

DESCRIPTION

BLADE OPENING AND CLOSING DEVICE AND IMAGING DEVICE

TECHNICAL FIELD

5 [0001]

The present technology relates to a technical field of a blade opening and closing device having an opening and closing blade for opening and closing an opening through which light is transmitted, and an imaging device
10 including the blade opening and closing device.

BACKGROUND ART

[0002]

In various imaging devices such as a video camera
15 and a still camera, an imaging element that photoelectrically converts light captured by an optical system including a lens group, an optical element, and the like is disposed. In such an imaging device, for example, light is controlled by a focal plane shutter
20 functioning as a blade opening and closing device and is incident on an imaging element at the time of imaging a subject.

[0003]

In some blade opening and closing devices, a base
25 body in which an opening is formed, an opening and closing blade that moves (travels) with respect to the base body, and a drive lever that applies a driving force to the opening and closing blade are provided, and an opening and closing operation in which the opening and
30 closing blade opens and closes the opening is performed by a rotation operation of the drive lever (See, for

example, Patent Document 1 and Patent Document 2.).

[0004]

The drive lever is rotated between a first rotation position (initial position) and a second rotation position. In a state where the drive lever is held at the first rotation position, the opening and closing blade is, for example, at an opening position for opening the opening, and in a state where the drive lever is held at the second rotation position, the opening and closing blade is, for example, at a closing position for closing the opening.

[0005]

The blade opening and closing device described in Patent Document 1 is provided with a first drive lever (in Patent Document 1, a first closing lever) and a second drive lever (in Patent Document 1, a second closing lever) that are rotatable, respectively.

[0006]

In the blade opening and closing device described in Patent Document 1, a biasing force is always applied to the second drive lever by a tension coil spring, the second drive lever is rotated against a biasing force of the tension coil spring, and the opening and closing blade is operated from an open position to a closed position.

CITATION LIST

PATENT DOCUMENT

[0007]

Patent Document 1: Japanese Patent Application Laid-Open No. 2002-296641

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0008]

5 Meanwhile, in the blade opening and closing device described in Patent Document 1, it is configured that a biasing force by the tension coil spring is always applied to the second drive lever, and when the opening and closing blade is operated from the open position to
10 the closed position, the second drive lever is rotated by a driving force that overcomes the biasing force by the tension coil spring.

[0009]

 Therefore, when the opening and closing blade is
15 operated from the open position to the closed position, it is necessary to apply a large driving force to the second drive lever, and accordingly, there is a possibility that a size of the drive body that applies the driving force to the second drive lever increases and
20 the power consumption increases. Furthermore, in order to ensure a reliable and stable rotation state from the second rotation position to the first rotation position of the drive lever, it is desirable to increase the biasing force of the tension coil spring.

25 [0010]

 However, in this case, it is necessary to apply a larger driving force to the second drive lever when the opening and closing blade is operated from the open position to the closed position, which further increases
30 the size of the drive body and the power consumption.

[0011]

Therefore, an object of the blade opening and closing device and the imaging device of the present technology is to reduce the size and power consumption of the drive body.

5

SOLUTIONS TO PROBLEMS

[0012]

First, a blade opening and closing device according to the present technology includes: a drive lever
10 rotatable in a first rotation direction from a first rotation position to a second rotation position and a second rotation direction from the second rotation position to the first rotation position; a drive body that applies a driving force to the drive lever as a
15 rotational force in the first rotation direction; a biasing spring that applies a driving force to the drive lever as a rotational force in the second rotation direction by biasing the drive lever; and an opening and closing blade that is operated in a closing direction of
20 closing an opening in accordance with a rotation operation of the drive lever in the first rotation direction, and is operated in an opening direction of opening the opening in accordance with an operation of the drive lever in the second rotation direction, in
25 which the driving force in the first rotation direction is applied from the drive body in a state where the driving force from the biasing spring is not applied to the drive lever, and the driving force in the second rotation direction is applied from the biasing spring in
30 a state where the driving force from the drive body is not applied to the drive lever.

[0013]

Therefore, when the opening and closing blade is operated in the closing direction of closing the opening, the rotation operation in the first rotation direction is performed in a state where the driving force is not applied from the biasing spring to the drive lever, and when the opening and closing blade is operated in the opening direction of opening the opening, the rotation operation in the second rotation direction is performed in a state where the driving force is not applied from the drive body to the drive lever.

[0014]

Second, in the above-described blade opening and closing device, it is desirable that a blade return spring that biases the opening and closing blade in the opening direction and biases the drive lever in the second rotation direction is provided.

[0015]

Therefore, the drive lever is rotated in the second rotation direction by the driving force of both the biasing spring and the blade return spring.

[0016]

Third, in the above-described blade opening and closing device, it is desirable that the drive body is provided with a rotor, the drive lever is made rotatable independently of a rotation operation of the rotor, the drive lever is integrally rotated with the rotor in the first rotation direction by a driving force of the drive body, and the drive lever is rotated in the second rotation direction independently of the rotor by a driving force of the biasing spring.

[0017]

Therefore, the drive lever is rotated in the first rotation direction by the driving force of the drive body, and is rotated in the second rotation direction by
5 the driving force of the biasing spring.

[0018]

Fourth, in the above-described blade opening and closing device, it is desirable that the rotor and a part of the drive lever are positioned to be opposite to each
10 other in a rotation axis direction of the rotor, and the biasing spring is disposed between the opposed rotor and a part of the drive lever.

[0019]

Therefore, the biasing spring is positioned between
15 the rotor and the drive lever in the rotation axis direction of the rotor.

[0020]

Fifth, in the above-described blade opening and closing device, it is desirable that the drive lever is
20 made rotatable in the first rotation direction independently of the rotor when the drive body is not energized.

[0021]

Therefore, when the drive lever is rotated in the
25 first rotation direction due to occurrence of an impact while the rotor is not rotating, the drive lever is rotated in the second rotation direction by a driving force different from a driving force of the rotor and is held at the first rotation position.

30 [0022]

Sixth, in the above-described blade opening and

closing device, it is desirable that a center of gravity of the rotor is located on a rotation axis.

[0023]

Therefore, this makes it difficult for the rotor to
5 rotate when an impact occurs.

[0024]

Seventh, in the above-described blade opening and closing device, it is desirable that a rotation axis of the rotor and a rotation axis of the drive lever are
10 identical.

[0025]

Therefore, the rotation of the rotor and the rotation of the drive lever are performed around the same fulcrum.

15 [0026]

Eighth, in the above-described blade opening and closing device, it is desirable that the rotor is provided with a pressing part, the drive lever is provided with a pressed part pressed by the pressing
20 part, and when the pressed part is pressed by the pressing part, the drive lever is rotated in the first rotation direction by a driving force of the drive body.

[0027]

Therefore, the driving force of the drive body is
25 transmitted from the pressing part to the pressed part, and the drive lever is rotated.

[0028]

Ninth, in the blade opening and closing device described above, it is desirable that a brake lever
30 operable between a deceleration start position and a rotation stop position is provided, and when the brake

lever is operated from the deceleration start position toward the rotation stop position, a rotation speed of the drive lever is reduced at a time of rotation in the first rotation direction.

5 [0029]

Therefore, the rotation speed of the drive lever is reduced by the brake lever at the time of rotation in the first rotation direction.

[0030]

10 Tenth, in the above-described blade opening and closing device, it is desirable that a lever support part is formed on the brake lever, and the drive lever rotated in the first rotation direction is supported by the lever support part.

15 [0031]

Therefore, since the rotation speed of the drive lever is decelerated by the brake lever and the drive lever is supported by the brake lever, it is not necessary to separately provide a member that decelerates
20 the rotation speed of the drive lever and a member that supports the drive lever.

[0032]

Eleventh, in the above-described blade opening and closing device, it is desirable that a brake stopper that
25 presses the brake lever and stops the brake lever at the rotation stop position is provided, and the brake lever is stopped at the rotation stop position by the brake stopper, the drive lever being held at the second rotation position.

30 [0033]

Therefore, the drive lever supported by the lever

support part is held at the second rotation position in a state where the brake lever is stopped at the rotation stop position by the brake stopper.

[0034]

5 Twelfth, in the blade opening and closing device described above, it is desirable that a support base on which the drive lever is rotatably supported is provided, the drive lever is provided with a connecting shaft to which the opening and closing blade is connected, a
10 position holding part that holds the drive lever at the first rotation position is formed in the support base, and the drive lever is held at the first rotation position by pressing the connecting shaft against the position holding part by a biasing force of the blade
15 return spring.

[0035]

Therefore, since the connecting shaft to which the opening and closing blade is connected is pressed against the position holding part, and the drive lever is held at
20 the first rotation position, it is not necessary to separately provide a part that connects the opening and closing blade to the drive lever and a part that holds the opening and closing blade at the first rotation position.

25 [0036]

An imaging device according to the present technology including: a blade opening and closing device that controls light taken in through an optical system; and an imaging element that photoelectrically converts
30 the light taken in through the optical system, in which the blade opening and closing device includes: a drive

lever rotatable in a first rotation direction from a first rotation position to a second rotation position and a second rotation direction from the second rotation position to the first rotation position; a drive body
5 that applies a driving force to the drive lever as a rotational force in the first rotation direction; a biasing spring that applies a driving force to the drive lever as a rotational force in the second rotation direction by biasing the drive lever; and an opening and
10 closing blade that is operated in a closing direction of closing an opening in accordance with a rotation operation of the drive lever in the first rotation direction, and is operated in an opening direction of opening the opening in accordance with an operation of
15 the drive lever in the second rotation direction, the driving force in the first rotation direction is applied from the drive body in a state where the driving force from the biasing spring is not applied to the drive lever, and the driving force in the second rotation
20 direction is applied from the biasing spring in a state where the driving force from the drive body is not applied to the drive lever.

[0037]

Therefore, in the blade opening and closing device,
25 when the opening and closing blade is operated in the closing direction of closing the opening, the rotation operation in the first rotation direction is performed in a state where the driving force is not applied from the biasing spring to the drive lever, and when the opening
30 and closing blade is operated in the closing direction of closing the opening, the rotation operation in the second

rotation direction is performed in a state where the driving force is not applied from the drive body to the drive lever.

[0038]

5 Fourteenth, in the above-described blade opening and closing device, it is preferable that the blade opening and closing device includes a drive block including the drive body and a mechanism block including the opening and closing blade,

10 a size of the drive block is smaller than a size of the mechanism block in a moving direction of the opening and closing blade, the drive block is positioned on an outer peripheral side of the mechanism block, and terminal parts are disposed on an outer peripheral side
15 of the mechanism block on opposite sides of the drive block in the moving direction of the opening and closing blade.

[0039]

 Therefore, the terminal parts are disposed in
20 spaces on the outer peripheral side of the mechanism block.

BRIEF DESCRIPTION OF DRAWINGS

[0040]

25 Fig. 1 illustrates an embodiment of a blade opening and closing device and an imaging device of the present technology together with Figs. 2 to 20, and is a perspective view of the imaging device.

 Fig. 2 is a perspective view illustrating the
30 imaging device as viewed from a direction different from that in Fig. 1.

Fig. 3 is a schematic side view of the imaging device.

Fig. 4 is a perspective view of the blade opening and closing device.

5 Fig. 5 is an exploded perspective view of the blade opening and closing device.

Fig. 6 is an exploded perspective view illustrating a drive mechanism and the like.

Fig. 7 is a front view illustrating a state where
10 an opening and closing blade is held at an open position.

Fig. 8 is a front view illustrating a state where the opening and closing blade is held at a closed position.

Fig. 9 is an exploded perspective view of a rotor,
15 a biasing spring, and a drive lever.

Fig. 10 is a rear view of the rotor, the biasing spring, and the drive lever.

Fig. 11 illustrates an operation of the blade opening and closing device together with Figs. 12 to 16,
20 and is a rear view illustrating an initial state.

Fig. 12 is a rear view illustrating a state immediately after a closing operation of the opening and closing blade is started.

Fig. 13 is a rear view illustrating a state where
25 the closing operation of the opening and closing blade is performed following Fig. 12, a connecting shaft of the drive lever is in contact with a brake lever, and the drive lever is held at a second rotation position.

Fig. 14 is a rear view illustrating a state
30 immediately after an opening operation of the opening and closing blade is started.

Fig. 15 is a rear view illustrating a state where the opening operation of the opening and closing blade is performed following Fig. 14 and the drive lever is separated from the brake lever.

5 Fig. 16 is a rear view illustrating a state where the connecting shaft is pressed against a position holding part and the drive lever is held at a first rotation position.

Fig. 17 illustrates an operation of the blade opening and closing device when an impact and the like occurs at the time of non-energization together with Fig. 18, and is a rear view illustrating a state where the drive lever is rotated toward the second rotation position.

15 Fig. 18 is a rear view illustrating a state where the drive lever rotated toward the second rotation position is rotated to the first rotation position by a biasing force of a biasing spring and the like.

Fig. 19 is a rear view illustrating a positional relationship and the like between a drive block and a mechanism block.

Fig. 20 is a block diagram of the imaging device.

MODE FOR CARRYING OUT THE INVENTION

25 [0041]

Hereinafter, modes for carrying out the present technology will be described with reference to the accompanying drawings.

[0042]

30 In the embodiment described below, the imaging device of the present technology is applied to a still

camera, and the blade opening and closing device of the present technology is applied to a focal plane shutter provided in the still camera.

[0043]

5 Note that the application range of the present technology is not limited to the still camera and the focal plane shutter provided in the still camera, and can be widely applied to, for example, various imaging devices incorporated in a video camera and other devices,
10 and various blade opening and closing devices such as an iris provided in these imaging devices.

[0044]

 In the following description, it is assumed that front, rear, upper, lower, left, and right directions are
15 indicated as directions viewed from the photographer at the time of imaging with the still camera. Therefore, a subject side is the front, and a photographer side is the rear.

[0045]

20 Note that the front, rear, upper, lower, left, and right directions described below are for convenience of description, and the implementation of the present technology is not limited to these directions.

[0046]

25 Furthermore, the lens group described below may include other optical elements such as one or a plurality of lenses and an iris in addition to one configured by the one or the plurality of lenses.

[0047]

30 < Schematic configuration of imaging device >

 First, a schematic configuration of an imaging

device will be described (see Figs. 1 to 3).

[0048]

The imaging device 1 includes, for example,
required units arranged inside and outside a horizontally
5 long flat housing 2 (see Figs. 1 and 2). As illustrated
in Fig. 1, the imaging device 1 may be a device to which
the interchangeable lens 200 can be attached and
detached.

[0049]

10 A flash 3 is provided on a front surface of the
housing 2. A shutter button 4, a zoom switch 5, and a
power button 6 are provided on an upper surface of the
housing 2 (see Figs. 1 and 2). A display 7, various
operation units 8, 8, ..., and a finder 9 are provided on
15 a rear surface of the housing 2.

[0050]

As illustrated in Fig. 3, in the housing 2, an
optical system 10 including a lens group, an optical
element, and the like, a blade opening and closing device
20 (focal plane shutter) 11 that controls an amount of light
taken in by the optical system 10, and an imaging element
12 that photoelectrically converts the light taken in via
the blade opening and closing device 11 are arranged in
order from the front side.

25 [0051]

< Configuration of blade opening and closing device
>

Hereinafter, the configuration of the blade opening
and closing device 11 will be described (see Figs. 4 to
30 10).

[0052]

The blade opening and closing device 11 includes a base body 13, a pressing plate 14, an opening and closing blade 15, links 16, 16, and a drive mechanism 17, and is disposed on the front surface side of the imaging element 12 (see Figs. 4 to 6).

[0053]

The base body 13 is formed in, for example, a horizontally long substantially rectangular shape, and has a rectangular opening 13a penetrating in the front-rear direction (see Figs. 4 and 5). The opening 13a is slightly larger than the effective incident area of light on the imaging surface of the imaging element 12. The effective incident area of light on the imaging surface is an area on which light that is captured by the optical system 10 and is necessary for generating an image is incident.

[0054]

A part of the base body 13 below the opening 13a is provided as a holding part 18 serving as a holding region where the opening and closing blade 15 is held at the open position, and a part of the base body 13 on one side of the opening 13a is provided as an attachment part 19. The imaging element 12 is disposed on the rear side of the base body 13.

[0055]

Pin insertion holes 19a, 19a protruding forward are formed at side ends of the attachment part 19 so as to be vertically separated from each other. A shaft moving hole 19b is formed in the attachment part 19, and the shaft moving hole 19b is formed in a substantially arc shape. The attachment part 19 is provided with a spring

hooking protrusion 19c protruding forward above the pin insertion holes 19a, 19a.

[0056]

The pressing plate 14 is formed in substantially
5 the same size and shape as the base body 13, and has a transmission hole 14a. The pressing plate 14 is attached to the base body 13 from the front side with the opening and closing blade 15 interposed therebetween. In a state where the pressing plate 14 is attached to the base body
10 13, the opening 13a is positioned immediately behind the transmission hole 14a.

[0057]

A clearance hole 14b is formed in the pressing plate 14, and the clearance hole 14b is formed in an arc
15 shape. In a state where the pressing plate 14 is attached to the base body 13, the clearance hole 14b is positioned on the front side of the shaft moving hole 19b.

[0058]

20 The opening and closing blade 15 includes a plurality of sheet-like sectors 15a, 15a, ... (see Fig. 5). In the blade opening and closing device 11 functioning as a focal plane shutter, for example, a so-called electronic front curtain shutter is configured by
25 a combination of an electronic curtain functioning as a front curtain by controlling the imaging element 12 and the opening and closing blade 15 provided as a mechanical structure and functioning as a rear curtain.

[0059]

30 The sectors 15a, 15a, ... are formed in a horizontally long shape, and for example, four sectors

are provided. In the opening and closing blade 15, at least parts of the sectors 15a, 15a, ... overlap each other in the thickness direction. The sectors 15a, 15a, ... are pivotably coupled to both links 16, 16, respectively.

[0060]

The links 16, 16 are formed in a sheet shape and function as parallel links. Support holes 16a, 16a are formed at one end parts of the links 16, 16 in the longitudinal direction, respectively. One link 16 is formed with a long connecting hole 16b at a part near one end in the longitudinal direction. A spring hooking hole 16c is formed in the other link 16.

[0061]

Support pins to be described later are inserted into the support holes 16a, 16a of the links 16, 16, respectively, and the links 16 and 16 are rotated with the support pins as fulcrums. The links 16, 16 are rotated with respect to the base body 13 and the pressing plate 14 while maintaining the parallel state.

[0062]

When the links 16, 16 are rotated, the sectors 15a, 15a, ... are moved (run) in a substantially vertical direction. At this time, the sectors 15a, 15a, ... have different movement amounts, and overlapping areas are changed, and an opening/closing operation is performed between an opening position (see Fig. 7) for opening the opening 13a of the base body 13 and a closing position (see Fig. 8) for closing the opening 13a.

[0063]

A moving direction from the open position to the

closed position of the opening and closing blade 15 is a closing direction, and a moving direction from the closed position to the open position of the opening and closing blade 15 is an opening direction.

5 [0064]

When the opening and closing blade 15 is moved as described above, the overlapping area of the sectors 15a, 15a, ... is changed according to the position to be moved, and the area is the smallest at the open position.

10 [0065]

Therefore, since the arrangement space of the opening and closing blade 15 is reduced at the open position and the area of the opening and closing blade 15 is the largest at the closed position, the blade opening and closing device 11 can be downsized in the moving direction of the opening and closing blade 15, and the opening 13a having a sufficient size can be formed.

[0066]

Note that, between the opening and closing blade 15 and the front surface of the base body 13 and between the opening and closing blade 15 and the rear surface of the pressing plate 14, a sheet (not illustrated) having a light transmission hole positioned corresponding to the opening 13a is disposed, and the operation of the opening and closing blade 15 is smoothed by these sheets.

[0067]

The drive mechanism 17 is configured by arranging necessary units on a support base 20 (see Figs. 5 and 6).

[0068]

30 The support base 20 is formed in a vertically long plate shape facing the front-rear direction. A

substantially arc-shaped shaft operation hole 21 is formed at a position near the lower end of the support base 20. One end edge of the shaft operation hole 21 in the longitudinal direction is formed as a position holding part 21a.

[0069]

Support pins 20a, 20a protruding forward are provided on the support base 20 so as to be vertically separated from each other. A receiving protrusion 20b protruding rearward is provided on an outer peripheral part of the support base 20.

[0070]

The support pins 20a, 20a are respectively inserted into the pin insertion holes 19a, 19a of the base body 13 from the rear, and inserted into the support holes 16a, 16a of the links 16, 16 from the rear. Therefore, the links 16, 16 are rotated with respect to the base body 13 and the pressing plate 14 with the support pins 20a, 20a as fulcrums, respectively.

[0071]

The support base 20 is attached to the attachment part 19 of the base body 13 from the rear. In a state where the support base 20 is attached to the attachment part 19, the shaft operation hole 21 is positioned immediately behind the shaft moving hole 19b.

[0072]

In a state where the support base 20 is attached to the attachment part 19, a blade return spring 22 is supported by one support pin 20a (see Figs. 7 and 8). The blade return spring 22 is, for example, a torsion coil spring, and includes an annular coil part 22a and

arm parts 22b, 22b protruding from the coil part 22a.

[0073]

In the blade return spring 22, the coil part 22a is supported by the support pin 20a, one arm part 22b is
5 supported by the spring hooking protrusion 19c of the base body 13, and the other arm part 22b is inserted into the spring hooking hole 16c of the link 16 and supported. Therefore, an urging force in one rotation direction is applied to the one link 16 by the blade return spring 22,
10 the urging force of the blade return spring 22 is transmitted from the one link 16 to the opening and closing blade 15, and the opening and closing blade 15 is urged in the opening direction by the blade return spring 22.

15 [0074]

A rotor shaft 23 is attached to the support base 20. The rotor shaft 23 protrudes rearward from the support base 20. A brake support part 24 is provided on the rear surface side of the support base 20. A brake
20 stopper 25 protruding rearward is attached to a rear surface of the support base 20. The brake support part 24 and the brake stopper 25 are positioned around the shaft operation hole 21.

[0075]

25 The drive mechanism 17 is provided with a cover plate 26 attached to the support base 20, a drive body 27 partially attached to the cover plate 26, a drive lever 28 rotatable with respect to the support base 20, and a biasing spring 29 biasing the drive lever 28 (see Figs. 4
30 to 6).

[0076]

The cover plate 26 includes a cover surface part 26a facing the front-rear direction and attached protrusions 26b, 26b, ... protruding forward from an outer peripheral part of the cover surface part 26a, and
5 distal end parts of the attached protrusions 26b, 26b, ... are attached to the support base 20 by screwing and the like.

[0077]

A drive body 27 includes a yoke 30, a coil 31, and
10 a rotor 32.

[0078]

The yoke 30 is formed in an annular shape, is attached to the cover surface part 26a of the cover plate 26 from the front, and is located inside the attached
15 protrusions 26b, 26b, The coil 31 is attached in a state of being wound around a part of the yoke.

[0079]

The rotor 32 includes a rotor base 33 including a resin material and a rotor magnet 34 attached to the
20 rotor base 33 (see Figs. 9 and 10). The center of gravity of the rotor 32 is located on or near the rotation axis.

[0080]

The rotor base 33 has an annular base part 35 and a
25 cylindrical part 36 protruding rearward from a central part of the base part 35. The rotor magnet 34 is formed in a cylindrical shape, and is attached to the rotor base 33 in a state where the cylindrical part 36 is inserted in the center part and one end surface in the axial
30 direction is in contact with the base part 35.

[0081]

On the outer peripheral part of the base part 35, a pressed part 37, a pressing part 38, an acting part 39, and a spring support part 40 protruding to the opposite side of the cylindrical part 36 are provided separately
5 in the circumferential direction in order.

[0082]

The drive lever 28 includes an action base 41 formed in a plate shape of a predetermined shape and a connecting shaft 42 protruding forward from one end of
10 the action base 41. The action base 41 has an annular rotation fulcrum part 41a and an arm part 41b protruding from the rotation fulcrum part 41a, and the connecting shaft 42 protrudes from a distal end part of the arm part 41b. The action base 41 is provided with a pressed part
15 41c protruding from a continuous part of the rotation fulcrum part 41a and the arm part 41b, and the pressed part 41c protrudes in a direction different from the protruding direction of the arm part 41b from the rotation fulcrum part 41a.

20 [0083]

The rotor shaft 23 is inserted into the rotation fulcrum part 41a of the drive lever 28, and the drive lever is rotatably supported by the support base 20 with the rotor shaft 23 as a fulcrum.

25 [0084]

In a state where the drive lever 28 is supported by the support base 20, the connecting shaft 42 of the drive lever 28 is inserted into the shaft operation hole 21 of the support base 20 and the shaft moving hole 19b of the
30 base body 13, and is inserted into the clearance hole 14b of the pressing plate 14. The connecting shaft 42 is

inserted into the connecting hole 16b formed in one link 16 between the shaft moving hole 19b and the clearance hole 14b (see Fig. 5). Therefore, when the drive lever 28 is rotated, the connecting shaft 42 is moved, the
5 links 16, 16 are rotated while maintaining the parallel state, and the sectors 15a, 15a, ... are moved in the substantially vertical direction with the rotation of the drive lever 28.

[0085]

10 Furthermore, in the rotor 32, the rotor shaft 23 is inserted into a part extending from the base part 35 to the cylindrical part 36, and the rotor shaft 23 is made rotatable with respect to the support base 20 as a fulcrum (see Fig. 6).

15 [0086]

As described above, the drive lever 28 is rotatable about the rotor shaft 23 as a fulcrum, the rotor 32 is rotatable about the rotor shaft 23 as a fulcrum, and the rotation axis of the rotor 32 and the rotation axis of
20 the drive lever 28 are the same.

[0087]

Therefore, since the rotation of the rotor 32 and the rotation of the drive lever 28 are performed around the same fulcrum, the blade opening and closing device 11
25 can be downsized.

[0088]

The biasing spring 29 is, for example, a torsion coil spring, and includes an annular coil part 29a and arm parts 29b, 29b protruding from the coil part 29a (See
30 Figs. 6, 9, and 10).

[0089]

In the biasing spring 29, the coil part 29a is supported by the rotor shaft 23, one arm part 29b is supported by the spring support part 40 of the rotor base 33 in the rotor 32, and the other arm part 29b is
5 supported by the pressed part 41c of the action base 41 in the drive lever 28. Therefore, a biasing force in a direction in which the pressing part 38 and the pressed part 41c approach each other is applied to the rotor 32 and the drive lever 28 in directions opposite to each
10 other.

[0090]

In the blade opening and closing device 11, the rotor 32 and the rotation fulcrum part 41a of the drive lever 28 are positioned to face each other in the
15 rotation axis direction of the rotor 32, and the biasing spring 29 is positioned between the rotor 32 and the rotation fulcrum part 41a positioned to face each other (see Fig. 10).

[0091]

20 As described above, in the blade opening and closing device 11, the rotor 32 and a part of the drive lever 28 are positioned to face each other in the rotation axis direction of the rotor 32, and the biasing spring 29 is disposed between the rotor 32 positioned to
25 face each other and a part of the drive lever 28.

[0092]

Therefore, since the biasing spring 29 is located between the rotor 32 and the drive lever 28 in the rotation axis direction of the rotor 32, the biasing
30 spring 29 does not protrude outward from the rotor 32 in the radial direction of the rotor 32, and the blade

opening and closing device 11 can be downsized.

[0093]

In the drive body 27 configured as described above, when a current is supplied to the coil 31, the rotor 32
5 is rotated in a direction corresponding to a direction of the current.

[0094]

Furthermore, the drive lever 28 is rotated between a first rotation position that is a rotation end in the
10 direction of the biasing force of the biasing spring 29 and a second rotation position that is a rotation end in a direction against the biasing force of the biasing spring 29. A rotation direction from the first rotation position to the second rotation position of the drive
15 lever 28 is a first rotation direction, and a rotation direction from the second rotation position to the first rotation position of the drive lever 28 is a second rotation direction.

[0095]

20 The drive mechanism 17 is provided with a brake lever 43 (see Fig. 6). The brake lever 43 is formed in a substantially V shape and is rotatable about the brake support part 24 of the support base 20 as a fulcrum. The brake lever 43 is rotated between a deceleration start
25 position where deceleration of the drive lever 28 is started and a rotation stop position where rotation is stopped.

[0096]

The brake lever 43 is provided with a V-shaped bent
30 part as a supported plate part 44, and the supported plate part 44 is supported by the brake support part 24.

In the brake lever 43, a part extending from the supported plate part 44 to one side is provided as a brake arm 45, and a part extending from the supported plate part 44 to the other side is provided as an acting arm 46.

[0097]

A concave part is formed at a side edge of the supported plate part 44, and this concave part is a lever support part 44a. The distal end part of the brake arm 45 is provided with an operated part 45a protruding rearward. The brake arm 45 is provided with a stopper part 45b protruding rearward on the outer peripheral part.

[0098]

The brake lever 43 is supported on the brake support part 24 by a support member 48 via a pressurizing spring 47. Therefore, the brake lever 43 is supported in a state where a constant load is applied to the support base 20 by the pressurizing spring 47, and is rotated with respect to the support base 20 when a rotational force larger than the frictional force with the support base 20 generated by the pressurizing spring 47 is applied.

[0099]

< Operation of blade opening and closing device >

Hereinafter, the operation of the blade opening and closing device 11 will be described (See Figs. 7, 8, and 11 to 16).

[0100]

First, an initial state of each unit in the drive mechanism 17 will be described (see Figs. 7 and 11).

[0101]

In an initial state before the power button 6 of the imaging device 1 is operated, the coil 31 is not energized, no driving force is generated in the drive
5 body 27, and the rotation of the rotor 32 is stopped (see Fig. 11). At this time, the rotor magnet 34 is attracted to the yoke 30 by a magnetic force, the rotor 32 is held at a predetermined rotational position by detent torque, and the pressed part 37 is pressed against the receiving
10 protrusion 20b of the support base 20.

[0102]

In the initial state, the drive lever 28 is biased in the second rotation direction by the biasing force of the biasing spring 29, and the connecting shaft 42 is
15 pressed against the position holding part 21a of the shaft operation hole 21 formed in the support base 20 and held at the first rotation position. At this time, the pressing part 38 of the rotor 32 is brought into contact with or close to the pressed part 41c of the drive lever
20 28. Furthermore, a biasing force of the blade return spring 22 in the second rotation direction is applied to the drive lever 28 via the links 16, 16 and the opening and closing blade 15, and the connecting shaft 42 is pressed against the position holding part 21a of the
25 shaft operation hole 21 by the biasing force of the blade return spring 22 and is held at the first rotation position.

[0103]

Note that, in the blade opening and closing device
30 11, only the blade return spring 22 of the blade return spring 22 and the biasing spring 29 may be provided. In

this case, the drive lever 28 is held at the first rotation position by the connecting shaft 42 being pressed against the position holding part 21a by the biasing force of the blade return spring 22.

5 [0104]

Furthermore, in the blade opening and closing device 11, for example, the spring force of the blade return spring 22 is smaller than the spring force of the biasing spring 29.

10 [0105]

In the initial state, the opening and closing blade 15 is biased in the opening direction by the blade return spring 22, and is held at the open position (see Fig. 7).

[0106]

15 At this time, the imaging element 12 is in a closed state (non-exposure state) in which no light is incident by the electronic curtain (front curtain).

[0107]

In the initial state, the brake lever 43 is held at the deceleration start position, and the brake arm 45 is separated from the connecting shaft 42 of the drive lever 28 (see Fig. 11). At this time, in the brake lever 43, the acting part 39 of the rotor 32 is brought into contact with the operated part 45a, the stopper part 45b is separated from the brake stopper 25, and the acting arm 46 is held at a position not overlapping the shaft operation hole 21.

[0108]

30 In the initial state described above, when the coil 31 is energized, the opening and closing operation of the opening and closing blade 15 is started (see Fig. 12).

At this time, control of the electronic curtain is started prior to the opening and closing operation of the opening and closing blade 15.

[0109]

5 When the coil 31 is energized, the rotation of the rotor 32 to one side is started, and the opening and closing blade 15 is operated in the closing direction from the open position to the closed position. When the operation from the open position toward the closed
10 position of the opening and closing blade 15 is performed, the electronic curtain is controlled according to the operation speed of the opening and closing blade 15 in a state where a slit is formed between the electronic curtain and the opening and closing blade 15,
15 and light is incident on the imaging element 12 through the formed slit to perform exposure.

[0110]

 When the rotation of the rotor 32 to one side is started, the pressed part 41c of the drive lever 28 is
20 pressed by the pressing part 38 of the rotor 32, and the drive lever 28 is rotated in the first rotation direction from the first rotation position to the second rotation position. The drive lever 28 is rotated by being pressed by the pressing part 38 of the rotor 32, and therefore is
25 rotated integrally with the rotor 32. Therefore, when the drive lever 28 is rotated in the first rotation direction, the biasing spring 29 is also rotated with the rotor 32 and the drive lever 28, the biasing force of the biasing spring 29 does not become a load on the rotor 32,
30 and the rotor 32 is rotated toward the second rotation position at high speed by the driving force of the drive

body 27.

[0111]

At this time, the acting part 39 is separated from the operated part 45a of the brake lever 43 as the rotor
5 32 rotates.

[0112]

As described above, in the blade opening and closing device 11, the pressing part 38 is provided in the rotor 32, the pressed part 41c pressed by the
10 pressing part 38 is provided in the drive lever 28, and the pressed part 41c is pressed by the pressing part 38, whereby the drive lever 28 is rotated in the first rotation direction by the driving force of the drive body 27.

15 [0113]

Therefore, since the driving force of the drive body 27 is transmitted from the pressing part 38 to the pressed part 41c and the drive lever 28 is rotated, the drive lever 28 can be reliably rotated with a simple
20 structure.

[0114]

The opening and closing blade 15 is operated at a high speed in the closing direction from the opening position to the closing position along with the rotation
25 of the drive lever 28.

[0115]

Subsequently, the coil 31 is energized, the rotor 32 is subsequently rotated to one side, and the drive lever 28 is further rotated toward the second rotation
30 position, whereby the opening and closing blade 15 is further operated toward the closing position (See Figs.

8, 11, and 13).

[0116]

When the drive lever 28 is further rotated toward the second rotation position, the connecting shaft 42 is brought into contact with the brake arm 45 of the brake lever 43 held at the deceleration start position, and the brake lever 43 is pressed by the connecting shaft 42 and rotated from the deceleration start position toward the rotation stop position against the frictional force with respect to the support base 20 (see Fig. 13). Therefore, the rotational speed of the drive lever 28 is gradually reduced as approaching the second rotation position by the brake lever 43, and the operation speed of the opening and closing blade 15 is also gradually reduced as approaching the closed position.

[0117]

At this time, the connecting shaft 42 of the drive lever 28 is inserted into the lever support part 44a of the brake lever 43, supported by the brake lever 43, and integrally rotated with the brake lever 43 to the second rotation position.

[0118]

The rotation of the brake lever 43 is stopped when the stopper part 45b of the brake arm 45 comes into contact with the brake stopper 25 attached to the support base 20, and is held at the rotation stop position. When the brake lever 43 is held at the rotation stop position, the rotation of the drive lever 28 is also stopped, and the drive lever 28 is held at the second rotation position.

[0119]

At this time, the energization to the coil 31 is stopped, and the rotation of the rotor 32 is stopped.

[0120]

In the state in which the drive lever 28 is held at
5 the second rotation position as described above, the
opening and closing blade 15 operated with the rotation
of the drive lever 28 reaches the closing position, the
operation from the opening position to the closing
position of the opening and closing blade 15 is
10 terminated, and the opening and closing blade 15 is held
at the closing position to close the opening 13a of the
base body 13 (see Fig. 8).

[0121]

As described above, the blade opening and closing
15 device 11 is provided with the brake lever 43 operable
between the deceleration start position and the rotation
stop position, and the brake lever 43 is operated from
the deceleration start position toward the rotation stop
position, so that the rotation speed of the drive lever
20 28 is reduced at the time of rotation in the first
rotation direction.

[0122]

Therefore, since the rotation speed of the drive
lever 28 is reduced by the brake lever 43 at the time of
25 rotation in the first rotation direction, when the drive
lever 28 is rotated by the driving force of the drive
body 27, it is possible to prevent the occurrence of an
impact due to contact with another member of the drive
lever 28, for example, the support base 20 and to stably
30 hold the drive lever 28 at the second rotation position.

[0123]

Furthermore, a lever support part 44a is formed in the brake lever 43, and the drive lever 28 rotated in the first rotation direction is supported by the lever support part 44a.

5 [0124]

Therefore, since the rotational speed of the drive lever 28 is decelerated by the brake lever 43 and the drive lever 28 is supported by the brake lever 43, it is not necessary to separately provide a member for
10 decelerating the rotational speed of the drive lever 28 and a member for supporting the drive lever 28, and it is possible to secure an appropriate operation state of the drive lever 28 while reducing the number of components.

[0125]

15 Moreover, the brake stopper 25 that presses the brake lever 43 to stop the brake lever 43 at the rotation stop position is provided, and the drive lever 28 is held at the second rotation position by the brake lever 43 being stopped at the rotation stop position by the brake
20 stopper 25.

[0126]

Therefore, since the drive lever 28 supported by the lever support part 44a is held at the second rotation position in a state where the brake lever 43 is stopped
25 at the rotation stop position by the brake stopper 25, the drive lever 28 can be held at the second rotation position in a stable state in a state of being supported by the brake lever 43.

[0127]

30 When the operation from the open position to the closed position of the opening and closing blade 15 is

completed, the operation from the closed position to the open position of the opening and closing blade 15 is subsequently started. When the operation from the closed position to the open position of the opening and closing blade 15 is started, the imaging element 12 is brought into a closed state (non-exposure state) in which no light is incident by the electronic curtain.

[0128]

The operation of the opening and closing blade 15 from the closed position to the open position is started by energizing the coil 31 in a direction opposite to the previous direction and rotating the drive lever 28 following the rotation of the rotor 32.

[0129]

When the coil 31 is energized in the opposite direction, the rotation of the rotor 32 to the other side is started (see Fig. 14). When the rotation of the rotor 32 to the other side is started, since the drive lever 28 is held in the second rotation position by the brake lever 43, the rotor 32 is rotated independently of the rotation of the drive lever 28.

[0130]

At this time, since the drive lever 28 is not rotated even if the rotor 32 is rotated, the opening and closing blade 15 is maintained in the closed position.

[0131]

When the rotor 32 is rotated to the other side to a certain position, the operated part 45a of the brake lever 43 is pressed by the acting part 39 with the rotation of the rotor 32 (see Fig. 15). The brake lever 43 is rotated from the rotation stop position toward the

deceleration start position by pressing the operated part 45a by the acting part 39.

[0132]

When the brake lever 43 is rotated from the
5 rotation stop position toward the deceleration start position, the drive lever 28 supported by the brake lever 43 is rotated in the second rotation direction from the second rotation position toward the first rotation position along with the rotation of the brake lever 43,
10 and the connecting shaft 42 is separated from the brake lever 43. Therefore, the drive lever 28 is released from the support state by the brake lever 43.

[0133]

At this time, the opening and closing blade 15 is
15 operated in the opening direction from the closing position to the opening position along with the rotation of the drive lever 28.

[0134]

Since the drive lever 28 is biased in the second
20 rotation direction by the blade return spring 22 and the biasing spring 29, when the support state by the brake lever 43 is released, the biasing force of the blade return spring 22 and the biasing spring 29 is used as a driving force, and the drive lever is rotated toward the
25 first rotation position at a high speed (see Fig. 16).

[0135]

At this time, since the rotor 32 is rotated to the other side prior to the rotation of the drive lever 28, the rotor magnet 34 is held in a state of being attracted
30 to the yoke 30 by the magnetic force and being returned to the initial state by the detent torque, and the

pressed part 37 is brought into a state of being pressed against the receiving protrusion 20b of the support base 20. When the rotor 32 returns to the initial state, the energization of the coil 31 is stopped.

5 [0136]

As described above, in the blade opening and closing device 11, the acting part 39 is provided in the rotor 32, the operated part 45a is provided in the brake lever 43, the brake lever 43 is operated from the
10 rotation stop position toward the deceleration start position by the operated part 45a being pressed by the acting part 39, and the support state of the drive lever 28 by the lever support part 44a is released with the operation of the brake lever 43 from the rotation stop
15 position toward the deceleration start position.

[0137]

Therefore, when the operated part 45a is pressed by the acting part 39 of the rotor 32 and the brake lever 43 is operated from the rotation stop position toward the
20 deceleration start position, the support state of the brake lever 43 with respect to the drive lever 28 is released. Therefore, the support state of the brake lever 43 with respect to the drive lever 28 is released along with the rotational operation of the rotor 32, and
25 it is possible to reliably rotate the drive lever 28 from the second rotation position toward the first rotation position while simplifying the structure without requiring the dedicated drive body 27 that applies the drive force for operating the brake lever 43 from the
30 rotation stop position toward the deceleration start position.

[0138]

Furthermore, when the drive lever 28 is pressed by the operated part 45a, the support state of the drive lever 28 by the lever support part 44a is released.

5 [0139]

Therefore, since the operated part 45a has both the function of operating the brake lever 43 from the rotation stop position toward the deceleration start position by the driving force of the rotor 32 and the
10 function of pressing the drive lever 28 to release the support state of the drive lever 28 by the lever support part 44a, the drive lever 28 can be reliably rotated from the second rotation position toward the first rotation position while simplifying the structure of the brake
15 lever 43.

[0140]

The drive lever 28 rotated in the second rotation direction is stopped when the connecting shaft 42 is pressed against the position holding part 21a of the
20 shaft operation hole 21, and is held at the first rotation position.

[0141]

At this time, the brake lever 43 is held at the deceleration start position, and the acting part 39 of
25 the rotor 32 is brought into contact with the operated part 45a and the stopper part 45b is separated from the brake stopper 25.

[0142]

The connecting shaft 42 of the drive lever 28 is
30 pressed against the position holding part 21a by the biasing force of the blade return spring 22 and the

biasing spring 29 and is held at the first rotation position.

[0143]

As described above, in the blade opening and closing device 11, the support base 20 on which the drive lever 28 is rotatably supported is provided, the connecting shaft 42 to which the opening and closing blade 15 is connected is provided to the drive lever 28, the position holding part 21a that holds the drive lever 28 at the first rotation position is formed in the support base 20, and the drive lever 28 is held at the first rotation position by pressing the connecting shaft 42 against the position holding part 21a.

[0144]

Therefore, since the connecting shaft 42 to which the opening and closing blade 15 is connected is pressed against the position holding part 21a and the drive lever 28 is held at the first rotation position, it is not necessary to separately provide a part for connecting the opening and closing blade to the drive lever 28 and a part for holding the opening and closing blade 15 at the first rotation position, and the drive lever 28 can be reliably held at the first rotation position while simplifying the configuration of the drive lever 28.

[0145]

The opening and closing blade 15 is operated in the opening direction with the rotation of the drive lever 28, and the drive lever 28 is held at the open position by being held at the first rotation position (see Fig. 7).

[0146]

As described above, in the imaging device 1, a so-called electronic front curtain shutter is configured by a combination of an electronic curtain that functions as a front curtain and the opening and closing blade 15 that is provided as a mechanical structure and functions as a rear curtain.

[0147]

Some imaging devices use an electronic shutter that electronically performs both the front curtain and the rear curtain. In this case, the front curtain is performed with clear electric charge, and the rear curtain is performed with continuous reading. However, in the case of an electronic shutter, since the speed is limited by the reading speed of the sensor, there is a possibility of causing a problem called rolling shutter distortion in which an image obtained by photographing a moving subject is distorted. On the other hand, there is an imaging device using a shutter that mechanically performs both the front curtain and the rear curtain. In this case, drive mechanisms of both the drive mechanism of the front curtain and the drive mechanism of the rear curtain are required, and there is a risk of an increase in size of the imaging device and an increase in the number of parts.

[0148]

Therefore, by adopting the configuration of the electronic front curtain shutter by the combination of the electronic curtain and the opening and closing blade 15 as in the imaging device 1, it is possible to suppress the occurrence of rolling shutter distortion while suppressing an increase in size of the imaging device 1

and an increase in the number of components.

[0149]

Note that, although the example in which the opening and closing blade 15 is operated from the open position to the closed position by the driving force of the drive body 27 has been described above, it is also possible to provide a spring mechanism that applies a biasing force from the open position to the closed position to the opening and closing blade 15, and rotate the drive lever 28 in the first rotation direction using the biasing force of the spring mechanism as the driving force to operate the opening and closing blade 15 from the open position to the closed position.

[0150]

< Operation of blade opening and closing device at time of non-energization >

Next, in the imaging device, an operation when an impact occurs at the time of non-energization in which the coil 31 is not energized will be described (see Figs. 17 and 18).

[0151]

There is a case where an impact is generated in the imaging device 1, for example, when the user moves the imaging device 1 in a state where the power is not turned on before the power button 6 is operated, or the imaging device 1 falls down by any chance.

[0152]

In such a case, the rotor 32 is hardly rotated because it is held in the initial state by the detent torque, but the drive lever 28 and the opening and closing blade 15 are rotated in the first rotation

direction from the first rotation position to the second rotation position against the biasing force of the blade return spring 22 and the biasing spring 29 depending on the magnitude of the force applied at the time of impact and the direction of the force (see Fig. 17).

[0153]

At this time, the brake lever 43 is held at the deceleration start position in a state where the acting part 39 of the rotor 32 is in contact with the operated part 45a in the initial state. Therefore, since the rotor 32 is not rotated, the brake lever 43 is not rotated from the deceleration start position to the rotation stop position.

[0154]

The drive lever 28 is made rotatable from the first rotation position toward the second rotation position to a position where the action base 41 is in contact with the operated part 45a of the brake lever 43. At this time, the opening and closing blade 15 is operated in the closing direction toward the closing position along with the rotation of the drive lever 28.

[0155]

When the force due to the impact decreases, the drive lever 28 and the opening and closing blade 15 are rotated in the second rotation direction toward the first rotation position by the biasing force of the blade return spring 22 and the biasing spring 29 (see Fig. 18). At this time, since biasing forces of both the blade return spring 22 and the biasing spring 29 are applied to the drive lever 28 and the opening and closing blade 15, the drive lever 28 is rotated at a high speed toward the

first rotation position, and the opening and closing blade 15 is operated at a high speed toward the open position.

[0156]

5 When the connecting shaft 42 is pressed against the position holding part 21a of the shaft operation hole 21, the rotation of the drive lever 28 rotated in the second rotation direction is stopped and held at the first rotation position, and the opening and closing blade 15
10 operated in the opening direction is held at the opening position.

[0157]

 As described above, in the blade opening and closing device 11, the drive lever 28 is rotatable in the
15 first rotation direction independently of the rotor 32 when the drive body 27 is not energized.

[0158]

 Therefore, when the drive lever 28 is rotated in the first rotation direction due to the generation of the
20 impact at the time of non-rotation of the rotor 32, the drive lever 28 is rotated in the second rotation direction by the driving force different from the driving force of the rotor 32 and is held at the first rotation position. Therefore, the drive body 27 does not need to
25 have a large detent torque for holding the drive lever 28 at the first rotation position, and the drive body 27 can be downsized and power consumption can be reduced.

[0159]

 Furthermore, after the drive lever 28 is rotated in
30 the first rotation direction by the generation of the impact, the drive lever 28 is rotated in the second

rotation direction by the biasing forces of both the blade return spring 22 and the biasing spring 29 and is held at the first rotation position, so that the rotation in the second rotation direction is performed at high speed and by a large driving force.

[0160]

Therefore, it is possible to suppress the occurrence of the bound due to the rebound when the connecting shaft 42 in the drive lever 28 comes into contact with the position holding part 21a, and the time from the rotation of the drive lever 28 in the first rotation direction to the return to the first rotation position is shortened, so that the user can quickly use the imaging device 1 after the impact occurs, and the usability can be improved.

[0161]

Moreover, since the center of gravity of the rotor 32 is located on or near the rotation axis, the rotor 32 is less likely to be rotated when an impact occurs, and rotation of the drive lever 28 in the first rotation direction accompanying rotation of the rotor 32 can be prevented.

[0162]

< Summary >

As described above, in the imaging device 1 and the blade opening and closing device 11, the drive lever 28 is made rotatable independently of the rotating operation of the rotor 32, the drive lever 28 is integrally rotated with the rotor 32 in the first rotation direction by the driving force of the drive body 27, and the drive lever 28 is rotated independently of the rotor 32 in the second

rotation direction by at least the biasing force of the blade return spring 22.

[0163]

Therefore, the rotation of the drive lever 28 in
5 the first rotation direction is performed together with
the rotor 32, the rotation of the drive lever 28 in the
second rotation direction is performed separately from
the rotor 32, and the drive lever 28 is held at least by
the biasing force of the blade return spring 22 at the
10 second rotation position. Therefore, it is not necessary
to rotate the drive lever 28 toward the second rotation
position by generating a driving force of a magnitude
that overcomes the detent torque in the drive body 27,
and it is possible to reduce power consumption and
15 downsize the drive body 27.

[0164]

Furthermore, the biasing spring 29 that is
supported between the rotor 32 and the drive lever 28 and
biases the drive lever 28 in the second rotation
20 direction is provided.

[0165]

Therefore, since the biasing spring 29 that biases
the drive lever 28 in the second rotation direction is
supported between the rotor 32 and the drive lever 28,
25 and the drive lever 28 is integrally rotated with the
rotor 32 in the first rotation direction, the biasing
force of the biasing spring 29 does not become a load on
the driving force of the drive body 27 when the drive
lever 28 rotates in the first rotation direction.
30 Therefore, it is possible to reduce the driving force of
the drive body 27 that rotates the drive lever 28 in the

first rotation direction. Furthermore, since the drive lever 28 is rotated in the second rotation direction by the biasing forces of both the blade return spring 22 and the biasing spring 29, the drive lever 28 can be reliably
5 rotated to the first rotation position at high speed.

[0166]

Moreover, in the imaging device 1 and the blade opening and closing device 11, the driving force in the first rotation direction is applied from the drive body
10 27 in a state where the driving force is not applied from the biasing spring 29 to the drive lever 28, and the driving force in the second rotation direction is applied from the biasing spring 29 in a state where the driving force is not applied from the drive body 27 to the drive
15 lever 28.

[0167]

Therefore, when the opening and closing blade 15 is operated in the closing direction to close the opening 13a, the rotating operation in the first rotation
20 direction is performed in a state where the driving force is not applied from the biasing spring 29 to the drive lever 28, and when the opening and closing blade 15 is operated in the opening direction to open the opening 13a, the rotating operation in the second rotation
25 direction is performed in a state where the driving force is not applied from the drive body 27 to the drive lever 28.

[0168]

Therefore, it is not necessary to apply a large
30 driving force to the drive lever 28 when the opening and closing blade 15 is operated from the open position to

the closed position, and it is possible to reduce the size and power consumption of the drive body 27.

[0169]

Furthermore, since the blade return spring 22 that
5 biases the opening and closing blade 15 in the opening direction and biases the drive lever 28 in the second rotation direction is provided, the drive lever 28 is rotated in the second rotation direction by the driving force of both the biasing spring 29 and the blade return
10 spring 22, so that the drive lever 28 can be rotated at high speed in the second rotation direction to shorten the operation time.

[0170]

Moreover, the drive body 27 having the rotor 32 is
15 provided as a drive body, the drive lever 28 is made rotatable independently of the rotating operation of the rotor 32, the drive lever 28 is integrally rotated with the rotor 32 in a first rotation direction by the driving force of the drive body 27, and the drive lever 28 is
20 rotated independently of the rotor 32 in a second rotation direction by the driving force of the biasing spring 29.

[0171]

Therefore, since the drive lever 28 is rotated in
25 the first rotation direction by the driving force of the drive body 27 and is turned in the second rotation direction by the driving force of the biasing spring 29, the drive lever 28 can be reliably and smoothly rotated in the first rotation direction and the second rotation
30 direction with a simple structure.

[0172]

< Others >

The blade opening and closing device 11 mainly includes a drive block 50 including the drive lever 28, the yoke 30, the coil 31, the rotor 32, and the brake lever 43, and a mechanism block 60 mainly including the base body 13, the pressing plate 14, and the opening and closing blade 15 (see Fig. 19).

[0173]

As described above, the drive block 50 mainly includes the drive lever 28, the yoke 30, the coil 31, the rotor 32, and the brake lever 43, has a simple structure, and is downsized.

[0174]

As described above, in the imaging device 1, since the size of the drive block 50 is reduced, the width of the drive block 50 is smaller than that of the mechanism block 60 in the moving direction (vertical direction) of the opening and closing blade 15. Therefore, in a state where the drive block 50 is disposed on the side of the mechanism block 60, it is possible to form arrangement spaces on both sides of the drive block 50 in the movement direction of the opening and closing blade 15 inside the housing 2.

[0175]

Therefore, in the imaging device 1, terminal parts 70, 70 are arranged on both sides of the drive block 50 in the moving direction of the opening and closing blade 15. The terminal part 70 is, for example, a terminal for a headphone, a terminal for a microphone, or a terminal for connection with an external device such as a high-definition multimedia interface (HDMI: registered

trademark) or a universal serial bus (USB).

[0176]

As described above, in the imaging device 1, a size of the drive block 50 is made smaller than a size of the mechanism block 60 in the moving direction of the opening and closing blade 15, the drive block 50 is located on the outer peripheral side of the mechanism block 60, and the terminal parts 70, 70 are arranged on the outer peripheral side of the mechanism block 60 on the opposite side with the drive block 50 interposed therebetween in the moving direction of the opening and closing blade 15.

[0177]

Therefore, since the terminal parts 70, 70 are arranged in the space on the outer peripheral side of the mechanism block 60, it is possible to miniaturize the imaging device 1 by effectively using the arrangement space.

[0178]

< One embodiment of imaging device >

Hereinafter, a configuration example of an embodiment of the imaging device according to the present technology will be described (see Fig. 20).

[0179]

The imaging device 1 includes a camera block 90 having an imaging function, a camera signal processing unit 91 that performs signal processing such as analog-digital conversion of a captured image signal, and an image processing unit 92 that performs recording/reproducing processing of the image signal. Furthermore, the imaging device 1 includes a display unit 93 (display 7) that displays a captured image and the

like, a reader/writer (R/W) 94 that writes and reads an image signal to and from the memory 100, a central processing unit (CPU) 95 that controls the entire imaging device 1, a lens drive control unit 96 that controls driving of a lens arranged in the camera block 90, and an operation unit 97 (a shutter button 4, a zoom switch 5, a power button 6, an operation unit 8, and the like) such as various switches on which a required operation is performed by a user.

10 [0180]

The camera block 90 may be provided as an interchangeable lens 200.

[0181]

The imaging device 1 is provided with an imaging element 12 such as a charge coupled device (CCD) or a complementary metal-oxide semiconductor (CMOS) that converts an optical image captured by the camera block 90 into an electrical signal.

[0182]

20 The camera signal processing unit 91 performs various types of signal processing such as conversion into a digital signal, noise removal, image quality correction, and conversion into a luminance/chrominance signal on the output signal from the imaging element 12.

25 [0183]

The image processing unit 92 performs compression encoding/expansion decoding processing of an image signal based on a predetermined image data format, conversion processing of a data specification such as resolution, and the like.

30

[0184]

The display unit 93 has a function of displaying various data such as an operation state of the user on the operation unit 97 and a captured image. Note that the imaging device 1 may not be provided with the display unit 93, and may be configured such that captured image data is sent to another display device and an image is displayed.

[0185]

The R/W 94 writes image data encoded by the image processing unit 92 into the memory 100 and reads image data recorded in the memory 100.

[0186]

The CPU 95 functions as a control processing unit that controls each circuit block provided in the imaging device 1, and controls each circuit block on the basis of an instruction input signal and the like from the operation unit 97.

[0187]

The lens drive control unit 96 controls a lens drive unit that moves the lens on the basis of a control signal from the CPU 95.

[0188]

The operation unit 97 outputs an instruction input signal corresponding to an operation by the user to the CPU 95.

[0189]

The memory 100 is, for example, a semiconductor memory attachable to and detachable from a slot connected to the R/W 94 or a semiconductor memory incorporated in the imaging device 1 in advance.

[0190]

Hereinafter, an operation in the imaging device 1 will be described.

[0191]

In the shooting standby state, under the control of the CPU 95, a shot image signal is output to the display unit 93 via the camera signal processing unit 91 and displayed as a camera-through image. Furthermore, when an instruction input signal is input from the operation unit 97, the CPU 95 outputs a control signal to the lens drive control unit 96, and the lens is moved under the control of the lens drive control unit 96.

[0192]

When a capturing operation is performed according to an instruction input signal from the operation unit 97, a captured image signal is output from the camera signal processing unit 91 to the image processing unit 92, subjected to compression encoding processing, and converted into digital data in a predetermined data format. The converted data is output to the R/W 94 and written to the memory 100.

[0193]

In a case where the image data recorded in the memory 100 is reproduced, predetermined image data is read from the memory 100 by the R/W 94 according to the operation on the operation unit 97, and after the image processing unit 92 performs the decompression decoding processing, the reproduced image signal is output to the display unit 93 and the reproduced image is displayed.

[0194]

Note that, in the present technology, "imaging" refers to a process including only a part or all of a

series of processes from a photoelectric conversion process of converting light captured by the imaging element 12 into an electrical signal to a process of converting an output signal from the imaging element 12
5 into a digital signal, noise removal, image quality correction, conversion into a luminance/chrominance signal, and the like by the camera signal processing unit 91, a compression encoding/decompression decoding process of an image signal based on a predetermined image data
10 format by the image processing unit 92, a conversion process of a data specification such as resolution, and a writing process of an image signal into the memory 100 by the R/W 94.

[0195]

15 That is, "imaging" may refer to only photoelectric conversion processing of converting light captured by the imaging element 12 into an electrical signal, or may refer to processing from photoelectric conversion processing of converting light captured by the imaging
20 element 12 into an electrical signal to processing such as conversion into a digital signal, noise removal, image quality correction, and conversion into a luminance/chrominance signal with respect to an output signal from the imaging element 12 by the camera signal
25 processing unit 91, or may refer to processing from photoelectric conversion processing of converting light captured by the imaging element 12 into an electrical signal to processing such as conversion into a digital signal with respect to an output signal from the imaging
30 element 12 by the camera signal processing unit 91, noise removal, image quality correction, and conversion into a

luminance/chrominance signal, and then refer to compression encoding/decompression decoding processing of an image signal based on a predetermined image data format and conversion processing of a data specification such as resolution by the image processing unit 92, The processing may refer to from photoelectric conversion processing of converting light captured by the imaging element 12 into an electrical signal to processing such as conversion of an output signal from the imaging element 12 into a digital signal, noise removal, image quality correction, and conversion into a luminance/chrominance signal by the camera signal processing unit 91, compression encoding/expansion decoding processing of an image signal based on a predetermined image data format by the image processing unit 92, and conversion processing of a data specification such as a resolution, and may refer to processing up to writing of an image signal into the memory 100 by the R/W 94. In the above processing, the order of each processing may be appropriately changed.

[0196]

Furthermore, in the present technology, the camera block 90 and the imaging device 1 may include only a part or all of the imaging element 12, the camera signal processing unit 91, the image processing unit 92, and the R/W 94 that perform the above-described processing.

[0197]

Furthermore, the camera block 90 may include a part of the imaging element 12, the camera signal processing unit 91, the image processing unit 92, and the R/W 94.

< Present technology >

The present technology can also be configured as follows.

[0198]

(1)

5 A blade opening and closing device including:
a drive lever rotatable in a first rotation
direction from a first rotation position to a second
rotation position and a second rotation direction from
the second rotation position to the first rotation
10 position;

a drive body that applies a driving force to the
drive lever as a rotational force in the first rotation
direction;

a biasing spring that applies a driving force to
15 the drive lever as a rotational force in the second
rotation direction by biasing the drive lever; and

an opening and closing blade that is operated in a
closing direction of closing an opening in accordance
with a rotation operation of the drive lever in the first
20 rotation direction, and is operated in an opening
direction of opening the opening in accordance with an
operation of the drive lever in the second rotation
direction,

in which the driving force in the first rotation
25 direction is applied from the drive body in a state where
the driving force from the biasing spring is not applied
to the drive lever, and

the driving force in the second rotation direction
is applied from the biasing spring in a state where the
30 driving force from the drive body is not applied to the
drive lever.

[0199]

(2)

The blade opening and closing device according to (1) described above, further including

5 a blade return spring that biases the opening and closing blade in the opening direction and biases the drive lever in the second rotation direction.

[0200]

(3)

10 The blade opening and closing device according to (1) or (2) described above, in which

the drive body is provided with a rotor,

the drive lever is made rotatable independently of a rotation operation of the rotor,

15 the drive lever is integrally rotated with the rotor in the first rotation direction by a driving force of the drive body, and

the drive lever is rotated in the second rotation direction independently of the rotor by a driving force of the biasing spring.

20

[0201]

(4)

The blade opening and closing device according to (3) described above, in which

25 the rotor and a part of the drive lever are positioned to be opposite to each other in a rotation axis direction of the rotor, and

the biasing spring is disposed between the opposed rotor and a part of the drive lever.

30

[0202]

(5)

The blade opening and closing device according to (3) or (4) described above, in which

the drive lever is made rotatable in the first rotation direction independently of the rotor when the drive body is not energized.

[0203]

(6)

The blade opening and closing device according to any one of (3) to (5) described above, in which

a center of gravity of the rotor is located on a rotation axis.

[0204]

(7)

The blade opening and closing device according to any one of (3) to (6) described above, in which

a rotation axis of the rotor and a rotation axis of the drive lever are identical.

[0205]

(8)

The blade opening and closing device according to any one of (3) to (7) described above, in which

the rotor is provided with a pressing part,
the drive lever is provided with a pressed part pressed by the pressing part, and

when the pressed part is pressed by the pressing part, the drive lever is rotated in the first rotation direction by a driving force of the drive body.

[0206]

(9)

The blade opening and closing device according to any one of (1) to (8) described above, further including

a brake lever operable between a deceleration start position and a rotation stop position,

in which when the brake lever is operated from the deceleration start position toward the rotation stop position, a rotation speed of the drive lever is reduced at a time of rotation in the first rotation direction.

[0207]

(10)

The blade opening and closing device according to (9) described above, further including

a lever support part formed on the brake lever, in which the drive lever rotated in the first rotation direction is supported by the lever support part.

[0208]

(11)

The blade opening and closing device according to (10) described above, further including

a brake stopper that presses the brake lever and stops the brake lever at the rotation stop position, in which the brake lever is stopped at the rotation stop position by the brake stopper, the drive lever being held at the second rotation position.

[0209]

(12)

The blade opening and closing device according to (2) described above, in which

a support base on which the drive lever is rotatably supported is provided,

the drive lever is provided with a connecting shaft to which the opening and closing blade is connected,

a position holding part that holds the drive lever at the first rotation position is formed in the support base, and

the drive lever is held at the first rotation position by pressing the connecting shaft against the position holding part by a biasing force of the blade return spring.

[0210]

(13)

10 An imaging device including:

a blade opening and closing device that controls light taken in through an optical system; and an imaging element that photoelectrically converts the light taken in through the optical system,

15 in which the blade opening and closing device includes:

a drive lever rotatable in a first rotation direction from a first rotation position to a second rotation position and a second rotation direction from the second rotation position to the first rotation position;

a drive body that applies a driving force to the drive lever as a rotational force in the first rotation direction;

25 a biasing spring that applies a driving force to the drive lever as a rotational force in the second rotation direction by biasing the drive lever; and

an opening and closing blade that is operated in a closing direction of closing an opening in accordance with a rotation operation of the drive lever in the first rotation direction, and is operated in an opening

direction of opening the opening in accordance with an operation of the drive lever in the second rotation direction,

the driving force in the first rotation direction
5 is applied from the drive body in a state where the driving force from the biasing spring is not applied to the drive lever, and

the driving force in the second rotation direction is applied from the biasing spring in a state where the
10 driving force from the drive body is not applied to the drive lever.

[0211]

(14)

The imaging device according to (13) described
15 above, in which

the blade opening and closing device includes a drive block including the drive body and a mechanism block including the opening and closing blade,

a size of the drive block is smaller than a size of
20 the mechanism block in a moving direction of the opening and closing blade,

the drive block is positioned on an outer peripheral side of the mechanism block, and

terminal parts are disposed on an outer peripheral
25 side of the mechanism block on opposite sides of the drive block in the moving direction of the opening and closing blade.

REFERENCE SIGNS LIST

30 [0212]

1 Imaging device

	11	Blade opening and closing device
	12	Imaging element
	13a	Opening
	15	Opening and closing blade
5	20	Support base
	21a	Position holding part
	22	Blade return spring
	25	Brake stopper
	27	Drive body
10	28	Drive lever
	29	Biasing spring
	32	Rotor
	38	Pressing part
	39	Acting part
15	41c	Pressed part
	42	Connecting shaft
	43	Brake lever
	44a	Lever support part
	45a	Operated part
20	50	Drive block
	60	Mechanism block
	70	Terminal part

CLAIMS

1. A blade opening and closing device comprising:
a drive lever rotatable in a first rotation
5 direction from a first rotation position to a second
rotation position and a second rotation direction from
the second rotation position to the first rotation
position;
a drive body that applies a driving force to the
10 drive lever as a rotational force in the first rotation
direction;
a biasing spring that applies a driving force to
the drive lever as a rotational force in the second
rotation direction by biasing the drive lever; and
15 an opening and closing blade that is operated in a
closing direction of closing an opening in accordance
with a rotation operation of the drive lever in the first
rotation direction, and is operated in an opening
direction of opening the opening in accordance with an
20 operation of the drive lever in the second rotation
direction,
wherein the driving force in the first rotation
direction is applied from the drive body in a state where
the driving force from the biasing spring is not applied
25 to the drive lever, and
the driving force in the second rotation direction
is applied from the biasing spring in a state where the
driving force from the drive body is not applied to the
drive lever.
30
2. The blade opening and closing device according to

claim 1, further comprising

a blade return spring that biases the opening and closing blade in the opening direction and biases the drive lever in the second rotation direction.

5

3. The blade opening and closing device according to claim 1, wherein

the drive body is provided with a rotor,

the drive lever is made rotatable independently of
10 a rotation operation of the rotor,

the drive lever is integrally rotated with the rotor in the first rotation direction by a driving force of the drive body, and

the drive lever is rotated in the second rotation
15 direction independently of the rotor by a driving force of the biasing spring.

4. The blade opening and closing device according to claim 3, wherein

20 the rotor and a part of the drive lever are positioned to be opposite to each other in a rotation axis direction of the rotor, and

the biasing spring is disposed between the opposed rotor and a part of the drive lever.

25

5. The blade opening and closing device according to claim 3, wherein

the drive lever is made rotatable in the first rotation direction independently of the rotor when the
30 drive body is not energized.

6. The blade opening and closing device according to claim 3, wherein

a center of gravity of the rotor is located on a rotation axis.

5

7. The blade opening and closing device according to claim 3, wherein

a rotation axis of the rotor and a rotation axis of the drive lever are identical.

10

8. The blade opening and closing device according to claim 3, wherein

the rotor is provided with a pressing part,

the drive lever is provided with a pressed part

15 pressed by the pressing part, and

when the pressed part is pressed by the pressing part, the drive lever is rotated in the first rotation direction by a driving force of the drive body.

20 9. The blade opening and closing device according to claim 1, further comprising

a brake lever operable between a deceleration start position and a rotation stop position,

25 wherein when the brake lever is operated from the deceleration start position toward the rotation stop position, a rotation speed of the drive lever is reduced at a time of rotation in the first rotation direction.

10. The blade opening and closing device according to claim 9, further comprising

30 a lever support part formed on the brake lever,

wherein the drive lever rotated in the first rotation direction is supported by the lever support part.

5 11. The blade opening and closing device according to claim 10, further comprising

a brake stopper that presses the brake lever and stops the brake lever at the rotation stop position,

10 wherein the brake lever is stopped at the rotation stop position by the brake stopper, the drive lever being held at the second rotation position.

12. The blade opening and closing device according to claim 2, wherein

15 a support base on which the drive lever is rotatably supported is provided,

the drive lever is provided with a connecting shaft to which the opening and closing blade is connected,

20 a position holding part that holds the drive lever at the first rotation position is formed in the support base, and

25 the drive lever is held at the first rotation position by pressing the connecting shaft against the position holding part by a biasing force of the blade return spring.

13. An imaging device comprising:

30 a blade opening and closing device that controls light taken in through an optical system; and an imaging element that photoelectrically converts the light taken in through the optical system,

wherein the blade opening and closing device includes:

a drive lever rotatable in a first rotation direction from a first rotation position to a second rotation position and a second rotation direction from the second rotation position to the first rotation position;

a drive body that applies a driving force to the drive lever as a rotational force in the first rotation direction;

a biasing spring that applies a driving force to the drive lever as a rotational force in the second rotation direction by biasing the drive lever; and

an opening and closing blade that is operated in a closing direction of closing an opening in accordance with a rotation operation of the drive lever in the first rotation direction, and is operated in an opening direction of opening the opening in accordance with an operation of the drive lever in the second rotation direction,

the driving force in the first rotation direction is applied from the drive body in a state where the driving force from the biasing spring is not applied to the drive lever, and

the driving force in the second rotation direction is applied from the biasing spring in a state where the driving force from the drive body is not applied to the drive lever.

14. The imaging device according to claim 13, wherein the blade opening and closing device includes a

drive block including the drive body and a mechanism
block including the opening and closing blade,

5 a size of the drive block is smaller than a size of
the mechanism block in a moving direction of the opening
and closing blade,

the drive block is positioned on an outer
peripheral side of the mechanism block, and

terminal parts are disposed on an outer peripheral
side of the mechanism block on opposite sides of the
10 drive block in the moving direction of the opening and
closing blade.