

PATENT SPECIFICATION

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(54) SHUTTER

(71) We, AGFA-GEVEART AKTIENGESELLSCHAFT, a body corporate organised according to the laws of Germany, of Leverkusen, Germany, 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 shutter mechanisms of the kind having shutter opening means which co-operates with a retarding device at least during the shutter opening operation.

The aim underlying the present invention is the provision of a shutter arrangement of the kind specified above, in which the retarding device is of a relatively simple construction and has low friction losses, and wherein the initial acceleration of the shutter opening means in the shutter opening operation is as great as possible.

The invention provides a shutter mechanism which comprises a shutter for an aperture mounted for movement between an aperture-blocking position and an aperture-unblocking position, a drive mechanism comprising a rotatably mounted drive member, the arrangement being such that it is moved with the said shutter, an inertial braking mechanism comprising a rotatably mounted inertial mass, the arrangement being such that it is driven by the said drive mechanism when the said shutter moves from the said blocking to the said unblocking position and that the inertial braking mechanism applies, during such movement to the said drive mechanism, an inertial braking force slowing the movement of the said shutter towards the said unblocking position, the said drive mechanism including a drive cam, the said inertial braking mechanism including a driven cam, the surface of the said drive cam bearing upon the surface of the said driven cam and transmitting to the said driven cam the drive force by means of which the said drive mechanism drives the said inertial braking mechanism, the said cams being so configured that, throughout the driving movement of the drive mechanism, the surface of the said drive cam rolls along the surface of the said driven cam without sliding.

With that arrangement, owing to the rolling movement of the drive cam on the driven cam, an almost frictionless transmission of force from the drive mechanism to the inertial braking mechanism can be achieved, and hence friction losses, which are difficult to assess and alter with wear, can be substantially avoided.

A further advantage offered by the arrangement of the invention is that during the cam rolling movement, the transmission ratio between the drive member and the inertia mass alters.

Preferably, there is provided a spring which is arranged to oppose the rotation of the inertial mass occurring during the shutter opening operation, and, advantageously, there is also provided a further spring which is arranged to urge the drive member to rotate so as to effect opening of the shutter.

Advantageously, the two cam surfaces touch, when the shutter is in the aperture blocking position, at a point which is situated in the region of the axis of rotation of the drive member and which shifts in the direction of the axis of rotation of the inertial mass whilst the drive member cam surface is rolling on the driven cam. The advantage ensuing from this arrangement is that the retarding effect of the inertial braking mechanism is only slight in the initial rotation phase of the drive member, and increases as the drive member pivots further, so that the initial acceleration of the initial mass is very high, due to the favourable transmission ratio. Thus the inertia of the mass is overcome very quickly, and the mass reaches its desired speed within a very short time. Since the point of contact between the two cam surfaces approaches the axis of rotation of the mass during the rolling movement, the effect of the mass in increasingly felt as the opening movement of the shutter opening means continues. Due to the changing ratio of transmission from the drive member to the mass, the mass has only a slight effect at the beginning of the running-down, or opening movement of the shutter.

Preferably, the curvatures of the two said cam surfaces are so selected that the shifting speed of the point of contact between the cam surfaces during its movement from the region of the axis of the drive member to the region of the axis of the mass increases, at least along a first portion of the cam surfaces. With this preferred arrangement, in addition to the changing transmission ratio of the turning moments during the rolling movement of one cam surface on another, the retarding effect of the mass on the drive member can be altered in a desired manner by using suitably shaped cam surfaces, as described above. Thus, within a first pivotal phase of the drive member, the retarding effect of the mass can be kept approximately constant and at a low level, whilst over a further angular range, in a later pivotal phase of the drive member, the retarding effect can be increased by means of appropriate configuration of the curvature of the cam surfaces. These effects prove to be of advantage in achieving a linear movement of the shutter opening means.

The invention also provides a camera which includes a shutter mechanism constructed in accordance with the invention.

Two types of shutter mechanisms constructed in accordance with the invention, will now be described, by way of example, with reference to the accompanying drawings, in which:

Figures 1 and 2 show the first type of mechanism in a starting phase and an end phase, respectively; and

Figure 3 shows part of the second type of mechanism.

With reference to the drawings, and initially to Figure 1, two leaves, 1 and 2, respectively, cover an objective aperture 3. The two leaves 1 and 2 are pivotable about a common axis 4. The leaf 1 has a slot 5 and the leaf 2 has a slot 6. A pin 7 engages both of the slots 5 and 6. The pin 7 is attached to a drive lever, indicated generally by the reference numeral 8, which is pivotable about an axis 9. An extension 10 of the drive lever is provided with a control cam surface 11. There is provided a drive spring 12 which urges the drive member 8 to rotate about the pivot 9 in the direction of the arrow B. A shutter closing member 20 is also provided, and, in the state in which the shutter arrangement is shown in Figure 1, is held to the side of the aperture 3 by means of an electro-magnet 21.

A retarding mass 14, acted on by a further spring 15, is rotatably mounted on an axis 13. The retarding mass 14 is provided with a control cam surface 16. The two control cam surfaces, 11 and 16, face one another and are in contact at a point A.

The operation of this first type of mechanism is as follows:

In the initial state, as shown in Figure 1,

the objective aperture 3 is covered by the two shutter opening leaves 1 and 2, and the point of contact A of the two control cam surfaces 11 and 16 is in the region of the axis of rotation 9 of the drive lever 8. To effect opening of the shutter, the drive lever 8 is liberated (in a known manner not shown) and hence is allowed to run down, in the direction indicated by the arrow B, under the influence of the spring 12. The cam surface 11 of the extension 10 is thereby pressed towards the cam surface 16 of the retarding mass 14, overcoming the force of the spring 15 so as to rotate the retarding mass in a clockwise direction. Due to the fact that the point of contact A between the cam surfaces 11 and 16 is situated in the region of the axis 9, the effect of the retarding mass 14 on the motion of the drive member 8, is at this stage of operation, only slight.

The two cam surfaces 11 and 16 are so constructed that their point of contact A only moves slowly towards the axis of rotation 13 of the retarding mass 14 during rotation of the drive lever 8 in a first angular phase. This guarantees a high initial acceleration, so that the two leaves 2 and 1 quickly attain a desired velocity and thereafter the characteristic of the opening is linear (that is, the speed of opening is constant). Only after the retarding mass 14 has been set in rotation and the leaves 1 and 2 have reached their prescribed angular speed does the configuration of the two cam surfaces 11 and 16 allow their point of contact A to shift more rapidly in the direction of the axis 13. The effect of the retarding mass 14 on the motion of the drive lever 8 is thereby increased accordingly. Figure 2 shows the shutter mechanism when the point of contact A of the cam surfaces 11 and 16 is in the immediate vicinity of the axis 13 of the retarding mass 14, at the end of the opening phase of the leaves 1 and 2.

In the mechanism shown in Figure 3, those parts which are the same as in the mechanism shown in Figures 1 and 2 are provided with the same reference numerals.

In this second type of mechanism, the cam surface 16 controlling the retarding mass 22 is provided on a disc 20, which is pivotable about an axis 21 and which has a toothed portion 23. By way of the toothed portion 23, the disc 20 co-operates with a toothed portion 24 of the retarding mass 22, the retarding mass being pivotable about an axis 25.

WHAT WE CLAIM IS:—

1. A shutter mechanism which comprises a shutter for an aperture mounted for movement between an aperture-blocking position and an aperture-unblocking position, a drive mechanism comprising a rotatably mounted drive member, the arrangement being such that it is moved with the said shut-



Preferably, the curvatures of the two said cam surfaces are so selected that the shifting speed of the point of contact between the cam surfaces during its movement from the region of the axis of the drive member to the region of the axis of the mass increases, at least along a first portion of the cam surfaces. With this preferred arrangement, in addition to the changing transmission ratio of the turning moments during the rolling movement of one cam surface on another, the retarding effect of the mass on the drive member can be altered in a desired manner by using suitably shaped cam surfaces, as described above. Thus, within a first pivotal phase of the drive member, the retarding effect of the mass can be kept approximately constant and at a low level, whilst over a further angular range, in a later pivotal phase of the drive member, the retarding effect can be increased by means of appropriate configuration of the curvature of the cam surfaces. These effects prove to be of advantage in achieving a linear movement of the shutter opening means.

The invention also provides a camera which includes a shutter mechanism constructed in accordance with the invention.

Two types of shutter mechanisms constructed in accordance with the invention, will now be described, by way of example, with reference to the accompanying drawings, in which:

Figures 1 and 2 show the first type of mechanism in a starting phase and an end phase, respectively; and

Figure 3 shows part of the second type of mechanism.

With reference to the drawings, and initially to Figure 1, two leaves, 1 and 2, respectively, cover an objective aperture 3. The two leaves 1 and 2 are pivotable about a common axis 4. The leaf 1 has a slot 5 and the leaf 2 has a slot 6. A pin 7 engages both of the slots 5 and 6. The pin 7 is attached to a drive lever, indicated generally by the reference numeral 8, which is pivotable about an axis 9. An extension 10 of the drive lever is provided with a control cam surface 11. There is provided a drive spring 12 which urges the drive member 8 to rotate about the pivot 9 in the direction of the arrow B. A shutter closing member 20 is also provided, and, in the state in which the shutter arrangement is shown in Figure 1, is held to the side of the aperture 3 by means of an electro-magnet 21.

A retarding mass 14, acted on by a further spring 15, is rotatably mounted on an axis 13. The retarding mass 14 is provided with a control cam surface 16. The two control cam surfaces, 11 and 16, face one another and are in contact at a point A.

The operation of this first type of mechanism is as follows:

In the initial state, as shown in Figure 1,

the objective aperture 3 is covered by the two shutter opening leaves 1 and 2, and the point of contact A of the two control cam surfaces 11 and 16 is in the region of the axis of rotation 9 of the drive lever 8. To effect opening of the shutter, the drive lever 8 is liberated (in a known manner not shown) and hence is allowed to run down, in the direction indicated by the arrow B, under the influence of the spring 12. The cam surface 11 of the extension 10 is thereby pressed towards the cam surface 16 of the retarding mass 14, overcoming the force of the spring 15 so as to rotate the retarding mass in a clockwise direction. Due to the fact that the point of contact A between the cam surfaces 11 and 16 is situated in the region of the axis 9, the effect of the retarding mass 14 on the motion of the drive member 8, is at this stage of operation, only slight.

The two cam surfaces 11 and 16 are so constructed that their point of contact A only moves slowly towards the axis of rotation 13 of the retarding mass 14 during rotation of the drive lever 8 in a first angular phase. This guarantees a high initial acceleration, so that the two leaves 2 and 1 quickly attain a desired velocity and thereafter the characteristic of the opening is linear (that is, the speed of opening is constant). Only after the retarding mass 14 has been set in rotation and the leaves 1 and 2 have reached their prescribed angular speed does the configuration of the two cam surfaces 11 and 16 allow their point of contact A to shift more rapidly in the direction of the axis 13. The effect of the retarding mass 14 on the motion of the drive lever 8 is thereby increased accordingly. Figure 2 shows the shutter mechanism when the point of contact A of the cam surfaces 11 and 16 is in the immediate vicinity of the axis 13 of the retarding mass 14, at the end of the opening phase of the leaves 1 and 2.

In the mechanism shown in Figure 3, those parts which are the same as in the mechanism shown in Figures 1 and 2 are provided with the same reference numerals.

In this second type of mechanism, the cam surface 16¹ controlling the retarding mass 22 is provided on a disc 20, which is pivotable about an axis 21 and which has a toothed portion 23. By way of the toothed portion 23, the disc 20 co-operates with a toothed portion 24 of the retarding mass 22, the retarding mass being pivotable about an axis 25.

WHAT WE CLAIM IS:—

1. A shutter mechanism which comprises a shutter for an aperture mounted for movement between an aperture-blocking position and an aperture-unblocking position, a drive mechanism comprising a rotatably mounted drive member, the arrangement being such that it is moved with the said shut-



3 ter, an inertial braking mechanism comprising
a rotatably mounted inertial mass, the
arrangement being such that it is driven by
the said drive mechanism when the said
5 shutter moves from the said blocking to the
said unblocking position and that the inertial
braking mechanism applies, during such
movement to the said drive mechanism,
an inertial braking force slowing the move-
10 ment of the said shutter towards the said
unblocking position, the said drive mechanism
including a drive cam, the said inertial
braking mechanism including a driven cam,
the surface of the said drive cam bearing upon
15 the surface of the said driven cam and
transmitting to the said driven cam the drive
force by means of which the said drive
mechanism drives the said inertial braking
mechanism, the said cams being so configured
20 that, throughout the driving movement of
the drive mechanism, the surface of the said
drive cam rolls along the surface of the said
driven cam without sliding.
2. A device as claimed in claim 1,
25 wherein there is provided a spring which is
arranged to oppose the rotation of the
inertial mass occurring during the shutter
opening operation.
3. A device as claimed in claim 1 or
30 claim 2, wherein there is provided a further
spring which is arranged to urge the drive
member to rotate so as to effect opening of
the shutter.
4. A device as claimed in any one of
35 claims 1 to 3, wherein the driven cam and
the drive cam contact each other at a point
in the vicinity of the axis of rotation of the
drive member when the shutter is in the

aperture blocking position, the arrangement
being such that the point contact between
the two cam surfaces moves away from the
axis of rotation of the drive member and
towards the axis of rotation of the inertial
mass during the rotation of the drive member
in the shutter opening operation.

5. A device as claimed in claim 4, wherein
the respective curvatures of the driven cam
surface and the drive cam surface are such
that, at least during an initial period of
rotation of the drive member, the velocity
50 at which the point of contact between the
two cam surfaces moves away from the axis
of rotation of the drive member towards the
axis of rotation of the inertial mass, increases.

6. A device as claimed in any one of
claims 1 to 5, wherein the said driven cam
is located on and fixed with respect to the
inertial mass.

7. A device as claimed in any one of
claims 1 to 5, wherein the said driven cam is
60 provided on a rotatably mounted control
member which meshes with a toothed portion
of the inertial mass.

8. A shutter mechanism substantially as
hereinbefore described with reference to, and
as shown in, Figures 1 and 2, or Figure 3, of
the accompanying drawings.

9. A camera when provided with a
shutter mechanism claimed in any one of
claims 1 to 8.

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