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(54) PHOTOGRAPHIC CAMERA

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America, of 343 State Street, Rochester, New York 14650, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a photographic camera with a diaphragm shutter automatically controlled in response to illumination.

It is an object of this invention to provide a photographic camera having an improved diaphragm shutter.

According to the present invention, there is provided a photographic camera with a diaphragm shutter automatically controlled in response to illumination and comprising a mechanical escapement mechanism including an escapement disk having a central surface or surfaces which extend into the path of the shutter during its opening movement, and wherein the shutter comprises a projection cooperating with the central surface or surfaces so that the shutter is impeded to varying degrees, the escapement disk being spaced from the projection of the shutter so that the shutter movement is initially unimpeded and only thereafter is influenced by the escapement mechanism.

The invention will be described further, by way of example, with reference to the drawings in which like numerals denote like parts in the different embodiments, and in which:—

Fig. 1 shows the diaphragm shutter mechanism, of a photographic camera in accordance with the present invention, in a cocked state;

Fig. 2 shows the mechanism shown in Fig. 1 during an exposure, with the shutter in its open position;

Fig. 3 shows an embodiment of a camera's

diaphragm shutter mechanism in which pre-selection of the diaphragm aperture can be effected;

Figs. 4 shows a further embodiment of a camera diaphragm shutter mechanism in which the diaphragm aperture can be effected; and

Fig. 5 is a graph of shutter openings i.e. stop values, against exposure time of the diaphragm shutter according to Figs. 1 and 2.

The mechanism will first be described with reference to the embodiment illustrated in Figs. 1 and 2. Shutter slides 1 and 2 are slidably mounted on a support 21 and are guided by means of slots 1g, 2d, 2e and pins 3 and 17. A transmission lever 4 rotatably mounted about a pin 17 is provided with two pins 5, 18 engaging in slots 1f, 2c of the shutter slides 1 and 2. The shutter slides 1 and 2 have openings 1a, 1b, 2a, 2b for forming a lens aperture and a photocell aperture. The shutter slide 1 has a portion 1d which is engaged by a shutter driving spring 15 and co-operates with a switch 20 of an electronic timing device (not shown in detail). The shutter slide 1 is, moreover, provided with a lug 1e adapted for engagement with a closing lever 11. A further bent-over portion 1c of the shutter slide 1 co-operates with a camera release 16, 16a. The bent-over portion 1c also carries a pin 6 which co-operates with an escapement disk.

An escapement disk 7 is mounted for rotation about a pivot 8 and is spring-biased in a counterclockwise direction. It has teeth 7b which engage with a gear wheel 9 of a rotatably mounted inertia wheel 10. The escapement disk 7 is provided with surfaces 7a, 7c, 7d which are arranged at different distances from the pivot point 8 of the escapement disk 7.

The closing lever 11 which is rotatably mounted about the pivot 12 is biased counterclockwise by a spring 19. The shutter driving spring 15 is secured to the closing lever 11, the closing lever being held

by a latch 13 engaging an upstanding portion 11a thereof. The latch 13 is rotatably mounted so as to be under the influence of an electromagnet 14 of the electronic timing device and is biased counterclockwise by a spring 23.

The mechanism functions as follows:

When the shutter, which in Fig. 1 is shown in its cocked state, is actuated by depression of the release 16, the bent-over portion 1c and thus the shutter slides 1 and 2 are released to carry out their functions. The shutter slides 1 and 2 are permanently connected via the transmission lever 4 so that the movements of the shutter slide 1 are transmitted to the shutter slide 2.

Under the influence of the spring 15, the shutter slides move in the directions of the arrows "A" and "B" respectively. Via the portion 1d, the switch 20 of the electronic timing device is closed, and, thereafter, the lens aperture and the photocell aperture (see Fig. 2) are formed. When the shutter slide 1 moves in the direction of the arrow "A", it is initially unimpeded until its pin 6 makes contact with the first surface or step 7a of the escapement disk 7 and impedes the shutter slide. The pin 6, to permit further movement of the shutter slide 1, has to pivot the escapement disk 7 clockwise and drive the inertia wheel 9, 10, whereby the movement of the shutter slide 1 is slowed down. After the escapement disk 7 has been pivoted through a predetermined angle, the pin 6 slides off the surface 7a and the shutter slide 1 can suddenly move further in the direction of the arrow "A" until the pin 6 comes into engagement with the next surface or step of the escapement disk 7 and the shutter slide 1 is again impeded. Further rotation of the escapement disk 7 causes another sudden advance of the pin 6 to the surface or step 7d with the corresponding effect on the shutter slides 1 and 2.

As soon as, during the opening of the shutter slides 1, and 2, the exposure time has been determined in a known manner by an electronic timing device (not shown) as a result of the light passing through the photocell diaphragm aperture, the electromagnet 14 attracts the latch 13. The latch is pivoted clockwise and thus releases the closing lever 11 to move in the direction of the arrow "C". Exposure is terminated by the closing lever 11 engaging with the shutter slide 1 at the lug 1e and moving it contrary to the direction of the arrow "A" until the shutter slides 1 and 2 have closed the lens and photocell diaphragms. At the end of this closing movement, the switch 20 is opened via the portion 1d of the shutter slide 1 and the electronic means is switched off. In the case of small apertures, the arrangement of the shutter driving spring 15 is advantageous in that the driving spring 15

which in such circumstances, is still under high tension additionally accelerates the released closing lever 11, which results in a shorter closing interval. When the closing lever 11 has abutted against the lug 1e, the spring 15 is no longer effective.

The configuration and arrangement of the escapement mechanism permits the shutter slides 1, 2 initially to perform their function unimpeded until the smallest diaphragm aperture has been formed (see diagram in Fig. 5). They are only impeded when the shutter slide pin 6 makes contact with the surface 7a of the escapement disk. Hence high efficiency is attained even when the shutter speeds are very high. The provision on the escapement disk 7 of stepped surfaces leads to the advantage that the impeding action can be suddenly interrupted or started. This offers constructional possibilities such as an adaptation of the shutter speed and aperture setting program to specific requirements, so that, for instance, in the case of an exposure interval of 1/30 sec. (the generally accepted limit for manual exposure), the maximum diaphragm aperture becomes effective and in the case of shorter exposure intervals, certain advantageous combinations of shutter speed and diaphragm aperture can be attained.

Instead of the stepped arrangement of the surfaces of the escapement disc, it can also comprise a curved cam surface 7e (see Fig. 3) the shape of the cam 7e having a similar influence on the action of the shutter slides 1 and 2 as the arrangement just described with reference to Figs. 1 and 2.

The embodiments according to Figs. 3 and 4 comprise additional means permitting not only the above-described automatic shutter speed/diaphragm aperture control but also a diaphragm pre-selection. For this purpose, the mechanism according to Figs. 3 and 4 is provided with a slider 17 slidable in the directions of the arrows "E" and then "D" (and in the opposite directions) and adapted to co-operate via a slot 17a (Fig. 3) or an arm 17b (Fig. 4) with a pin 22 additionally arranged on the escapement disk 7. The slider 17 can be inserted into notches 21b provided on its support arm 21a and marked with diaphragm stop values.

The mechanism according to Fig. 3 functions as follows:

In the drawing, the setting slider 17 is shown in a position where it is opposite to the setting mark "automatic", in which the shutter action is exactly as described in connection with Figs. 1 and 2, however, with the delay characteristics as caused by the cam surface 7e of the escapement disk. If a diaphragm pre-selection is to be made, the slider 17 is moved in the direction of the arrow "E", the slot 17a of the slider 17

receiving the pin 22 of the escapement disk 7. The slider 17 is then moved in the direction of the arrow "D" until it comes to rest at the desired setting mark. When the slider 17 is moved in the direction of the arrow "D", the escapement disk 7 is pivoted clockwise. When the shutter 1, 2 is released, the shutter slide pin 6 travels unimpeded until it contacts that point of the cam surface 7e of the escapement disk which corresponds to the set diaphragm stop value, the exposure interval is electronically determined and the exposure terminated by the release of the closing lever 11.

The operation of the mechanism according to Fig. 4 only differs from the mechanism according to Fig. 3 in the diaphragm pre-selection range in that the slider 17 does not change the position of the pin 22 of the escapement disk 7 when the desired stop value is set. The slider 17 is, however, provided with an abutment arm 17b against which the pin 22 of the escapement disk 7 abuts during the action of the shutter to hold the shutter slides 1, 2 in the pre-selected diaphragm position. In this embodiment, the shutter slides 1, 2 perform their action unimpeded until the shutter slide pin 6 makes contact with the surface 7a whereafter they are subsequently delayed during the co-operation of the pin 6 with the surface 7a and the cam surface 7e until the pin 22 of the escapement disk is caused by the clockwise rotation of the escapement disk 7 to abut against the arm 17b of the slider 17. The determination of the shutter speed as well as the functioning thereof in the "automatic range" corresponds to that described with reference to Figs. 1 to 3.

The mechanism according to Fig. 4 is characterized in that in the case of high scene brightness and of a large pre-set diaphragm, the shutter does not travel up to the pre-set diaphragm aperture but closes earlier in response to illumination. As a result, a proper exposure will be made even in the case of an incorrect diaphragm pre-selection.

In the embodiments according to Figs. 1 to 4, the escapement disk 7 instead of being provided with steps 7a, 7d or a cam surface 7e, may also comprise contiguous inclined surfaces or a combination of steps and/or cams and/or inclined surfaces. Thus constructional means are provided for establishing a shutter speed — diaphragm aperture setting program by simple, inexpensive means and in accordance with actual requirements. Moreover, as a result of the initial unimpeded movement of the shutter, high efficiency is attained even in the case of maximum shutter speeds.

Another advantage of the mechanism is attained by the arrangement of the springs 15 and 19 in that the spring 15 which causes

the opening of the shutter slides 1 and 2, becomes ineffective as described while the closing lever 11 runs down so that the spring 19 driving the closing lever 11 has not to overcome the force of spring 15. This facilitates the harmonizing of the springs 15, 19.

WHAT WE CLAIM IS:—

1. A photographic camera with a diaphragm shutter automatically controlled in response to illumination and comprising a mechanical escapement mechanism including an escapement disk having a central surface or surfaces which extend into the path of the shutter during its opening movement, and wherein the shutter comprises a projection co-operating with the central surface or surfaces so that the shutter is impeded to varying degrees, the escapement disk being spaced from the projection of the shutter so that the shutter movement is initially unimpeded and only thereafter is influenced by the escapement mechanism.

2. A camera according to Claim 1, wherein the control surfaces comprise steps so that the shutter projection is unimpeded between adjacent steps.

3. A camera according to Claim 1 or 2, wherein the shutter comprises two shutter slides which are connected via a stationarily mounted transmission lever, the movements of one of the shutter slides being changed, by the transmission lever, into opposite movements of the other shutter slide.

4. A camera according to Claim 1, 2 or 3, wherein the shutter slide comprising the projection has a portion which is engaged by a driving spring and is provided with a lug co-operating with a stationarily mounted spring-biased closing lever, the shutter driving spring also engaging with the closing lever.

5. A camera according to Claim 4, wherein the closing lever has an upstanding portion which is engaged by a rotatably mounted latch under the influence of an electromagnet and retains the closing lever, under spring-bias, in a cocked condition.

6. A camera according to Claim 4 or Claim 5 as appendant to Claim 4 wherein the said portion of the shutter slide co-operates with a switch of an electronic timing device.

7. A camera according to Claim 3 or any Claim appendent thereto wherein the shutter slides each comprise an opening for the taking raypath and an opening for a photocell, the respective openings of the slides cooperating to form the lens and photocell diaphragm apertures.

8. A camera according to any of Claims 1 to 7, wherein the escapement disk or an inertia means co-operating therewith comprises a pin engageable by a diaphragm pre-selector, the diaphragm pre-selector

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receiving the pin 22 of the escapement disk 7. The slider 17 is then moved in the direction of the arrow "D" until it comes to rest at the desired setting mark. When the slider 17 is moved in the direction of the arrow "D", the escapement disk 7 is pivoted clockwise. When the shutter 1, 2 is released, the shutter slide pin 6 travels unimpeded until it contacts that point of the cam surface 7e of the escapement disk which corresponds to the set diaphragm stop value, the exposure interval is electronically determined and the exposure terminated by the release of the closing lever 11.

The operation of the mechanism according to Fig. 4 only differs from the mechanism according to Fig. 3 in the diaphragm pre-selection range in that the slider 17 does not change the position of the pin 22 of the escapement disk 7 when the desired stop value is set. The slider 17 is, however, provided with an abutment arm 17b against which the pin 22 of the escapement disk 7 abuts during the action of the shutter to hold the shutter slides 1, 2 in the pre-selected diaphragm position. In this embodiment, the shutter slides 1, 2 perform their action unimpeded until the shutter slide pin 6 makes contact with the surface 7a whereafter they are subsequently delayed during the co-operation of the pin 6 with the surface 7a and the cam surface 7e until the pin 22 of the escapement disk is caused by the clockwise rotation of the escapement disk 7 to abut against the arm 17b of the slider 17. The determination of the shutter speed as well as the functioning thereof in the "automatic range" corresponds to that described with reference to Figs. 1 to 3.

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In the embodiments according to Figs. 1 to 4, the escapement disk 7 instead of being provided with steps 7a, 7d or a cam surface 7e, may also comprise contiguous inclined surfaces or a combination of steps and/or cams and/or inclined surfaces. Thus constructional means are provided for establishing a shutter speed — diaphragm aperture setting program by simple, inexpensive means and in accordance with actual requirements. Moreover, as a result of the initial unimpeded movement of the shutter, high efficiency is attained even in the case of maximum shutter speeds.

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2. A camera according to Claim 1, wherein the control surfaces comprise steps so that the shutter projection is unimpeded between adjacent steps.

3. A camera according to Claim 1 or 2, wherein the shutter comprises two shutter slides which are connected via a stationarily mounted transmission lever, the movements of one of the shutter slides being changed, by the transmission lever, into opposite movements of the other shutter slide.

4. A camera according to Claim 1, 2 or 3, wherein the shutter slide comprising the projection has a portion which is engaged by a driving spring and is provided with a lug co-operating with a stationarily mounted spring-biased closing lever, the shutter driving spring also engaging with the closing lever.

5. A camera according to Claim 4, wherein the closing lever has an upstanding portion which is engaged by a rotatably mounted latch under the influence of an electromagnet and retains the closing lever, under spring-bias, in a cocked condition.

6. A camera according to Claim 4 or Claim 5 as appendant to Claim 4 wherein the said portion of the shutter slide co-operates with a switch of an electronic timing device.

7. A camera according to Claim 3 or any Claim appendent thereto wherein the shutter slides each comprise an opening for the taking raypath and an opening for a photocell, the respective openings of the slides cooperating to form the lens and photocell diaphragm apertures.

8. A camera according to any of Claims 1 to 7, wherein the escapement disk or an inertia means co-operating therewith comprises a pin engageable by a diaphragm pre-selector, the diaphragm pre-selector



- being adapted to be moved into the range of movement of the pin and to pivot the pin or limit pivoting movement thereof in accordance with the diaphragm pre-selection so that the escapement disk is retained in or moves to a position determining the pre-selected diaphragm.
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9. A photographic camera substantially as hereinbefore described with reference to and as illustrated in Figs. 1, 2 and 5 or Figs. 1, 2 and 5 as modified by Fig. 3 or Fig. 4 of the accompanying drawings. 10
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