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(54) **BLADE DRIVING DEVICE, IMAGING DEVICE AND ACTUATOR COMPRISING THE BLADE DRIVING DEVICE**

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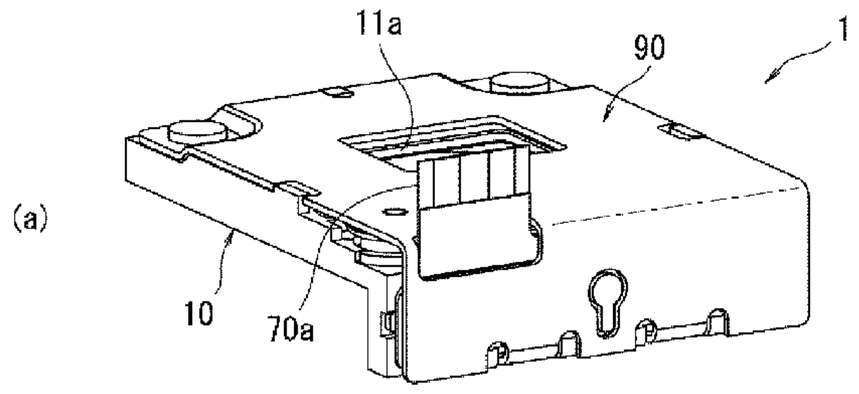
(57) **ABSTRACT**

A blade driving device having a base plate with an opening for an optical path; first and second blades, at different locations on the base plate, and each rotate to open/close the opening. A first magnet secured to the first blade; a second magnet secured to the second blade; a yoke secured on the base plate; and a first and second coil coiled on the yoke. The yoke has a first magnetic pole portion adjacent to the first magnet, a second magnetic pole portion adjacent to the second magnet, and connecting portions, connecting the first magnetic pole portion and the second magnetic pole portion. The first magnetic pole portion and the second magnetic pole portion have, respectively, adjacent pieces and adjacent to the corresponding magnets, and extending portions and continuous with the adjacent pieces and provided extending in a direction perpendicular to the blade supporting face of the base plate.



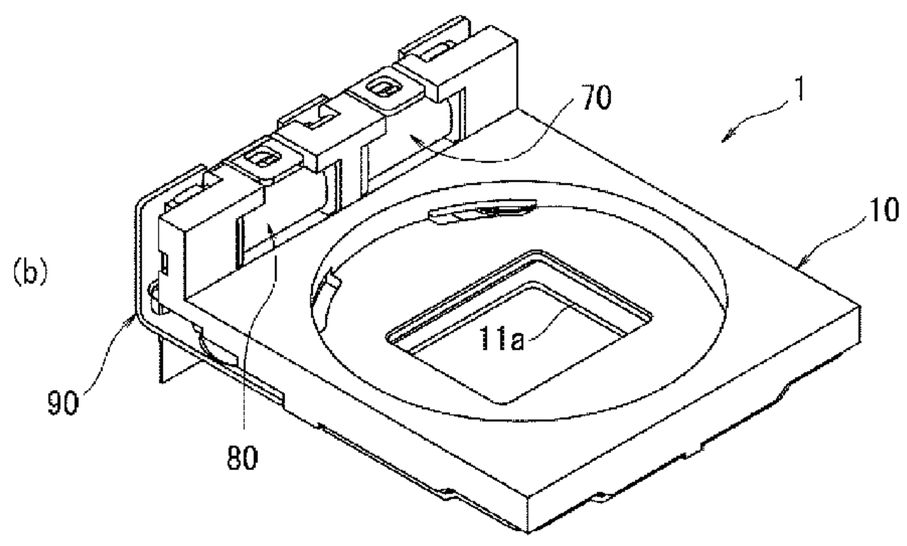
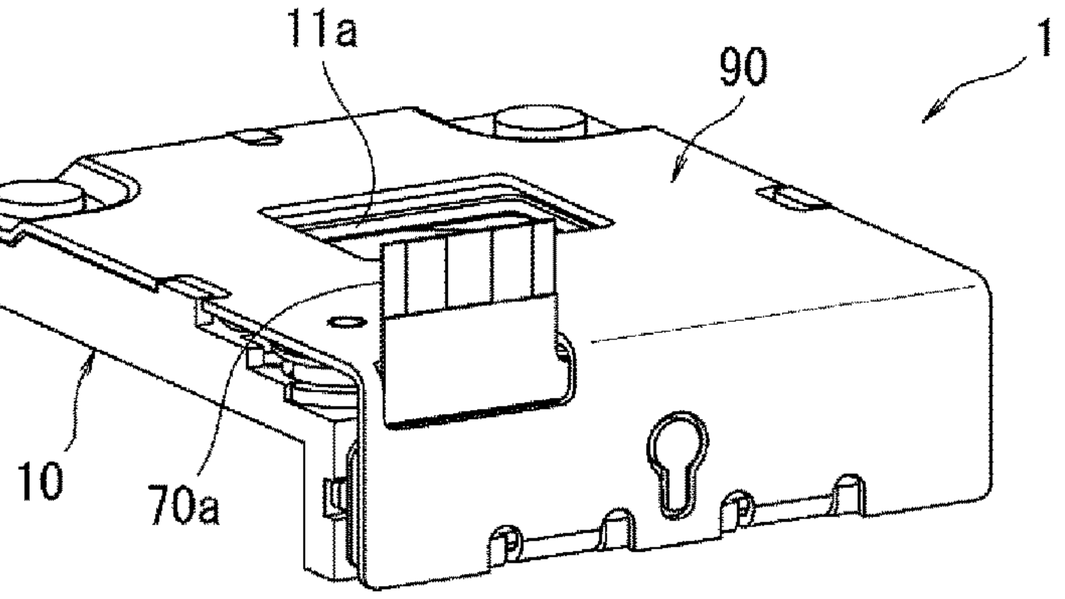


FIG. 1

(a)



(b)

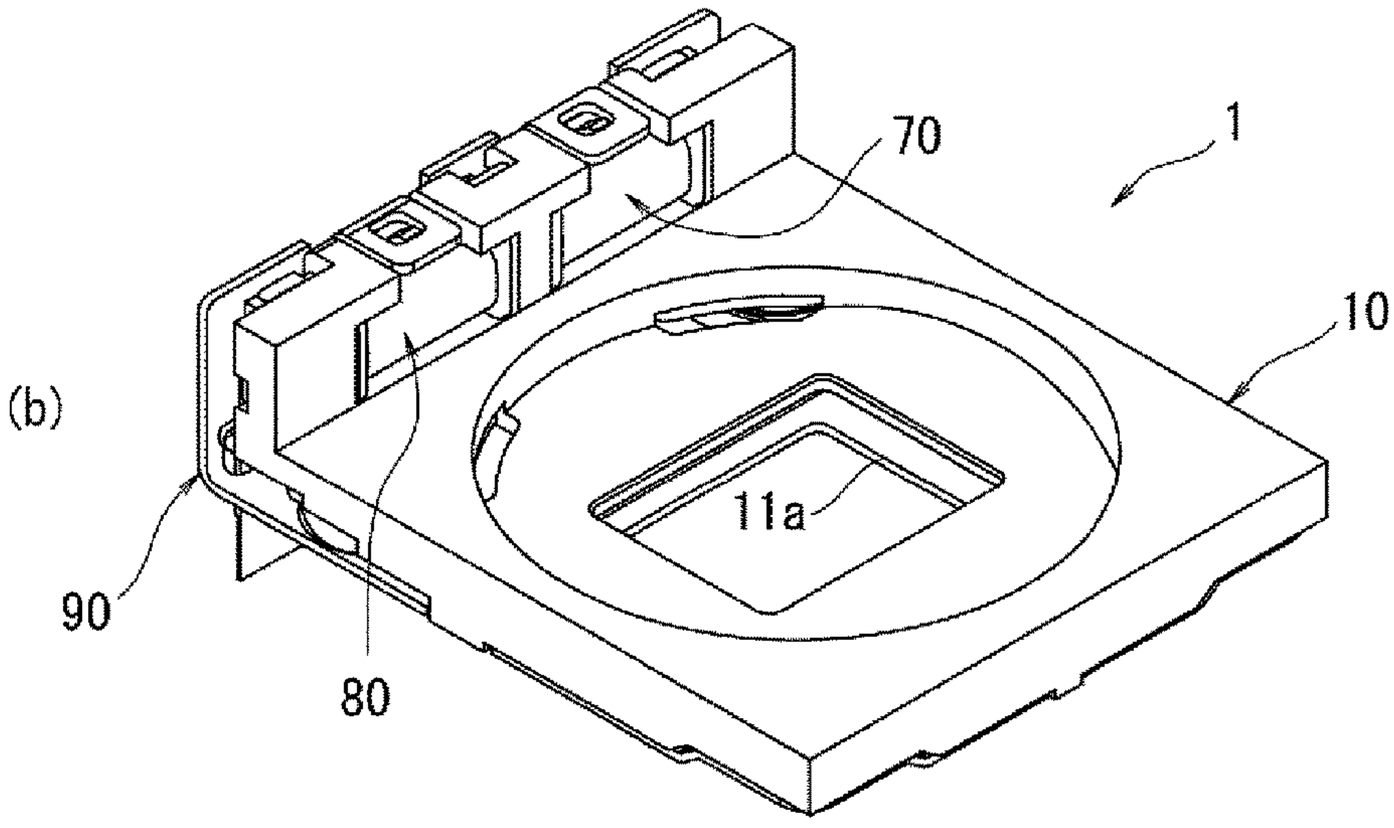


FIG. 2

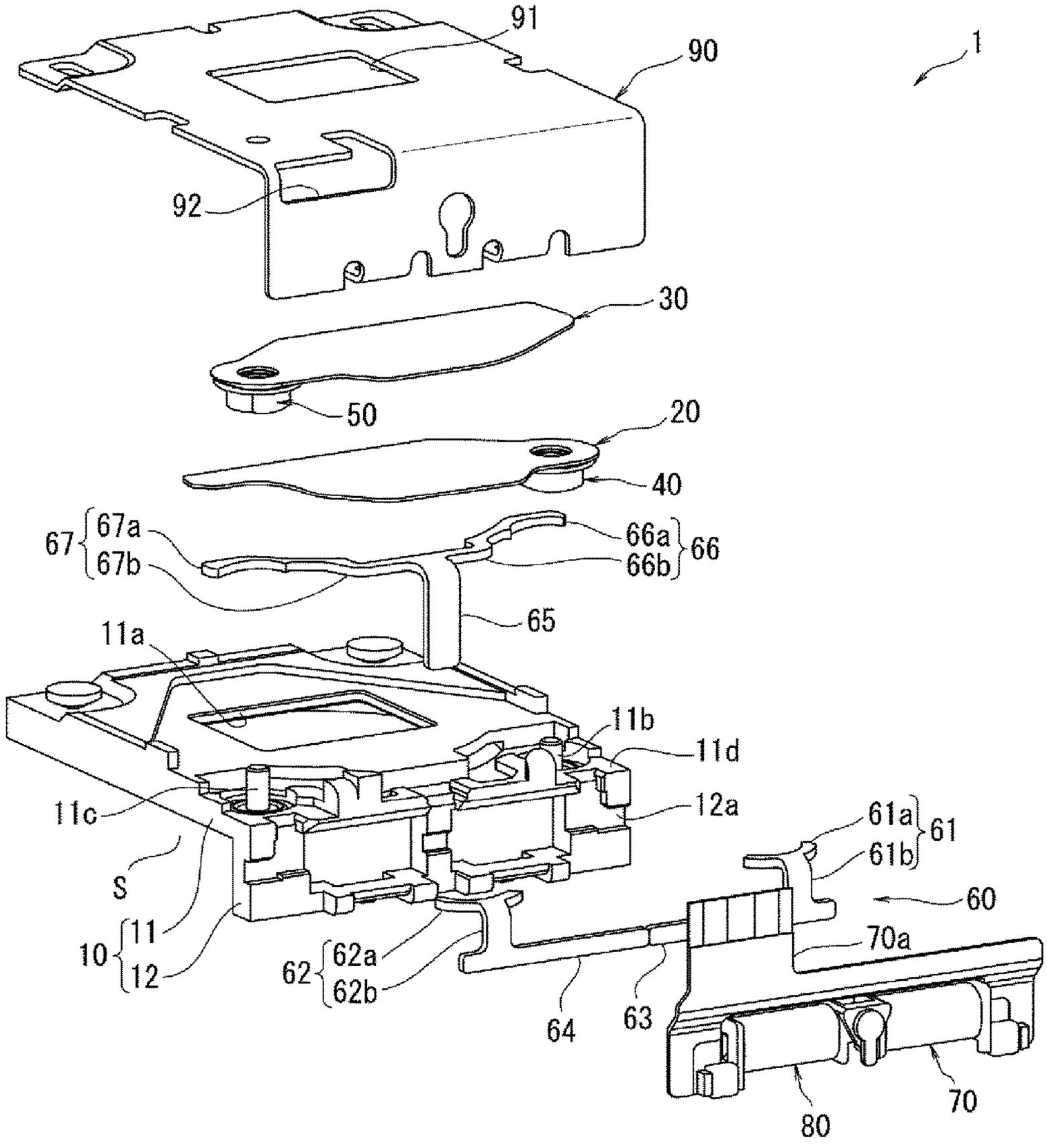

1
90
91
92
30
50
20
40
67
67a
67b
66
66a
66b
65
11a
11b
11d
11c
12a
S
10
11
12
62
62a
62b
61
61a
61b
60
70a
64
63
70
80

FIG. 3

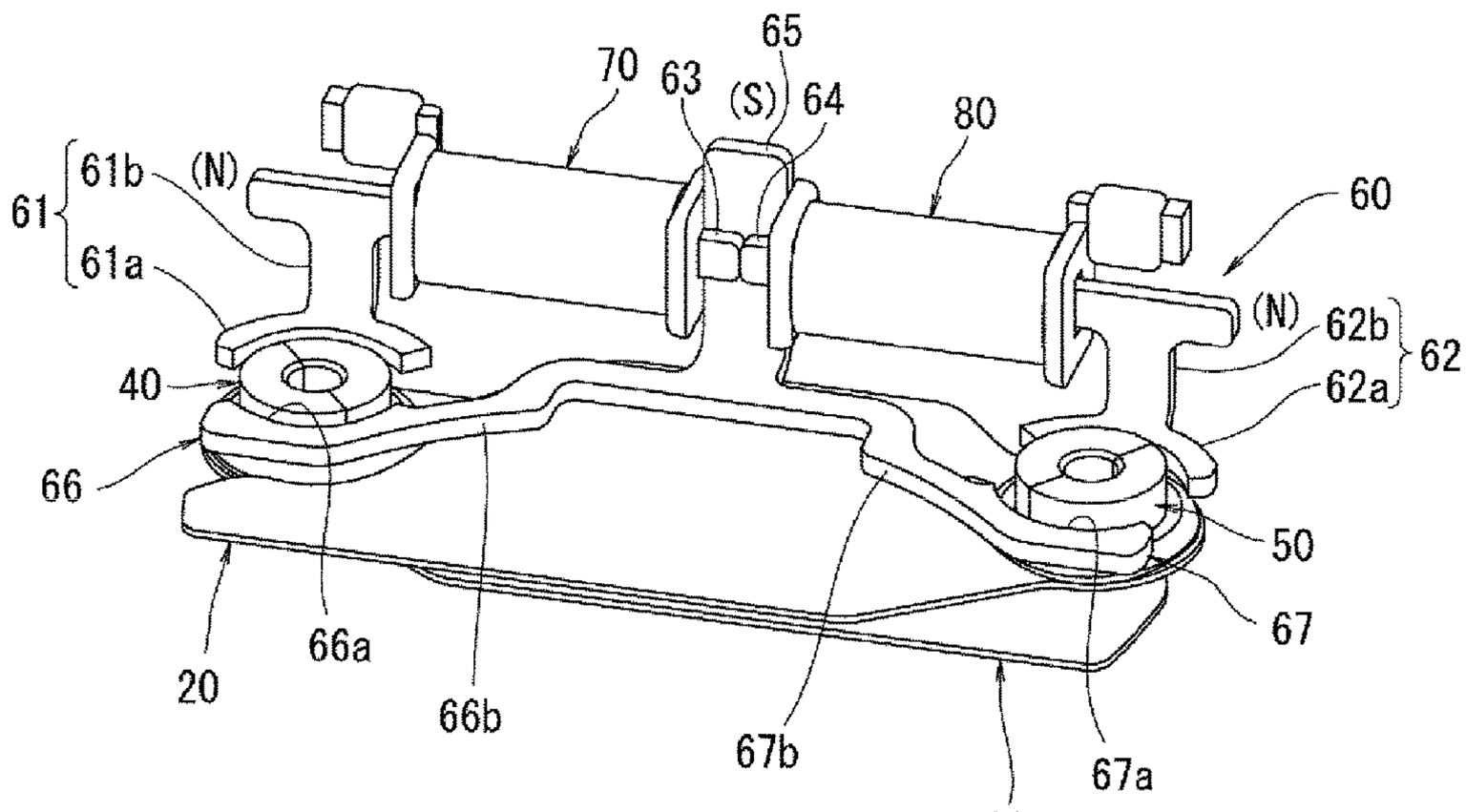

65
70
63
(S)
64
80
61
61b
(N)
61a
60
(N)
62b
62
62a
40
66
50
67
20
66a
66b
67b
67a
30

FIG. 4

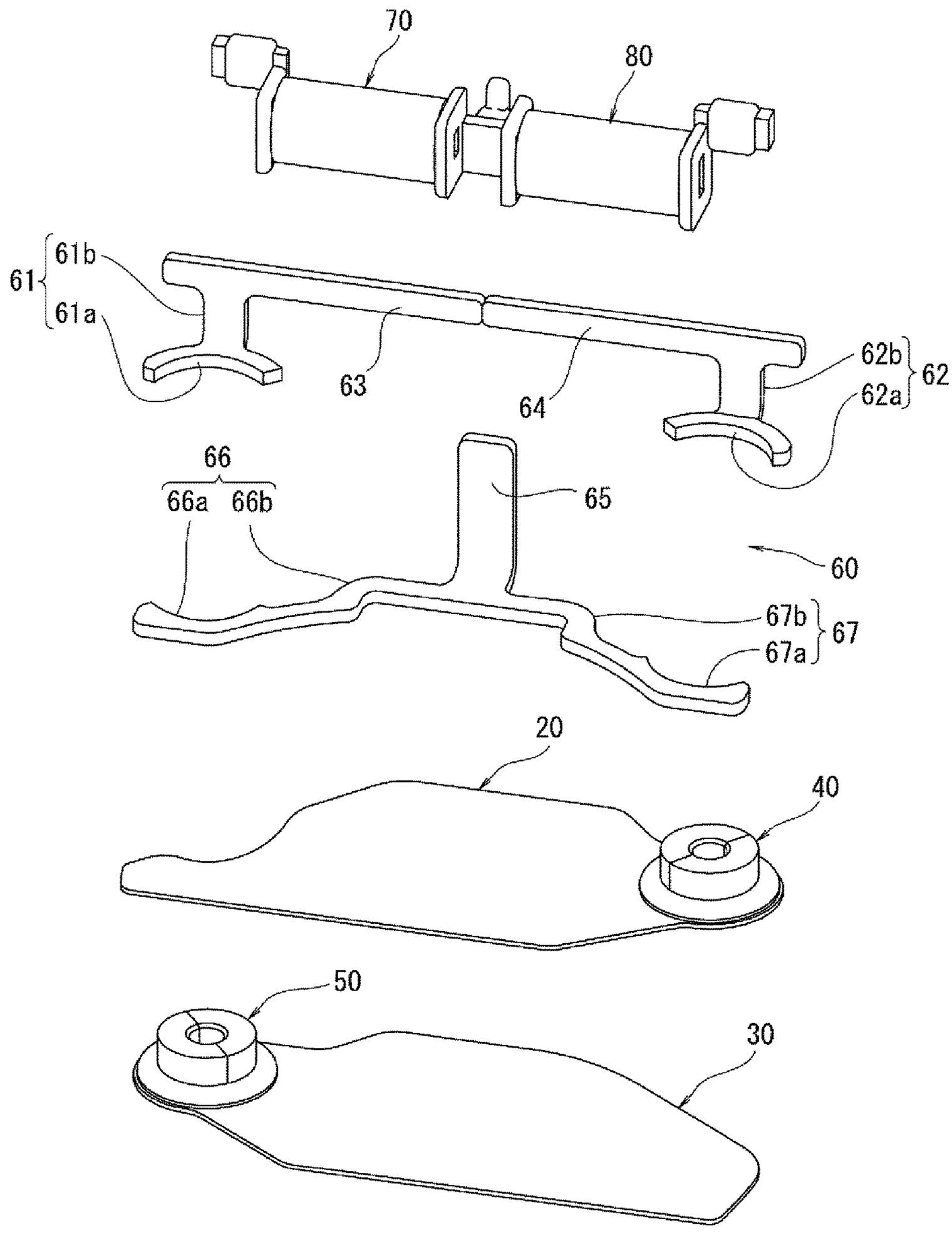
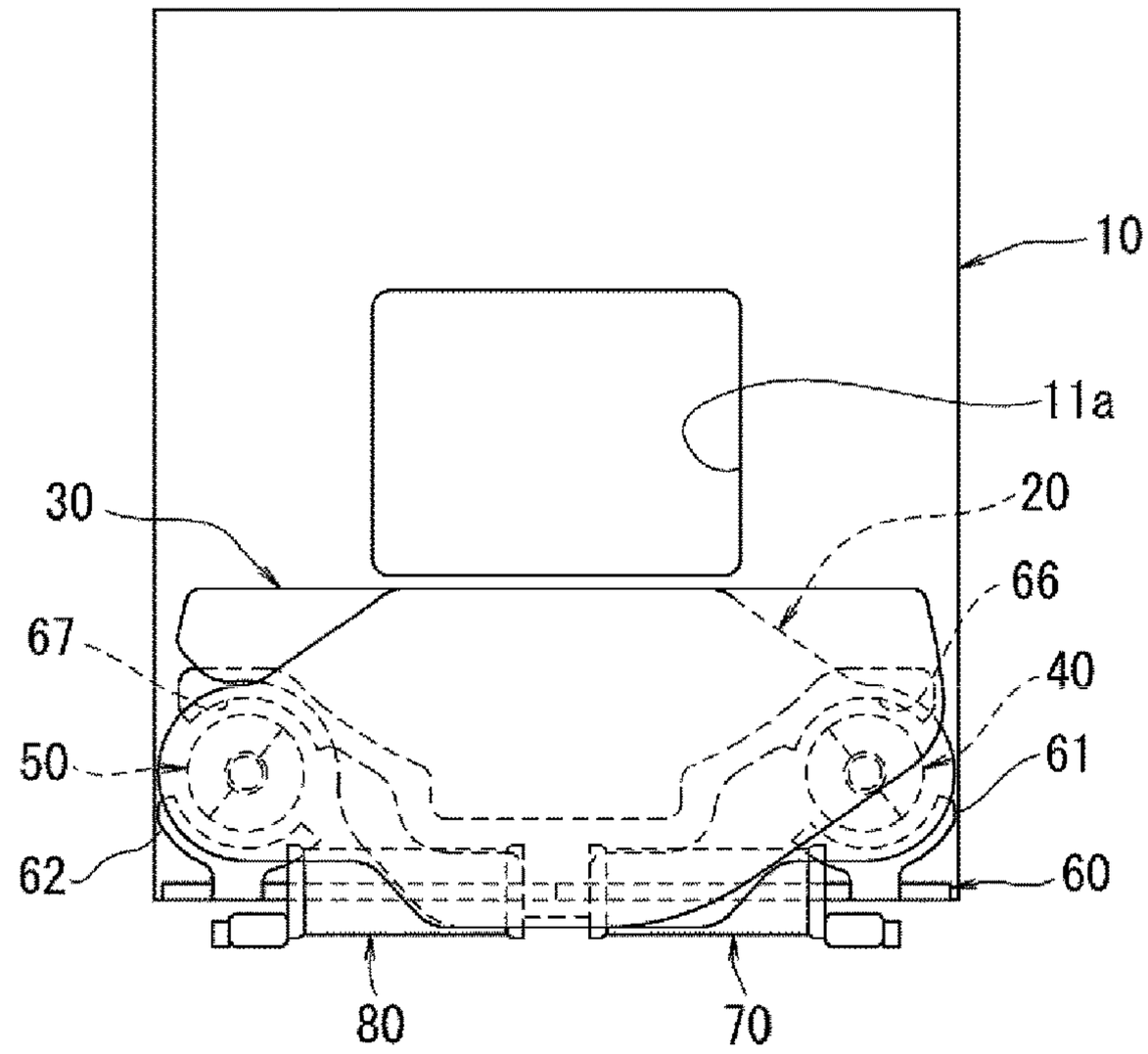

70
80
61
61b
61a
63
64
62b
62a
62
66
66a
66b
65
60
67b
67a
67
20
40
50
30

FIG. 5

(a)


10
11a
30
20
66
67
40
50
61
62
60
80
70

(b)

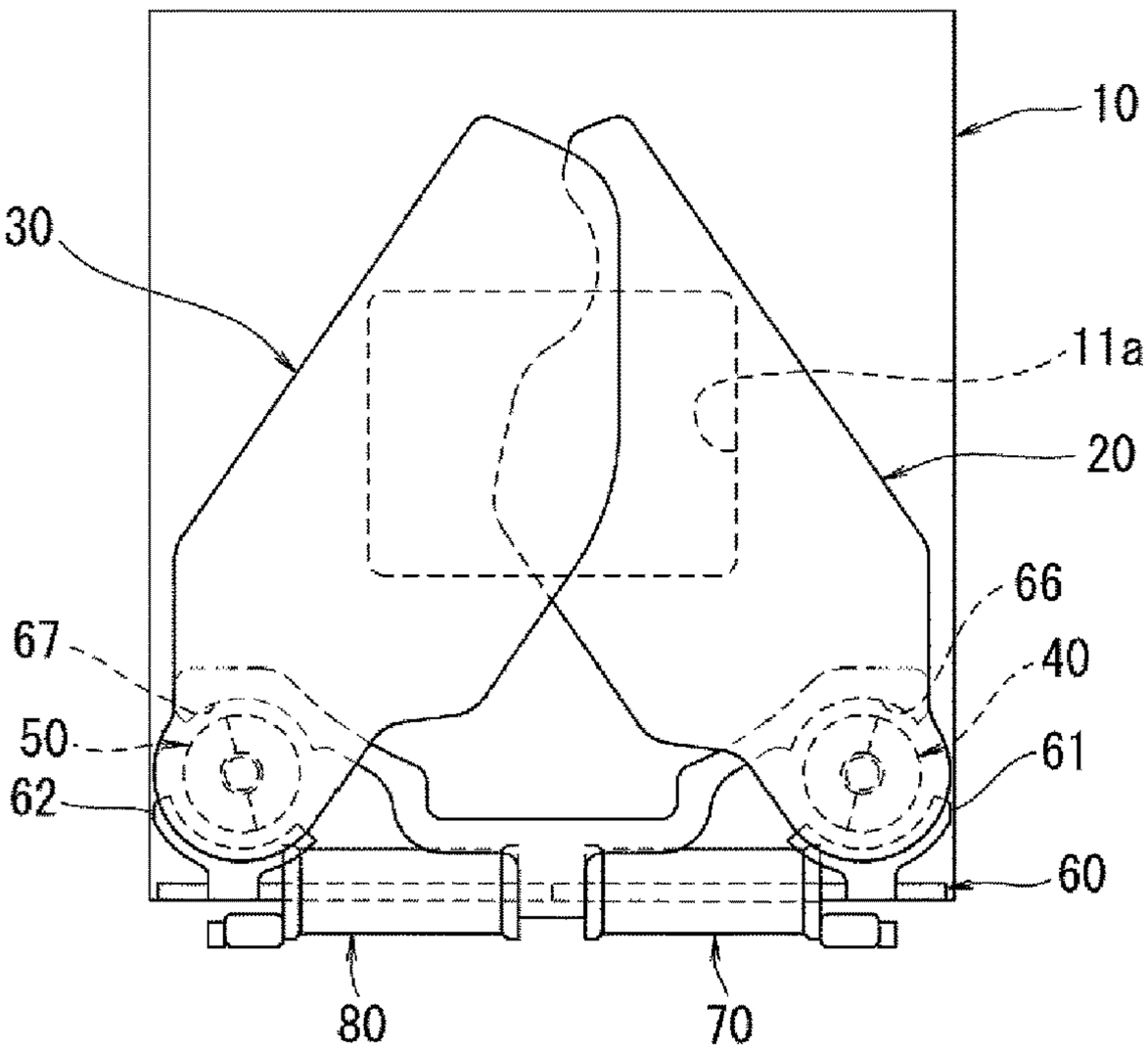
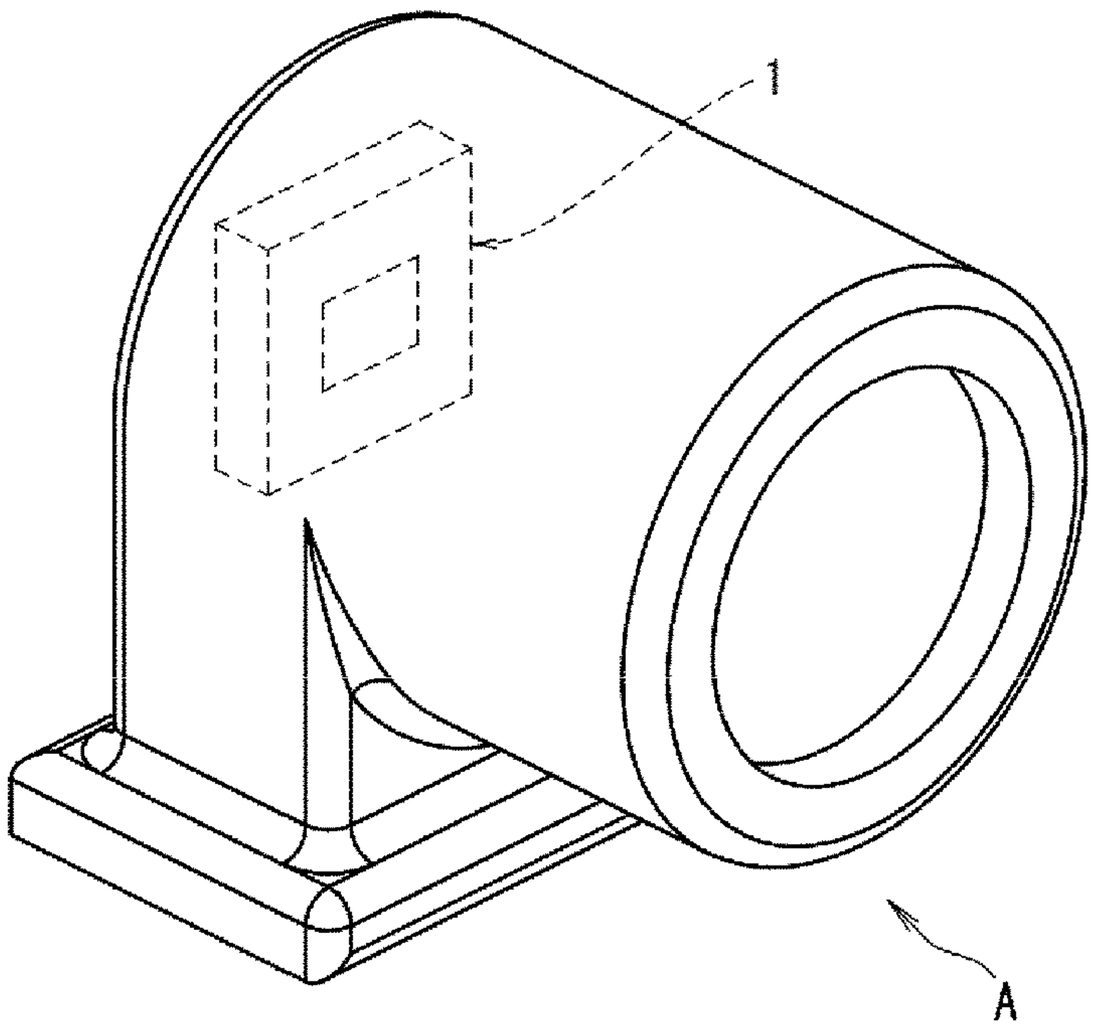

10
30
11a
20
66
67
40
50
61
62
60
80
70

FIG. 6

(a)



(b)

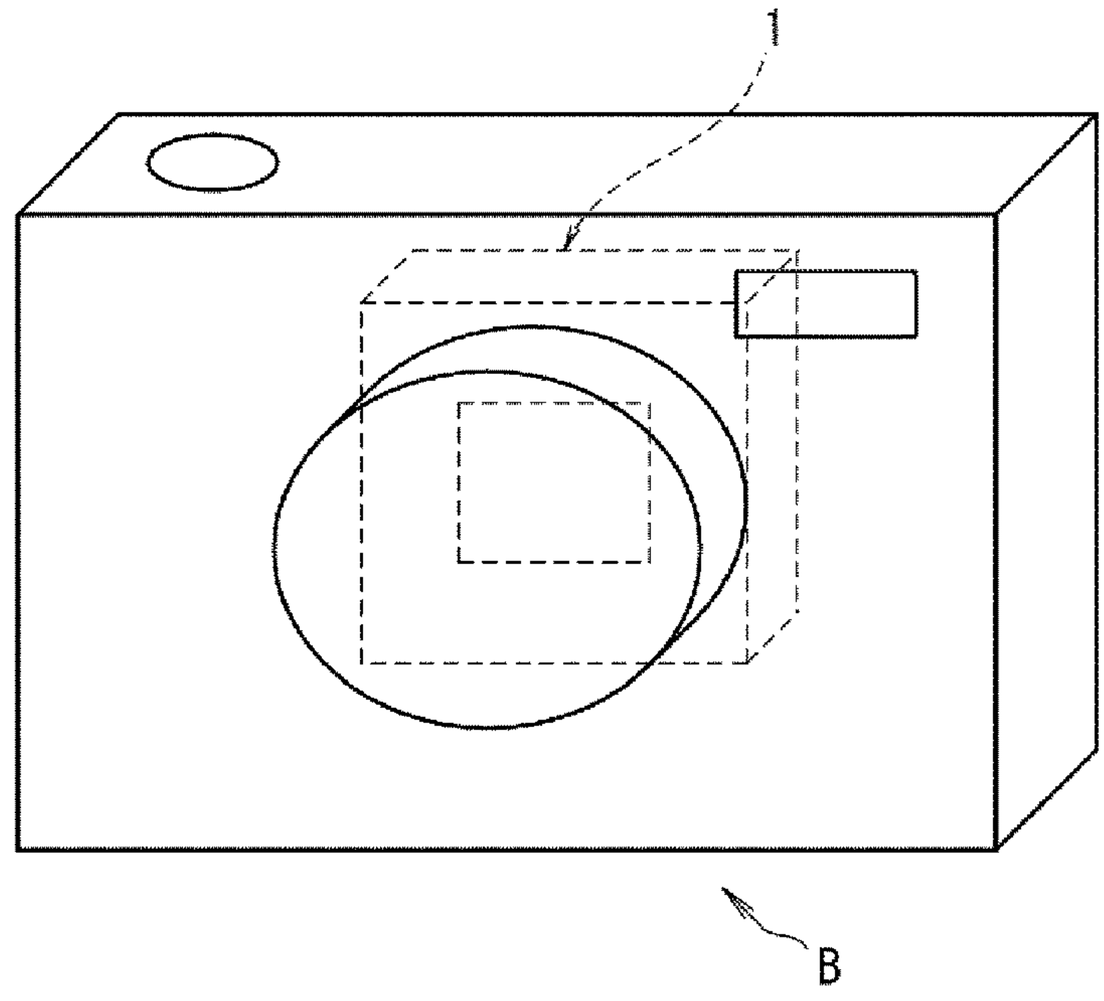
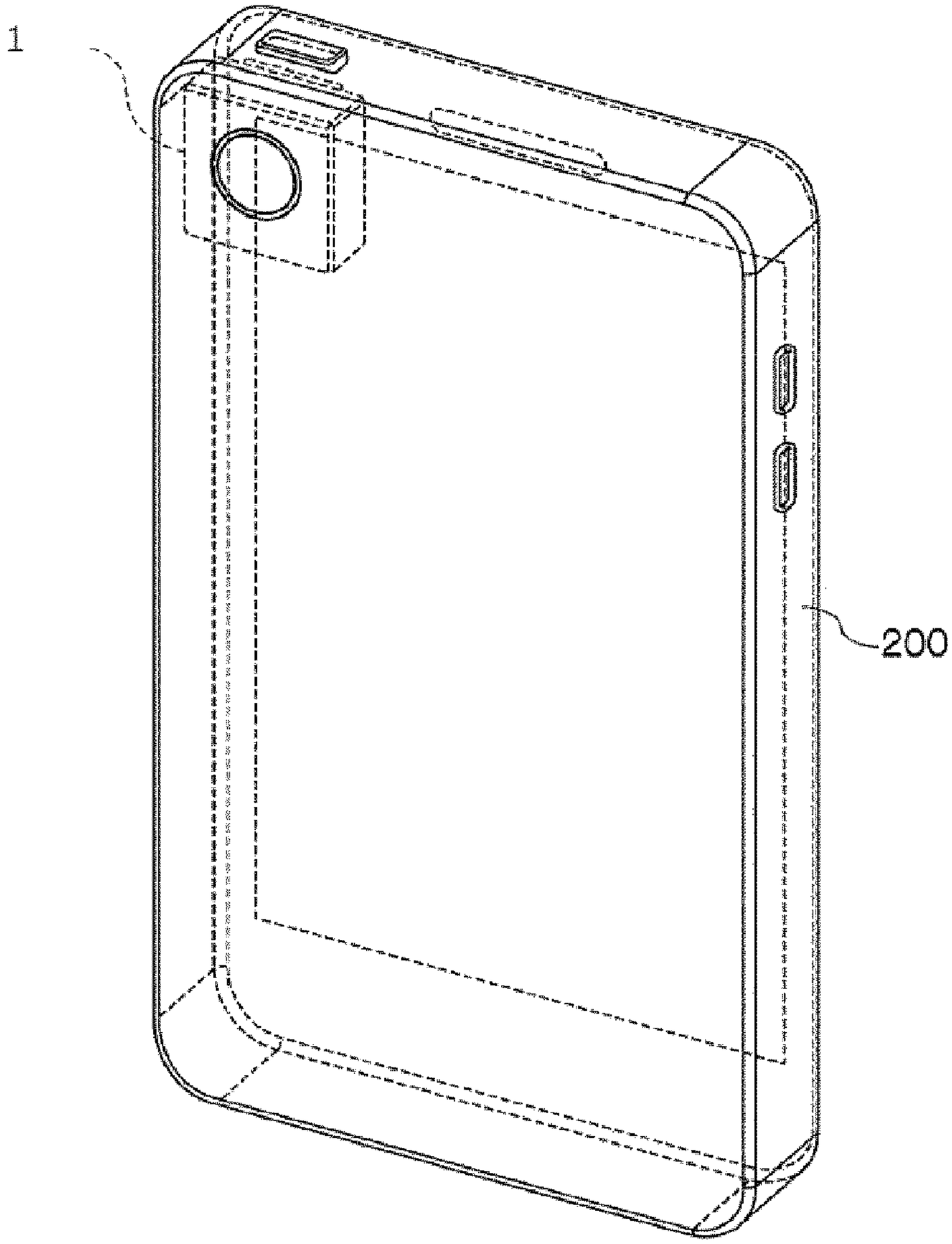


FIG. 7



BLADE DRIVING DEVICE, IMAGING DEVICE AND ACTUATOR COMPRISING THE BLADE DRIVING DEVICE

FIELD OF TECHNOLOGY

[0001] The present invention relates to a blade driving device for opening and closing, through blades, an opening for an optical path, and to an imaging device and an actuator comprising this blade driving device.

BACKGROUND

[0002] Conventionally, as this type of invention, there is been, as described in Japanese Unexamined Patent Application Publication 2012-78502, for example, a shutter mechanism for a camera, comprising: a base plate that has an opening portion for an optical path; a plurality of shutter blades for opening/closing the opening portion through each rotating at different positions over the base plate; and a driving source structured from a rotor, a coil, a yoke, and the like.

[0003] In this type of prior art, shutter blades for driving have been rotated by driving pins that are integrated with the rotor, to rotate other shutter blades, through driving linkage portions provided on these shutter blades for driving.

SUMMARY

[0004] Given this prior art, the rotational force of the rotor is relayed to a plurality of shutter blades through a plurality of driving pins and driving linkage portions, and thus the power relaying structure is complex. Moreover, the driving source is provided on one side of the base plate, and the shutter blades are provided on the other side, with the base plate therebetween, and thus there is a tendency for the structure to be thick in the direction of the axis of rotation. Given this, a thinner, more compact structure is desired.

[0005] The present invention is equipped with the following structures:

[0006] A blade driving device, having a base plate that has an opening for an optical path; a first blade and a second blade, at different locations on the base plate, and that each rotate to open/close the opening; a first magnet that is secured around the axis of rotation of the first blade; a second magnet that is secured around the axis of rotation of the second blade; a yoke that is secured on the base plate; and a first coil and a second coil that are coiled on the yoke, wherein: the yoke comprises a first magnetic pole portion that is adjacent to the first magnet, a second magnetic pole portion that is adjacent to the second magnet, and a connecting portion for connecting the first magnetic pole portion and the second magnetic pole portion; and the first magnetic pole portion and the second magnetic pole portion each comprise an adjacent piece that is adjacent to the corresponding magnet, and an extending portion that is continuous with the adjacent piece and that is provided extending in a direction that is perpendicular to the blade supporting face of the base plate.

BRIEF DESCRIPTIONS OF THE DRAWINGS

[0007] FIG. **1** depicts an example of a blade driving device according to the present invention, wherein (a) is an exterior perspective diagram viewed from the cover member side, and (b) is an exterior perspective diagram viewed from the base plate side.

[0008] FIG. **2** is an assembly perspective diagram of the blade driving device.

[0009] FIG. **3** is a perspective diagram wherein critical portions of this blade driving device are viewed from the incident light side.

[0010] FIG. **4** is a perspective diagram depicting the assembly of critical portions of the blade driving device.

[0011] FIG. **5** is a plan view depicting the blade driving device with a portion thereof omitted, wherein (a) shows the state wherein the opening is open and (b) shows the state wherein the opening is closed.

[0012] FIG. **6** is perspective diagrams showing respective examples, in (a) and (b), of imaging devices equipped with this blade driving device.

[0013] FIG. **7** is a perspective diagram depicting a mobile device equipped with this blade driving device.

DETAILED DESCRIPTION

[0014] Examples of the present invention will be explained below in reference to the drawings. In the descriptions below, identical reference symbols in the different drawings below indicate positions with identical functions, and redundant explanations in the various drawings are omitted as appropriate.

[0015] Referencing FIG. **1** and FIG. **2**, this blade driving device **1** has a base plate **10**, having an opening **11***a* for an optical path; a first blade **20** and a second blade **30**, for opening/closing the opening **11***a*, through rotation thereof, at different positions over the base plate **10**; a first magnet **40**, secured around the axis of rotation of the first blade **20**, and having polarities in opposing directions on two sides in the radial direction; a second magnet **50**, secured around the axis of rotation of the second blade **30**, having polarities in opposing directions on two sides in the radial direction; a yoke **60** that is secured to the base plate **10**; a first coil **70** and a second coil **80** that are coiled onto the yoke **60**; and a cover member **90**.

[0016] The base plate **10** is formed in essentially a L-shape, when viewed from the side, and has a main unit portion **11** that has an opening **11***a* toward the center, and a supporting piece **12**, for supporting the yoke **60**, and the like, described below, protruding in one optical axial direction, on one end side of the main unit portion **11**. A space S on the incident light side of this base plate **10** is used for assembling a lens unit, and the like, not shown.

[0017] This base plate **10** is formed as a single unit from, for example, aluminum, magnesium, another metal material, an alloy of these, or the like.

[0018] The main unit portion **11** is formed in a rectangular plate-shape, with a rectangular through hole-shape opening **11***a* toward the center thereof. In the example depicted in FIG. **2**, the vertical direction in the figure, in the opening **11***a*, is the optical axial direction, formed so that light will be incident into the opening **11***a*.

[0019] Moreover, supporting shafts **11***b* and **11***c* are provided near the supporting piece **12** on the surface of the main unit portion **11** that is in the direction opposite of the direction in which the supporting piece **12** protrudes. The supporting shafts **11***b* and **11***c* support, respectively, the first blade **20** and the second blade **30**, described below, and protrude in the direction opposite that of the supporting piece **12**.

[0020] The supporting shaft **11***b* and **11***c* is each a circular column-shaped shaft that protrudes perpendicularly in

respect to the surface of the main unit portion **11**. In one supporting shaft **11***b*, the outer peripheral surface makes sliding contact with the inner peripheral surface of the first magnet **40**, to support the first magnet **40** so as to enable rotation. Similarly, with the other supporting shaft **11***c*, the outer peripheral surface thereof makes sliding contact with the inner peripheral surface of the second magnet **50**, to support the second magnet **50** so as to enable rotation.

[0021] Moreover, recessed portions **11***d*, which cause the thickness of the main unit portion **11** to be thinner, are provided around the supporting shaft **11***b* and **11***c* on the main unit portion **11**, where the first magnet **40** and the second magnet **50**, and the adjacent pieces **61***a*, **62***a*, **66***a*, and **67***a*, are fitted into the recessed portions **11***d*.

[0022] A fitting/supporting portion **12***a*, of a recessed shape, for fitting together with and securing the yoke **60**, the first coil **70**, the second coil **80**, and the like, is provided on the outer side face of the supporting piece **12**.

[0023] Referencing FIG. **3**, FIG. **4**, and FIG. **5**, the first blade **20** and the second blade **30** are formed in respective thin plate shapes from, for example, aluminum alloy, or the like, and are rotated to open/close the opening **11***a* of the base plate **10**.

[0024] In the first blade **20**, the first magnet **40** is secured around the axis of rotation, on the incident light side surface, so as to rotate together therewith. Similarly, in the second blade **30** as well, the second magnet **50** is secured around the axis of rotation, on the incident light side surface thereof, so as to rotate together therewith.

[0025] The first blade **20** and the second blade **30** overlap each other partially around the first magnet **40** and the second magnet **50**. In the example that is illustrated, the second blade **30** overlaps, on the side opposite from the incident light side, the first blade **20**, which overlaps the base plate **10**.

[0026] The first magnet **40** and the second magnet **50** are each cylindrical permanent magnets that are symmetrical in the radial direction, have mutually differing magnetic poles (north and south), and are formed from a magnetic material such as, for example, samarium cobalt, ferrite, neodymium, or the like.

[0027] The first magnet **40** is adhesively secured, through an adhesive agent, around the axis of rotation of the first blade **20**, and is equipped in a ring shape so as to enable rotation in respect to the supporting shaft **11***b* of the base plate **10**.

[0028] Similarly, the second magnet **50** is secured, through an adhesive agent, around the axis of rotation of the second blade **30**, and is equipped in a ring shape so as to enable rotation in respect to the supporting shaft **11***c* of the base plate **10**.

[0029] The yoke **60** is structured from a magnetic material, and comprises, integrally, a first magnetic pole portion **61** that is near to the first magnet **40** from one side in the radial direction; a second magnetic pole portion **62** that is near to the second magnet **50** in the radial direction; connecting portions **63** and **64** for connecting between the first magnetic pole portion **61** and the second magnetic pole portion **62**; a connecting piece **65**, for connecting to the vicinity of the center of the connecting portions **63** and **64**; a third magnetic pole portion **66**, extending from the connecting piece **65**, that is near to the other side of the first magnet **40** in the radial direction; and a fourth magnetic pole portion **67** that extends from the connecting piece **65**, that is near to the second magnet **50** on the other side in the radial direction.

[0030] Note that while for example, as illustrated in FIG. **4**, the yoke **60** is structured as a single unit from a plurality of piece members as a form that is particularly suitable for manufacturing (referencing FIG. **4**), as another embodiment of the yoke **60**, it may be a member wherein some or all parts are formed integrally in advance.

[0031] The first magnetic pole portion **61** comprises, integrally: an adjacent piece **61***a* that is adjacent, on one side in the radial direction, to the outer peripheral surface of the corresponding first magnet **40**; and an extending portion **61***b*, which is provided extending in the crosswise direction (the optical axial direction) in respect to the blade supporting surface of the base plate, and is continuous with the adjacent piece **61***a*.

[0032] The adjacent piece **61***a* has an arc-shaped end face that is adjacent to the outer peripheral surface of the first magnet **40**, with a prescribed clearance. The extending portion **61***b* is a position that is bent to essentially a right angle, in respect to the adjacent piece **61***a*, and fits together with the fitting/supporting portion **12***a*.

[0033] Similarly, the second magnetic pole portion **62** comprises, integrally: an adjacent piece **62***a* that is adjacent, on one side in the radial direction, to the outer peripheral surface of the corresponding second magnet **50**; and an extending portion **62***b*, which is provided extending in the crosswise direction in respect to the blade supporting surface of the base plate **10**, and is continuous with the adjacent piece **62***a*.

[0034] The adjacent piece **62***a* has an arc-shaped end face that is adjacent to the outer peripheral surface of the second magnet **50**, with a prescribed clearance. The extending portion **62***b* is a position that is bent to essentially a right angle, in respect to the adjacent piece **62***a*, and fits together with the fitting/supporting portion **12***a*.

[0035] One connecting portion **63** extends straight from the extending portion **61***b* toward the second magnetic pole portion **62** side, and the other connecting portion **64** extends straight from the extending portion **62***b* to the first magnetic pole portion **61** side. Given this, there is mutually abutting contact between the connecting portion **63** and the connecting portion **64**.

[0036] The first coil **70** and the second coil **80**, described below, are equipped in ring shapes on the connecting portion **63** and the connecting portion **64**.

[0037] Moreover, the connecting piece **65** extends in the optical axial direction, and is connected through layering together with the contacting parts of the connecting portion **63** and the connecting portion **64**, described above.

[0038] This connecting piece **65** is secured through press fitting into the fitting/supporting portion **12***a* of the base plate **10**, together with the connecting portion **63** and the connecting portion **64**.

[0039] In this way, in the yoke **60**, the shape is such that a portion thereof is bent in the optical axial direction, and thus is able to reduce the size of the blade driving device **1** in the plan view in the optical axial direction.

[0040] The third magnetic pole portion **66** comprises, integrally, an arc-shaped adjacent piece **66***a* that is adjacent to the outer peripheral surface of the corresponding first magnet **40**, with a prescribed clearance therefrom, and an

extending portion **66***b* that extends from an end portion of the adjacent piece **66***a* toward the fourth magnetic pole portion **67** side.

[0041] Similarly, the fourth magnetic pole portion **67** comprises, integrally, an arc-shaped adjacent piece **67***a* that is adjacent to the outer peripheral surface of the corresponding second magnet **50**, with a prescribed clearance therefrom, and an extending portion **67***b* that extends from an end portion of the adjacent piece **67***a* toward the third magnetic pole portion **66** side.

[0042] The extending portion **66***b* and the extending portion **67***b* are connected integrally with the connecting piece **65**, described above, at the parts thereof that are toward the center (referencing, in particular, FIG. **2** and FIG. **3**).

[0043] The first coil **70** is positioned between the first magnetic pole portion **61** and the connecting piece **65**, and installed, in a ring shape, on the connecting portion **63**.

[0044] Moreover, the second coil **80** is positioned between the second magnetic pole portion **62** and the connecting piece **65**, and is installed in a ring shape on the connecting portion **64**, so as to be lined up in a straight line with the first coil **70**.

[0045] Given this, the first coil **70** and the second coil **80** are wired electrically so as to form a magnetic circuit wherein the first magnetic pole portion **61** and the second magnetic pole portion **62** will have the same polarity, and the connecting portions **63** and **64**, which are toward the center, will have polarities that are opposite those of the first magnetic pole portion **61** and the second magnetic pole portion **62**.

[0046] Explaining in greater detail, in the first coil **70** and the second coil **80**, the wire materials thereof are coiled mutually opposing directions. Additionally, in the first coil **70** and the second coil **80**, the terminals (not shown) at the positions that are toward the center, between the connecting portions **63** and **64** (that is, toward the connecting piece **65**) are connected together electrically. In the first coil **70** and the second coil **80**, the two terminals on the sides opposite from the aforementioned connecting location (that is, on the first magnetic pole portion **61** side and the second magnetic pole portion **62** side) are connected to external power supply circuits, not shown, through a terminal plate **70***a* (referencing FIG. **2**).

[0047] Consequently, when DC electric power, or the like, is supplied to these two coils **70** and **80**, the first magnetic pole portion **61** and the second magnetic pole portion **62**, on one end side and the other end side of these two coils **70** and **80**, will go to the same polarity (for example, the north polarity), and the connecting piece **65**, to the center of these two coils **70** and **80**, will go to the opposite polarity (for example, the south polarity), and, accompanying this, both the third magnetic pole portion **66** and the fourth magnetic pole portion **67** will go to the aforementioned opposite polarity (for example, the south polarity) (referencing FIG. **3**).

[0048] In the state wherein the first coil **70** and the second coil **80** are installed, in the yoke **60** the adjacent pieces **61***a*, **62***a*, **66***a*, and **67***a* in the first through fourth magnetic pole portions **61**, **62**, **66**, and **67** will be disposed on the blade supporting surface side of the base plate **10**, and the extending portions **61***b* and **62***b*, the connecting portions **63** and **64**, and the connecting piece **65** will be disposed on one side face side of the base plate **10** (and, specifically, at the supporting piece **12**).

[0049] The cover member **90** is made from a hard material, such as, for example, a nonmagnetic stainless steel material, and is formed in a plate shape that has a cross-sectional L shape, covering, for example, the main unit portion **11** of the base plate **10** and the outer surface of the supporting piece **12**.

[0050] An opening **91**, that communicates with the opening **11***a* of the base plate **10**, is formed toward the center of the cover member **90**.

[0051] The cover member **90** is connected securely to the base plate **10**, so as to cover the first blade **20**, the second blade **30**, the first magnet **40**, the second magnet **50**, the yoke **60**, the first coil **70**, the second coil **80**, the terminal plate **70***a*, and the like, described above, where the terminal part of the terminal plate **70***a* is inserted through the through hole **92** (referencing FIG. **2**), to be exposed on the outside.

[0052] Given this, a photodetecting element, not shown (for example, a ferroelectric sensor, a thermopile, a bolometer, or another infrared radiation sensor, a CCD image sensor, a CMOS image sensor, or the like) is equipped so as to cover the opening **91** on the side of the cover member **90** that is opposite from the incident light side.

[0053] The operating effects that are the distinctive feature of the blade driving device **1** with the structure set forth above will be explained in detail next.

[0054] When DC electric power is supplied to the two coils **70** and **80**, then, as illustrated in FIG. **3**, the same polarity as that of the first magnetic pole portion **61** and the second magnetic pole portion **62** (for example, the north polarity) will be produced at the one end side and the other end side of the two coils **70** and **80**, and, simultaneously, both the third magnetic pole portion **66** and the fourth magnetic pole portion **67** will go to the polarity that is opposite that of the first magnetic pole portion **61** and the second magnetic pole portion **62** (for example, the south polarity), and, through the magnetic effects received from these magnetic pole portions, the first magnet **40** and the first blade **20**, and the second magnet **50** and the second blade **30**, will each rotate in the direction to open (or close) the opening **11***a*. Moreover, when the direction of the DC electric power is reversed, the first magnet **40** and first blade **20**, and the second magnet **50** and second blade **30**, will each rotate in the direction opposite of the direction described above.

[0055] In this way, because the magnet and blade, as a single unit, are rotated directly by the blade driving device **1**, this enables smooth operation with good responsiveness, with little play, backlash, or the like, in the power transmission train, when compared to the prior art wherein the force from a single driving source is transmitted through linking pins, and the like, to a plurality of blades.

[0056] Moreover, because the first blade **20**, the second blade **30**, the first magnet **40**, the second magnet **50**, the adjacent pieces **61***a*, **62***a*, **66***a*, and **67***a*, and the like, move along the surface on one side of the base plate **10**, overall the structure is thin. In particular, in the preferred example that is depicted in FIG. **2**, the yoke **60** is fitted together with the part of the base plate **10** wherein one edge is bent to essentially a L-shape (specifically, the recessed portion **11***d* and the fitting/supporting portion **12***a*, and the like), to achieve a thin, compact structure.

[0057] The imaging unit as described above is depicted in FIG. **6**(*a*) and (*b*).

[0058] Imaging device A, illustrated in FIG. **6**(*a*), is an example of an infrared radiation camera (a night vision camera), equipped with a blade driving device **1**, a lens that is positioned to the front of the blade driving device **1**, a photodetecting element, a processing circuit for processing an image signal that is captured by the photodetecting element, a memory, and the like, within a casing.

[0059] Imaging device B, as illustrated in FIG. **6**(*b*), is an example of a digital camera, equipped with a blade driving device **1**, a lens that is positioned to the front of the blade driving device **1**, a photodetecting element, a processing circuit for processing an image signal that is captured by the photodetecting element, a memory, and the like, within a casing.

[0060] The imaging devices A and B have relatively small structures, with good ease of operation as well, through the structure, described above, for the blade driving device **1**.

[0061] Moreover, the blade driving device **1** can be applied not only to these imaging devices A and B, but also to the mobile device **200** depicted in FIG. **7**, and to vehicle-mounted devices, and the like, as well.

[0062] Note that while in the embodiment described above the yoke **60** is shaped with one edge side bent into a cross-sectional essentially L-shape, along the base plate **10** that has a cross-sectional L-shape, the base plate **10** may be formed instead into an essentially flat plate-shape, and the yoke **60** may be formed into a flat plate-shape along the blade supporting face of the base plate **10**.

[0063] Moreover, while in the present embodiment the blade driving device **1** was assembled into the camera module in such a way that the side to which the supporting piece **12** protrudes will be on the imaging subject side, in another embodiment it may be assembled into a camera module in such a way that the side to which the supporting piece **12** protrudes is on the sensor side instead, that is, the opposite of the form described above.

[0064] Moreover, while in the embodiment set forth above, as a particularly preferred form, the first coil **70** and the second coil **80** were coiled in mutually opposite directions, with the terminals thereof connected at the center, instead the first magnetic pole portion **61** and the second magnetic pole portion **62** may be of the same polarity with the connecting portions **63** and **64** connected with opposite polarities at the center thereof, or, as another example, the first coil **70** and the second coil **80** need not have the center terminals connected, but instead may be coiled in the same direction, with the polarities described above produced through control of the electric power that is supplied to the individual coils.

[0065] Moreover, the first magnet **40**, the second magnet **50**, the yoke **60**, the first coil **70**, and the second coil **80**, together, are termed an "actuator."

[0066] Additionally, as another embodiment, the structure need not include the third magnetic pole portion **66** and the fourth magnetic pole portion **67** that are included in the yoke **60**. In other words, a structure is possible wherein the third magnetic pole portion **66**, the fourth magnetic pole portion **67**, and the connecting piece **65** are omitted from the yoke **60**. This makes it possible to make the actuator even smaller, enabling the blade driving device **1** to be made even smaller.

[0067] Moreover, as another embodiment, in the plan view the first magnet **40** and the second magnet **50** may be polygons, for example, hexagons, or the like, instead of circles.

[0068] While embodiments according to the present invention were described in detail above, the specific structures thereof are not limited to these embodiments, but rather design variations within a range that does not deviate from the spirit and intent of the present invention are also included in the present invention. Moreover, insofar as there are no particular contradictions or problems in purposes or structures, or the like, the technologies of the various embodiments described above may be used together in combination.

1. A blade driving device, comprising:
- a base plate comprising an opening for an optical path;
- a first blade and a second blade, at different locations on the base plate, and that each rotate to open/close the opening;
- a first magnet secured around an axis of rotation of the first blade;
- a second magnet secured around an axis of rotation of the second blade;
- a yoke secured on the base plate; and
- a first coil and a second coil coiled on the yoke, wherein:
- the yoke comprises:
  - a first magnetic pole portion that is adjacent to the first magnet,
  - a second magnetic pole portion that is adjacent to the second magnet, and
  - a connecting portion for connecting the first magnetic pole portion and the second magnetic pole portion; and
  - wherein the first magnetic pole portion and the second magnetic pole portion each comprise:
    - an adjacent piece that is adjacent to the corresponding magnet, and
    - an extending portion that is continuous with the adjacent piece and that is provided extending in a direction that is perpendicular to the blade supporting face of the base plate.

2. The blade driving device as set forth in claim **1**, wherein:
- the first coil and the second coil are each provided on the connecting portion.

3. The blade driving device as set forth in claim **1**, wherein:
- the first coil and the second coil are electrically connected so they have the same polarity as the first magnetic pole portion and the second magnetic pole portion, and so that the vicinity of a center thereof has a polarity that is opposite of that of the first magnetic pole portion and the second magnetic pole portion.

4. The blade driving device as set forth in claim **1**, wherein:
- the connecting portion connects the extending portion of the first magnetic pole portion side and the extending portion of the second magnetic pole portion side so as to be collinear.

5. The blade driving device as set forth in claim **1**, wherein:
- in the yoke, the adjacent pieces in the first magnetic pole portion and the second magnetic core portion are disposed on the blade supporting surface side of the base plate, and the extending portion and the connecting portion are disposed are one side surface of the base plate.

6. The blade driving device as set forth in claim 1, wherein:

the adjacent portion of the first magnetic pole portion and the adjacent portion of the second magnetic pole portion are each provided adjacent to one side, in the radial direction, of the respectively corresponding magnets;

the yoke further comprises a third magnetic pole portion extending from the connecting portion and adjacent to the adjacent piece on the other side, in the radial direction, in respect to the first magnet, and a fourth magnetic pole portion that is adjacent to the adjacent piece on the other side, in the radial direction, in respect to the second magnet; and

the adjacent piece of the third magnetic pole portion and the adjacent piece of the fourth magnetic pole portion are connected in a single unit and connected to the connecting portion.

7. An imaging device comprising a blade driving device as set forth in claim 1.

8. An actuator comprising:

a first magnet and a second magnet that are each supported so as to enable rotation, a yoke, and a first coil and a second coil that are wound on the yoke, wherein:

the yoke comprises a first magnetic pole portion that corresponds to the first magnet, a second magnetic pole portion that corresponds to the second magnet, and a connecting portion for connecting the first magnetic pole portion and the second magnetic pole portion; and

the first magnetic pole portion and the second magnetic pole portion each comprise an adjacent piece that is near to one side, in the radial direction, in respect to the corresponding magnet, and an extending portion that is provided extending in a direction that is perpendicular in respect to this adjacent piece.

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