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SHUTTER MECHANISM

The present invention generally relates to shutter mechanisms in photographic cameras usable with chemical flash lamps. More particularly, the present invention relates to an improved shutter mechanism for synchronizing film exposure with the peak intensity of an ignited flash lamp.

Relatively fast shutter speeds may be used in combination with modern high-speed amateur colour film (e.g. ASA 400) to reduce the effects of camera and/or subject motion, thereby resulting in sharper pictures. Some popularly priced amateur cameras take advantage of the extra sharpness that can be achieved with high-speed films by having fast (e.g. 1/200 to 1/500 second) shutter speeds for daylight operation. Unfortunately, the performance of low priced amateur cameras employing chemical flash illumination for indoor operation typically has not similarly benefited from the advent of high-speed films. One popular format for chemical flash employs a flash firing mechanism including a piezoelectric crystal that is struck by a hammer to generate a pulse of electricity which ignites the contents of a chemical flash lamp. Generally, the piezoelectric crystal is struck at the same time that the shutter begins to open, or shortly before, as for example in UK Patent Application Serial No. 2000307 and U.S. Patent No. 4183648. FIG. 1 of the drawings shows a plot of the light intensity produced by a piezoelectrically ignited flash lamp versus time. At time 0, the piezoelectric crystal is struck. As can be seen in FIG. 1, it took

approximately 13 milliseconds from the time that the piezoelectric crystal was struck to the instant when the output of the flash lamp reached its peak intensity. If a relatively fast shutter speed is employed (e.g. 2 to 10 milliseconds; 1/500 to 1/100 second) and the shutter begins to open upon the hammer striking the piezoelectric crystal, the shutter will close before the flash intensity has passed its peak. Much of the flashlight will therefore be wasted. To overcome this problem, many inexpensive cameras are designed to employ a relatively slow shutter speed (e.g. 30 milliseconds) in the flash mode. By using such a slow shutter speed, the shutter is sure to be open when the flash intensity passes its peak. Although this technique makes full use of the flash illumination available, it sacrifices some sharpness potential in the high speed film.

An improvement to using a slow shutter speed in the flash mode is to delay opening of the shutter until shortly before the piezoelectrically ignited flash lamp reaches its peak intensity, then to open the shutter for a relatively short exposure time in synchronization with the peak flash intensity. It has been a problem, however, to design a simple shutter mechanism that could be actuated about the same time as the flash lamp is ignited and, after an initial delay, would produce the desired relatively short exposure time. One such shutter mechanism is shown in U.S. Patent No. 4,349,259, and includes a primary shutter blade having an intermediate opening and a flap-like auxiliary blade fixed on the primary blade adjacent the opening. In operation, the primary blade is actuated in synchronization with piezoelectric

ignition of a flash lamp. A stationary cam folds the auxiliary blade over the opening in the primary blade as the opening passes over an exposure aperture, thereby delaying film exposure with respect to flash ignition. Once clear of the cam, the auxiliary blade straightens by virtue of its own restoring force to uncover the opening. Then, on spring-urged return movement of the primary blade, the opening passes over the exposure aperture to effect film exposure substantially simultaneously with the ignited flash reaching its peak intensity.

While the shutter mechanism in US Patent No. 4349259 delays shutter opening after flash ignition to synchronize film exposure with the peak intensity of an ignited flash, it suffers from a number of problems. For example, in low ambient temperatures (e.g. 20°F) the auxiliary blade will become less flexible and lose some degree of its restoring ability, possibly to the point where it may contact the cam during return movement of the primary blade, thereby stalling the primary blade. Moreover the use of a single blade having an intermediate opening, i.e., the primary blade, for uncovering and recovering the exposure aperture, makes it difficult to accurately vary the exposure time.

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In accordance with the present invention there is provided a shutter mechanism for a photographic camera of the type wherein flash firing means ignites a chemical flash lamp, and opening and closing of a shutter is syn-
5 chronised with intensity of an ignited flash lamp, the mechanism comprising an opening blade and a closing blade for respectively opening and closing said shutter, means for effecting movement of said opening and closing blades, substantially simultaneously with said firing means ignit-
10 ing a flash lamp, in a forward direction without opening said shutter, and return means for first moving said open- ing blade in a reverse direction and then moving said closing blade in said reverse direction to respectively open and close said shutter, whereby initial opening of
15 said shutter is delayed after flash ignition such that the shutter is fully open at the peak intensity of an ignited flash lamp.

The present invention will now be described by way of example with reference to the accompanying drawings
20 in which:

Fig. 1 is a graph showing a plot of light intensity from a piezoelectrically ignited chemical flash lamp versus time and a plot of shutter opening and closing versus time; and

25 FIGS. 2-5 are a series of elevational views of a shutter mechanism according to the present invention, illustrating the operation of shutter opening and closing blades to synchronize film exposure with the peak intensity
30 of a piezoelectrically ignited chemical flash lamp.

Because cameras are well known, this description will be directed in particular to elements forming part of or cooperating directly with apparatus in accordance with the present
35 invention. It is to be understood, however, that

camera elements not specifically shown or described may take various forms known to those skilled in the camera art.

Referring now to the drawings, there is shown synchronization apparatus for flash firing and shutter operation in a still picture camera. In FIG. 2, a piezoelectric firing spring 1 is illustrated in the form of an elongated leaf spring having opposite end portions 3 and 5. Included on end portion 3 of the firing spring 1 is a hammer 7 for striking a piezoelectric generator indicated generally as 9. When struck in this manner, the piezoelectric generator 9 produces an electric pulse for flash firing. The other end portion 5 of the firing spring 1 is fixed by a mounting pin 11 to a camera plate 13. A fulcrum 14 for the firing spring 1 is disposed between its opposite end portions 3 and 5 to serve as a support about which the firing spring 1 is flexed.

Provided within the camera is a firing spring latch 15 which is pivotally movable about a mounting pin 17 fixed to the plate 13. The latch 15 is biased by a spring 19 to pivot in a counterclockwise direction, as viewed in FIG. 2, against a fixed stop 21. When the latch 15 is located against the stop 21, an end portion 23 of the latch 15 is orientated to engage the end portion 3 of the firing spring 1 and, thereby, releasably retain the firing spring 1 in a tensioned, i.e. cocked, position, shown in FIG. 2. When released by the latch 15, the firing spring 1 swings to a firing, i.e. impacting, position, shown in FIG. 3, whereupon the hammer 7 strikes the piezoelectric generator 9 to produce an electric pulse for flash firing.

The piezoelectric generator 9 includes a piezoelectric crystal 25 and a pair of opposed anvil end portions 27 and 29 located at either side of the crystal 25. As shown in FIG. 2, the piezoelectric generator 9 is mounted within the camera on a rib member 31 which may be fixed to the plate 13. A pair of terminals 33 and 35, secured to the crystal 25, are connected to respective electrical leads 37 and 39 which lead to a pair of resilient electrical contacts 41 and 43. The electrical contacts 41 and 43 are located within a flash-receiving socket 45 formed within a top wall 47 of the camera. The socket 45 is configured to receive a stem 48 of a multiple flash unit 49, such as a General Electric "Flip Flash", which contains a number of chemical flash lamps 51 (only one is illustrated). The stem 48, when received in the socket 45, makes an electrical connection with the contacts 41 and 43, thereby electrically coupling the flash unit 49 to the piezoelectric crystal 25.

A shutter, indicated generally as 53, includes an opening blade 55 and a closing blade 57 pivotally movable with respect to each other about a common mounting pin 59 on the camera plate 13 to open and close the shutter 53. The opening blade 55 has a rectangular-shaped opening 61 which is aligned with an exposure aperture 63 in the camera plate 13, and is of sufficient dimensions to uncover the exposure aperture 63, i.e. open the shutter 53, as shown in FIG. 5. The various positions of the opening and closing blades 55 and 57, relative to the exposure aperture 63, as shown in FIGS. 2 - 5, and the condition of the shutter 53 during the respective blade positions, are set forth in the

table below:

FIG. No.	Condition of Shutter 53	Position of Opening	Position of Closing
		Blade 55	Blade 57
5	2	Closed	Uncovering
	3	Closed	Covering
	4	Closed	Covering
	5	Open	Uncovering

By this arrangement, therefore, the shutter 53 is closed to prevent film exposure whenever either one of the blades 55 and 57 is in a covering position, relative to the exposure aperture 63, and is open to effect film exposure when both of the blades 55 and 57 are in respective uncovering positions relative to the exposure aperture.

The operation of the apparatus will now be described:

When the camera is set or cocked for picture-taking, as shown in FIG. 2, and it is desired to initiate a film exposure, a shutter release button 65, adjacent an opening 67 in the top wall 47 of the camera, is manually depressed. This causes a pin member 69, which extends from the shutter release button 65 through the opening 67, to pivot the latch 15 in a clockwise direction about its mounting pin 17, separating the end portion 23 of the latch 15 from the end portion 3 of the firing spring 1. The resulting release of the firing spring 1 allows it to rapidly swing to the firing position, shown in FIG. 3, whereupon the hammer 7 sharply strikes the anvil end portion 27 of the piezoelectric generator 9 to induce a mechanical shock in the piezoelectric crystal 25. The mechanical shock is sufficient to

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cause the crystal 25 to produce an electric pulse, which is transmitted along the electrical leads 37 and 39 to the electrical contacts 41 and 43 in the flash-receiving socket 45. The electric pulse
5 ignites the contents of one of the chemical flash lamps 51 contained in the multiple flash unit 49 in the flash-receiving socket 45.

As shown in FIG. 2, a spring 71 urges the opening blade 55 in a clockwise direction about the
10 mounting pin 59 to normally locate a tab 73 on the opening blade 55 against the anvil end portion 29 of the piezoelectric generator 9. Moreover, a spring 75 similarly urges the closing blade 57 to normally
15 locate a tab 77 on the closing blade against an edge portion 79 of the opening blade 55. Consequently, when the shock wave developed by the mechanical shock to the crystal 25 is transmitted through the anvil end portion 29 to the tab 73 on the opening blade 55, the opening and closing blades 55 and 57
20 are actuated, substantially simultaneously with the piezoelectric ignition of a flash lamp 51, to pivot jointly in a forward direction F, as shown in FIG. 3, without opening the shutter 53. Then the opening blade 55 rebounds off a stop 81 on the
25 camera plate 13 and is pivoted by the spring 71 in a reverse direction R, as shown in FIG. 4, thereby separating from the closing blade 57, which continues to pivot in the forward direction F. Shortly thereafter, the closing blade 57 rebounds
30 off a stop 83 on the camera plate 13 and is pivoted by the spring 75 in the reverse direction R behind the opening blade 55, as shown in FIG. 5. Such movement of the opening and closing blades 55 and 57 in a staggered relation, with the opening blade 55
35 leading the closing blade 57, causes the shutter 53 to

open as the rectangular-shaped opening 61 in the opening blade 55 (uncovered, for the most part, by the closing blade 57) initially passes over the exposure aperture 63. Then, the shutter 53 is caused to
5 close as the closing blade 57 initially moves over the exposure aperture 63. Both the opening and closing blades 55 and 57 come to rest as shown in FIG. 2.

In the preferred embodiment of the present invention, the mass of the opening and closing
10 blades 55 and 57, the impact force of the firing spring 1, the respective locations of the stops 81 and 83, and the return force of the springs 71 and 75 were chosen, as shown in FIG. 1, (a) to initiate opening of the shutter 53 approximately 11
15 milliseconds after the piezoelectric generator 9 produces an electric pulse to ignite a flash lamp 51; (b) to synchronize full opening of the shutter with the peak intensity of the ignited flash lamp at approximately 13 milliseconds; and (c) to close the
20 shutter approximately 2 milliseconds later. Thus, a relative short exposure time is effected and the shutter 53 is fully open at the peak flash intensity to optimally utilize the flashlight.

Known means (not shown) may be included for
25 returning the piezoelectric firing spring 1 to the cocked position, shown in FIG. 2. For example, the firing spring 1 may be returned by a lever movable by engagement with a film advancing mechanism in the camera. As the firing spring 1 is returned to the
30 cocked position, its end portion 3 will contact a cam surface 85 on the end portion 23 of the latch 15. The latch 15 is then pivoted by the end portion 3 of the firing spring 1 in a clockwise direction about the mounting pin 17 to permit re-engagement of
35 the latch end portion 23 with the spring end portion 3.

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Although the drawings show the opening and closing blades 55 and 57 disposed for actuation by a mechanical shock received from the piezoelectric generator 9 when the generator 9 is struck by the hammer 7, it will be appreciated by those having ordinary skill in the art that other embodiments, such as a striker device, for actuating the blades, are possible in accordance with the teachings of the present invention. Moreover, the stop 83 off which the closing blade 57 rebounds may be made adjustable to vary the interval between successive movement of the opening and closing blades 55 and 57 in the reverse direction R, thereby to change the exposure time. One possible way of making the stop 83 adjustable is to seat it for movement in a slot 87, as shown in FIG. 2, between several discrete locations. A manually operated cam, not shown, may be provided to effect such movement of the stop 83.

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CLAIMS

1 A shutter mechanism for a photographic camera of
the type wherein flash firing means ignites a chemical flash
lamp, and opening and closing of a shutter is synchronised
5 with intensity of an ignited flash lamp, the mechanism com-
prising an opening blade and a closing blade for respect-
ively opening and closing said shutter, means for effecting
movement of said opening and closing blades, substantially
simultaneously with said firing means igniting a flash lamp,
10 in a forward direction without opening said shutter, and
return means for first moving said opening blade in a
reverse direction and then moving said closing blade in
said reverse direction to respectively open and close said
shutter, whereby initial opening of said shutter is delayed
15 after flash ignition such that the shutter is fully open at
the peak intensity of an ignited flash lamp.

2 A shutter mechanism according to claim 1, wherein
said opening and closing blades are supported for pivotal
movement about a common axis as said blades move in the
20 forward and reverse directions.

3 A shutter mechanism according to claim 1 or 2
comprising means for coupling said opening and closing
blades for movement jointly in said forward direction to
prevent shutter opening and for uncoupling said blades
25 to permit their independent movement in the reverse direc-
tion for shutter opening and closing.

4 A shutter mechanism according to claim 1, 2 or 3
wherein said opening and closing blades move in said reverse
direction simultaneously in staggered relation with said
30 opening blade leading said closing blade.



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5 A shutter mechanism according to any one of the preceding claims wherein said opening and closing blades are normally arranged in an overlapping relation over an exposure aperture to close said shutter.

5 6 A shutter mechanism according to any one of the preceding claims wherein said opening and closing blades each have respective covering and uncovering positions relative to an or the exposure aperture, said blades being movable in said forward direction to covering and uncover-
10 ing positions respectively, and movable in the reverse direction to uncovering and covering positions respectively.

7 A shutter mechanism according to claim 6, wherein said shutter is open when both of said opening and closing blades are in respective uncovering positions and said shut-
15 ter is closed when at least one of said blades is in a covering position.

8 A shutter mechanism according to any one of the preceding claims wherein said return means includes respect-
20 ive spaced stops off which said opening and closing blades rebound for movement in said reverse direction.

9 A shutter mechanism according to claim 8 as appendant to claim 6 or 7 wherein said opening blade in a covering position rebounds off its respective stop and then said closing blade in an uncovering position rebounds
25 off its respective stop, for successive movement in the reverse direction, said opening and closing blades being separately urged by spring means in the reverse direction to respective uncovering and covering positions.

10 A shutter mechanism according to claim 9 wherein
30 said stop off which said closing blade rebounds is adjustable to vary the interval between successive movement of said opening and closing blades in the reverse direction.

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- 11 A shutter mechanism according to any one of the preceding claims wherein the flash firing means comprises a piezoelectric generator for receiving a mechanical shock to produce an electric pulse for igniting a flash lamp,
- 5 said opening and closing blades being supported so as to be actuatable in said forward direction by said mechanical shock.
- 12 A shutter mechanism according to claim 11 wherein said opening blade in a position uncovering an or
- 10 the exposure aperture is supported in contact with said piezoelectric generator to receive such a mechanical shock.
- 13 A shutter mechanism according to claim 1 substantially as hereinbefore described with reference to the accompanying drawings.
- 15 14 A photographic camera comprising flash firing means for igniting a chemical flash lamp, and a shutter mechanism according to any one of claims 1 to 13.
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