending through one of said substantially radial slots and one of said first guide slots; a plurality of second pins, one of said second pins being attached to each of said diaphragm blades and extending into one of said second guide slots corresponding to the diaphragm blade to which said second pin is attached, whereby relative motion of one of said rings with respect to the other of said rings causes each of said first pins to traverse a respective one of said first guide slots corresponding to one of said diaphragm blades and each of said second pins to traverse a respective one of said second guide slots corresponding to the diaphragm blade to which said second pin is attached.

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