



US010365542B2

(12) **United States Patent**
Shinano et al.

(10) **Patent No.:** **US 10,365,542 B2**

(45) **Date of Patent:** **Jul. 30, 2019**

(54) **LENS BARREL AND CAMERA PROVIDED WITH SAME**

(58) **Field of Classification Search**

None

See application file for complete search history.

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**, Osaka (JP)

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,327,292 A *	7/1994	Eguchi	F16M 11/041
			359/811
6,035,134 A *	3/2000	Sato	G02B 27/646
			348/208.11

(Continued)

FOREIGN PATENT DOCUMENTS

JP	9-222541	8/1997
JP	10-083025	3/1998

(Continued)

(72) Inventors: **Fumio Shinano**, Osaka (JP); **Tetsuya Morita**, Osaka (JP); **Hideaki Kawane**, Osaka (JP)

(73) Assignee: **PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CO., LTD.**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/996,570**

(22) Filed: **Jun. 4, 2018**

(65) **Prior Publication Data**

US 2018/0275491 A1 Sep. 27, 2018

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2016/005233, filed on Dec. 27, 2016.

(30) **Foreign Application Priority Data**

Dec. 28, 2015 (JP) 2015-256594

(51) **Int. Cl.**
G03B 17/14 (2006.01)
G02B 7/02 (2006.01)

(Continued)

(52) **U.S. Cl.**
CPC **G03B 17/14** (2013.01); **G02B 7/021** (2013.01); **G02B 7/14** (2013.01); **G03B 17/561** (2013.01); **G03B 17/565** (2013.01)

OTHER PUBLICATIONS

International Search Report of PCT application No. PCT/JP2016/005233 dated Apr. 4, 2017.

Primary Examiner — Clayton E. LaBalle

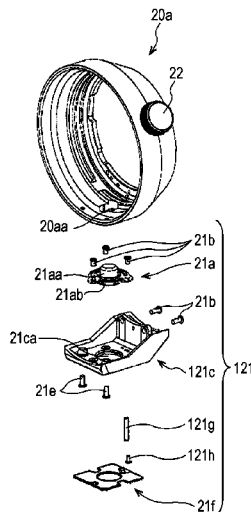
Assistant Examiner — Dennis Hancock

(74) *Attorney, Agent, or Firm* — Wenderoth, Lind & Ponack, L.L.P.

(57) **ABSTRACT**

A lens barrel is detachably attached to a camera body, and includes an exterior unit, a rear frame, a tripod mount, and a tripod lock screw. The exterior unit includes an optical system. The rear frame is mounted to the exterior unit so as to be rotatable around an optical axis. An outer peripheral surface of the lens barrel is configured with the exterior unit and the rear frame. The tripod mount is provided on the rear frame to be fixed to a tripod. The tripod lock screw fixes a rotational position around the optical axis of the rear frame to the camera body at a predetermined rotational position, in a state in which the lens barrel is mounted to the camera body.

10 Claims, 19 Drawing Sheets



- (51) **Int. Cl.**
G02B 7/14 (2006.01)
G03B 17/56 (2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2003/0218809 A1* 11/2003 Yamazaki G02B 7/02
359/819
2005/0237635 A1* 10/2005 Sugita F16M 11/16
359/818
2009/0185297 A1* 7/2009 Sugita G03B 17/561
359/819
2013/0022347 A1* 1/2013 Imura G03B 17/14
396/530

FOREIGN PATENT DOCUMENTS

JP 2001-350078 12/2001
JP 2012-037693 2/2012
JP 2012-047898 3/2012
JP 2013-045034 3/2013

* cited by examiner

FIG. 1A

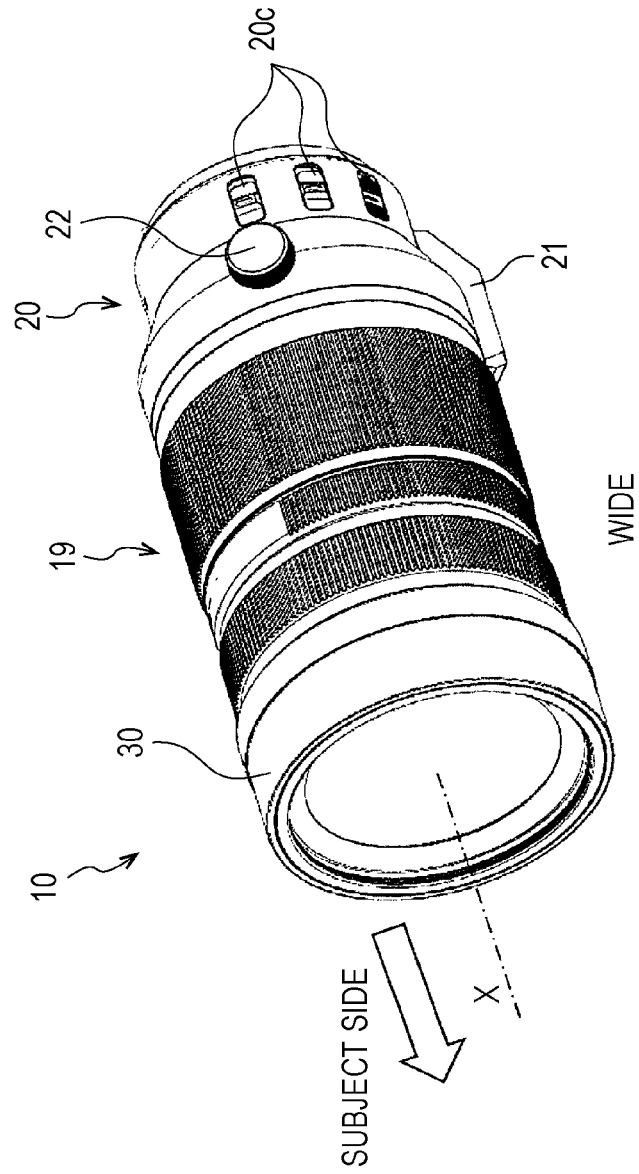


FIG. 1B

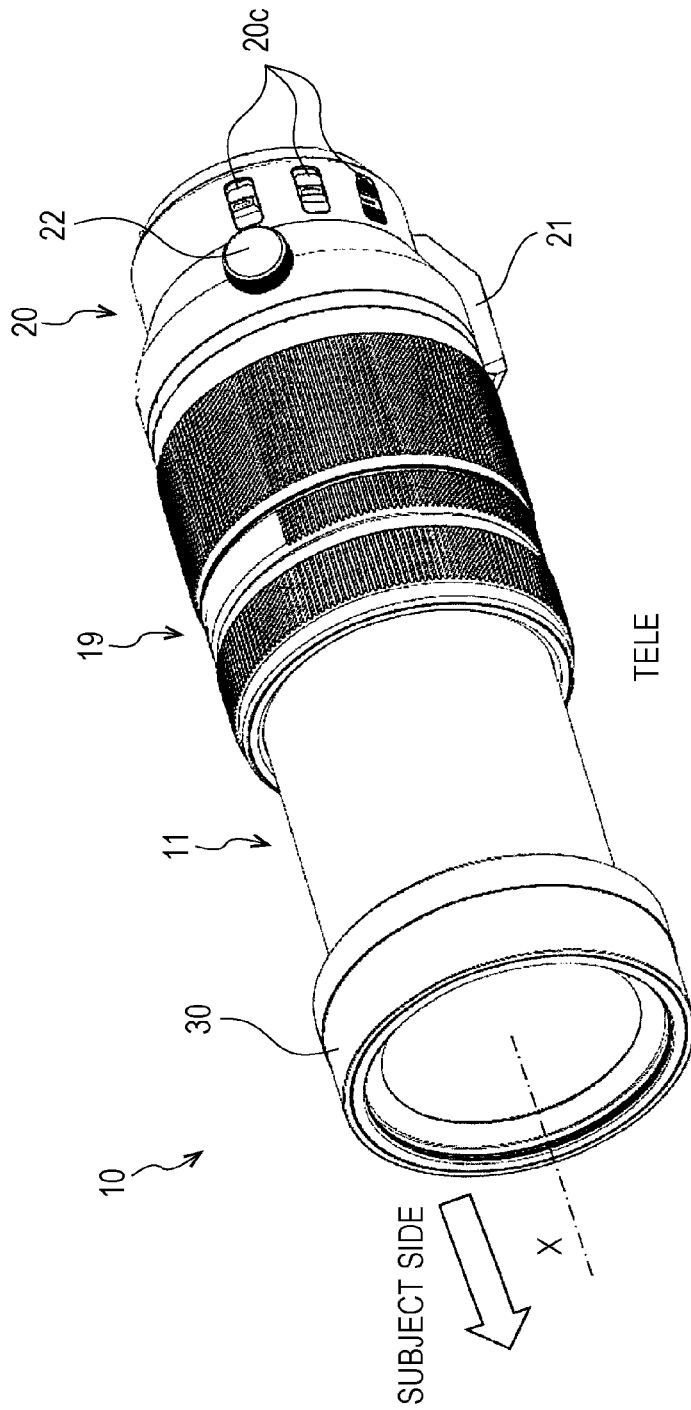
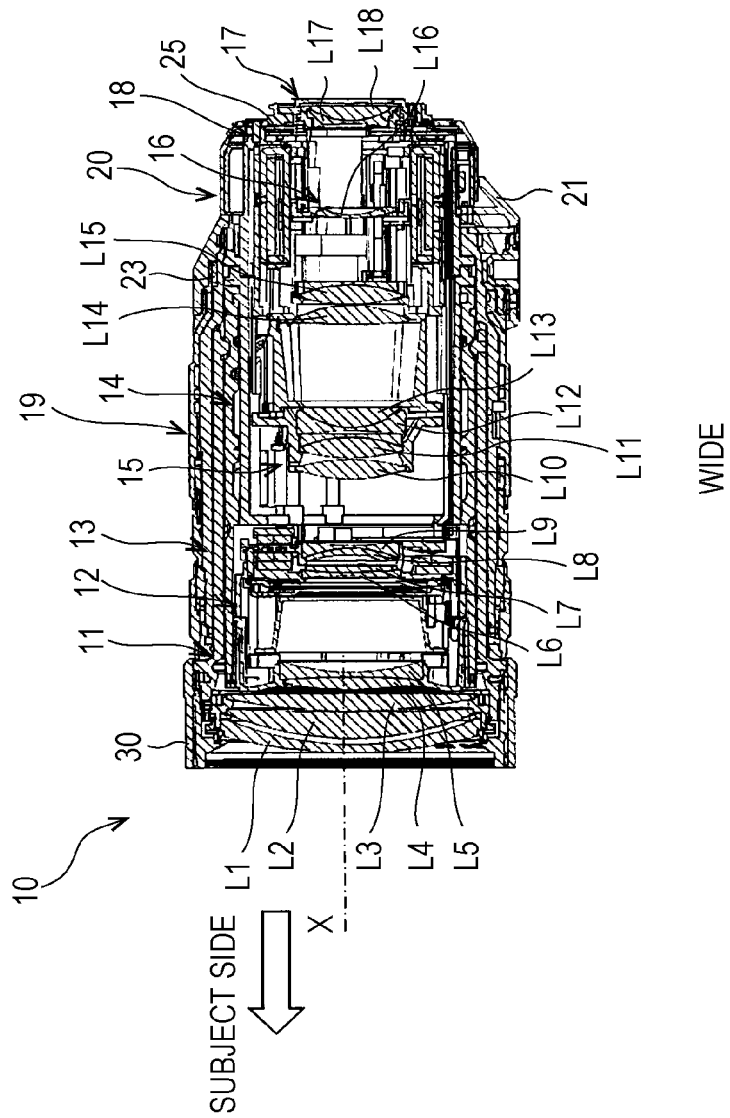
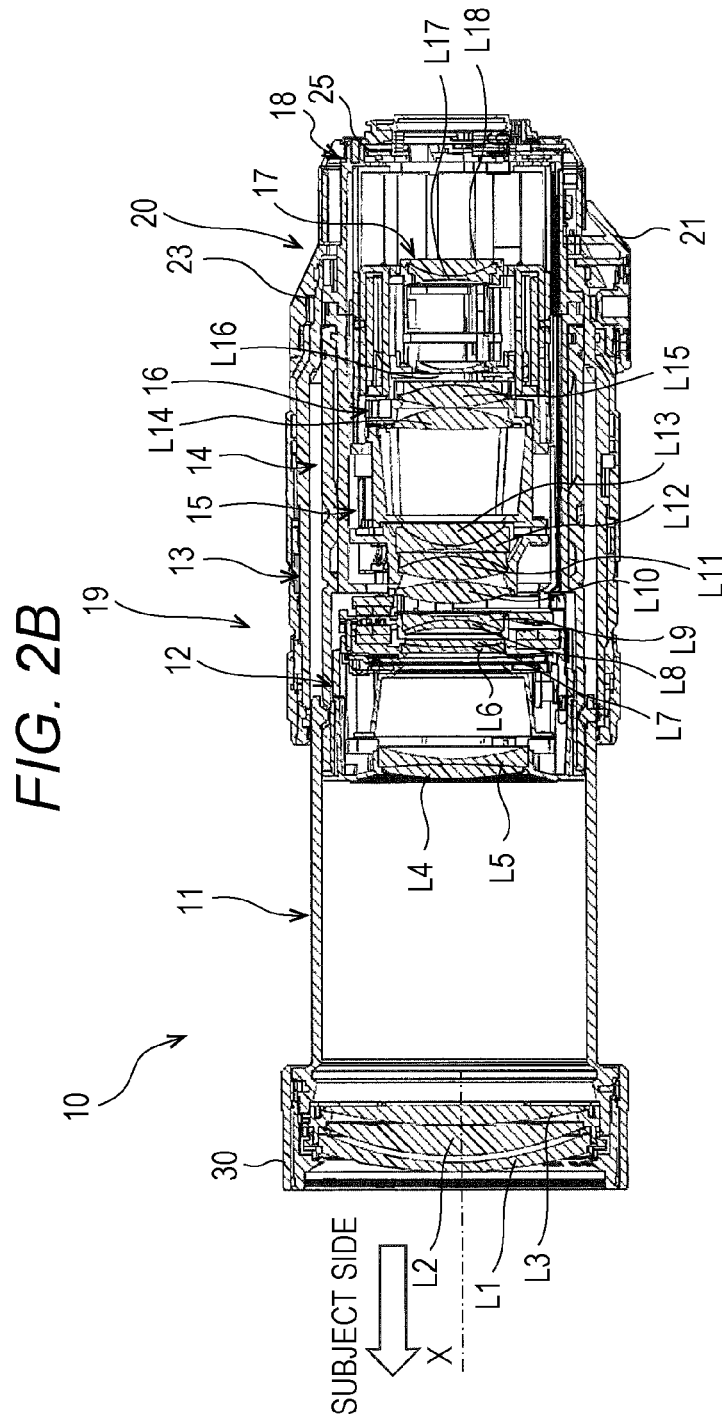


FIG. 2A





TELE

FIG. 3

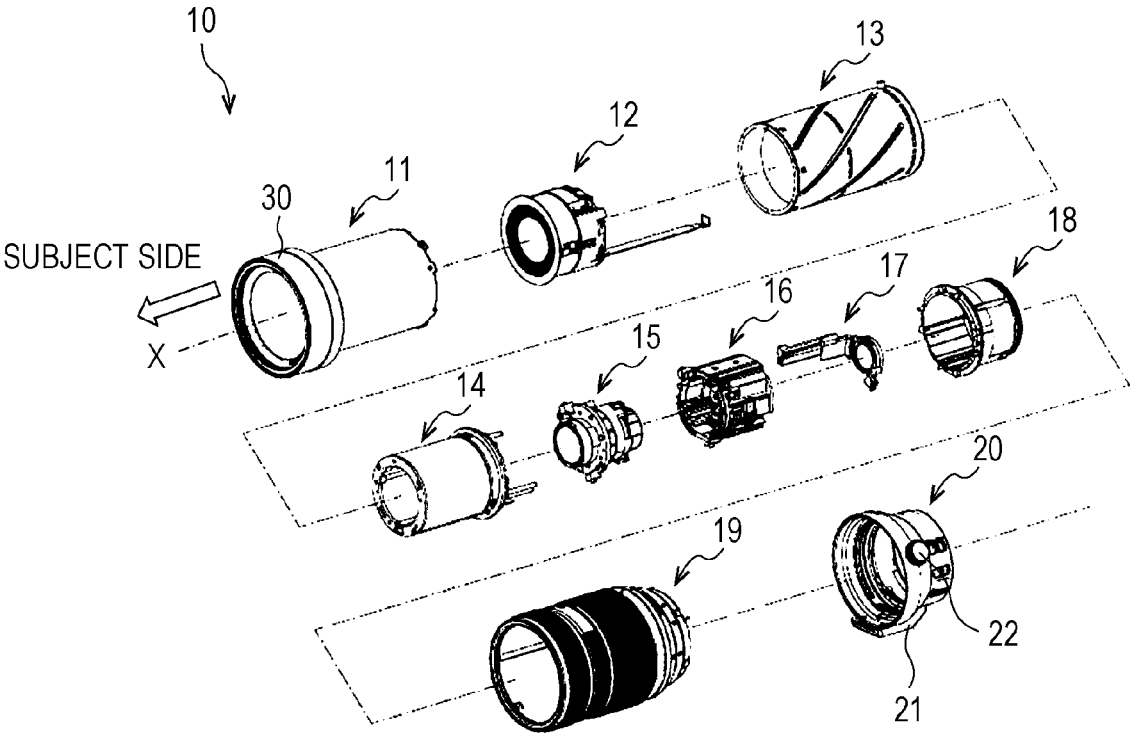


FIG. 4

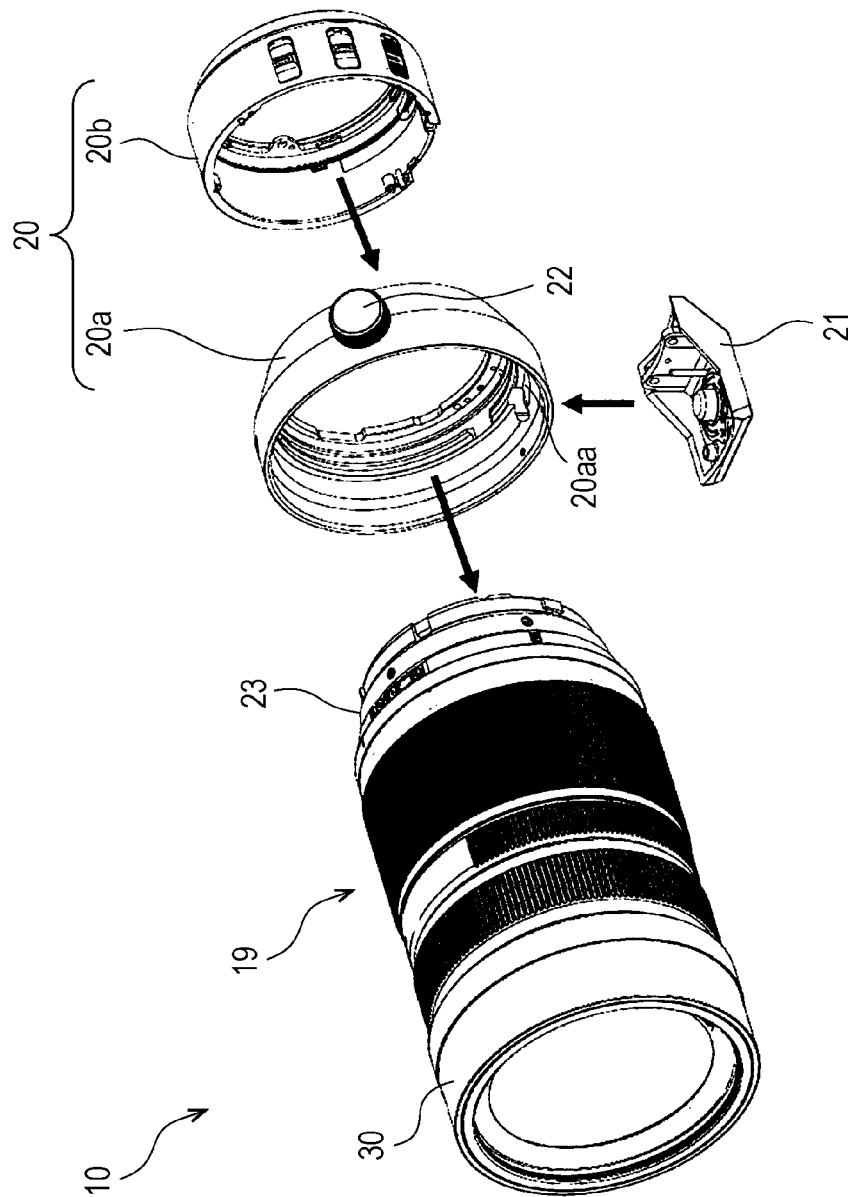


FIG. 5

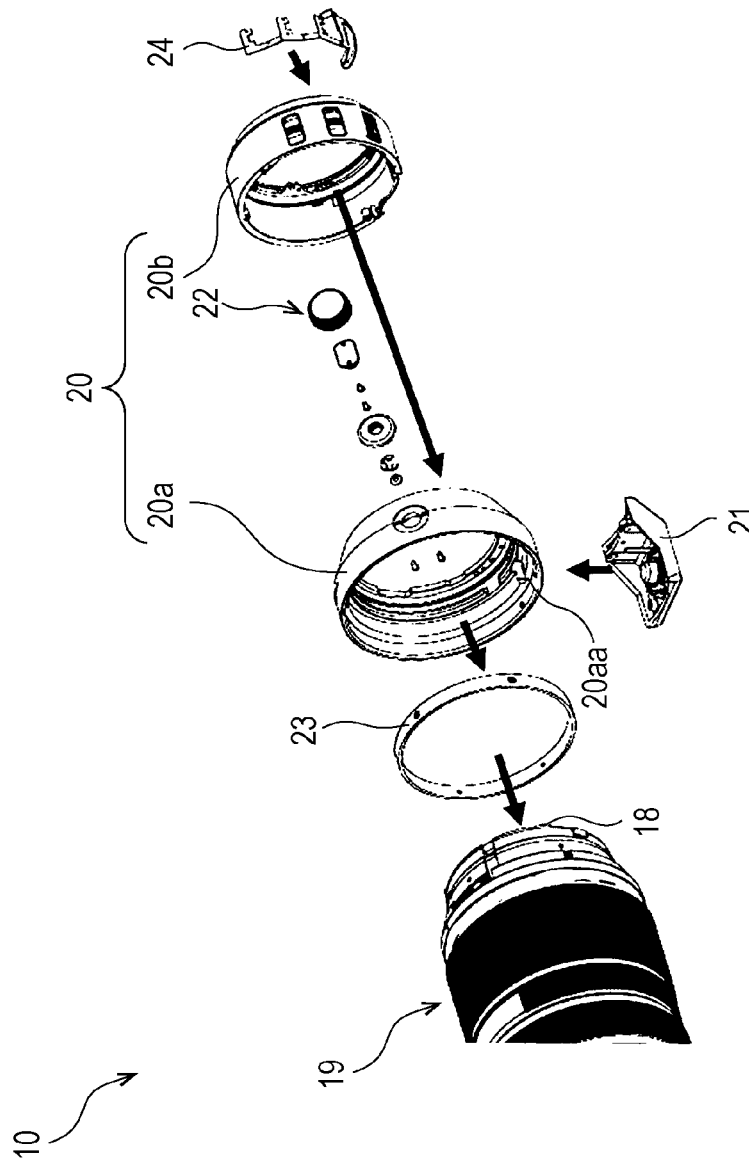


FIG. 6

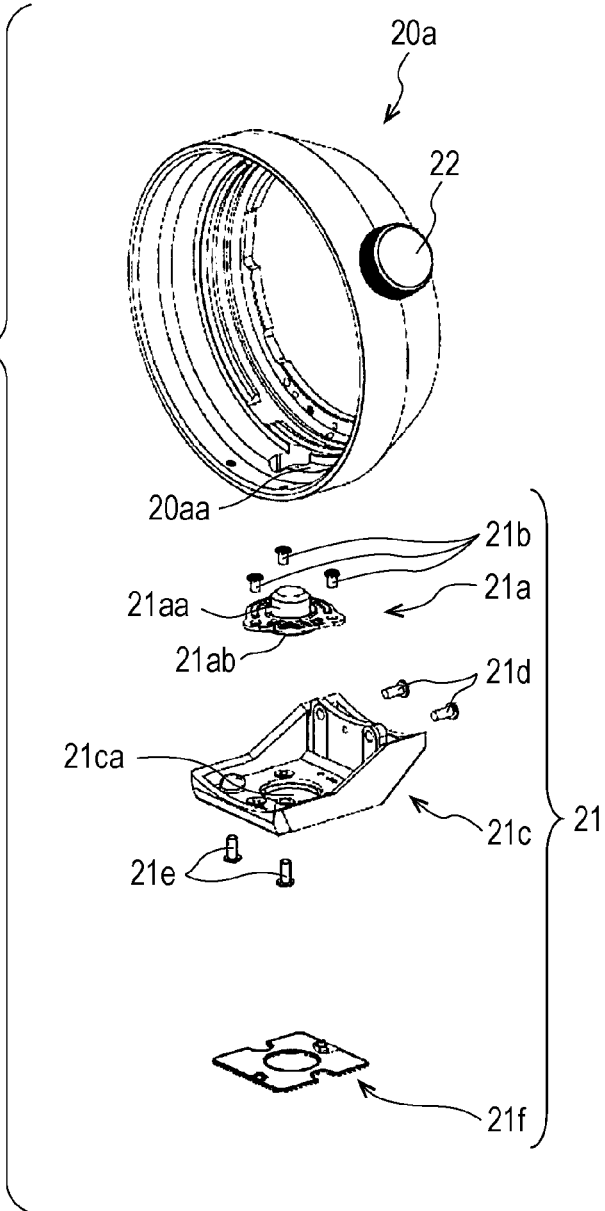


FIG. 7

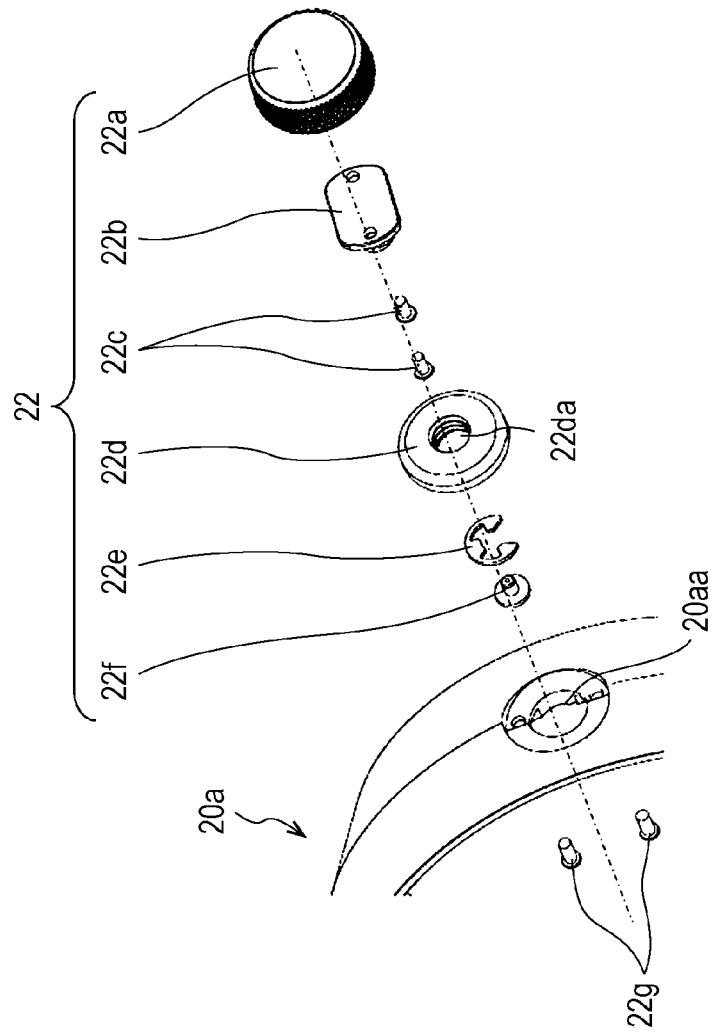


FIG. 8

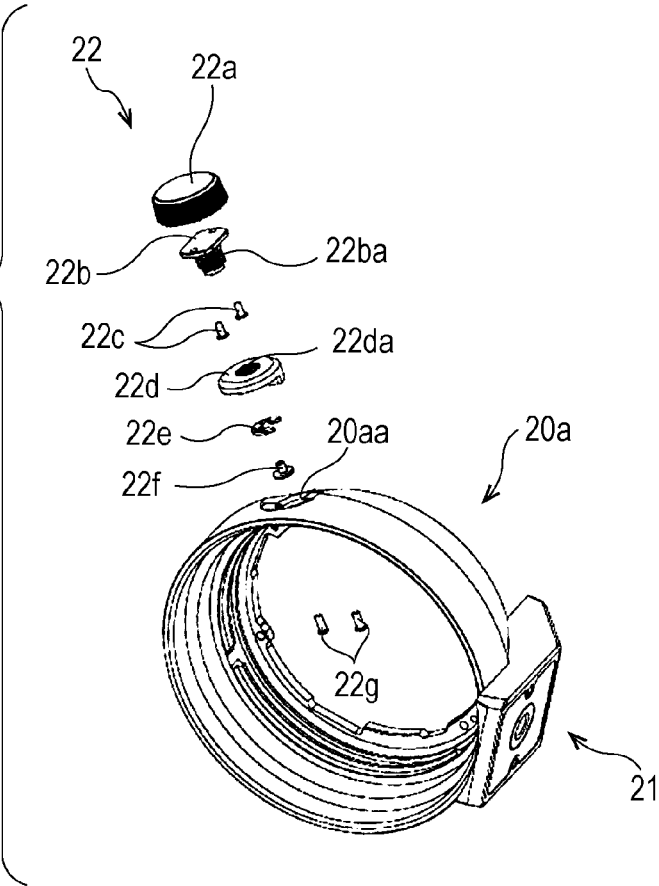


FIG. 9

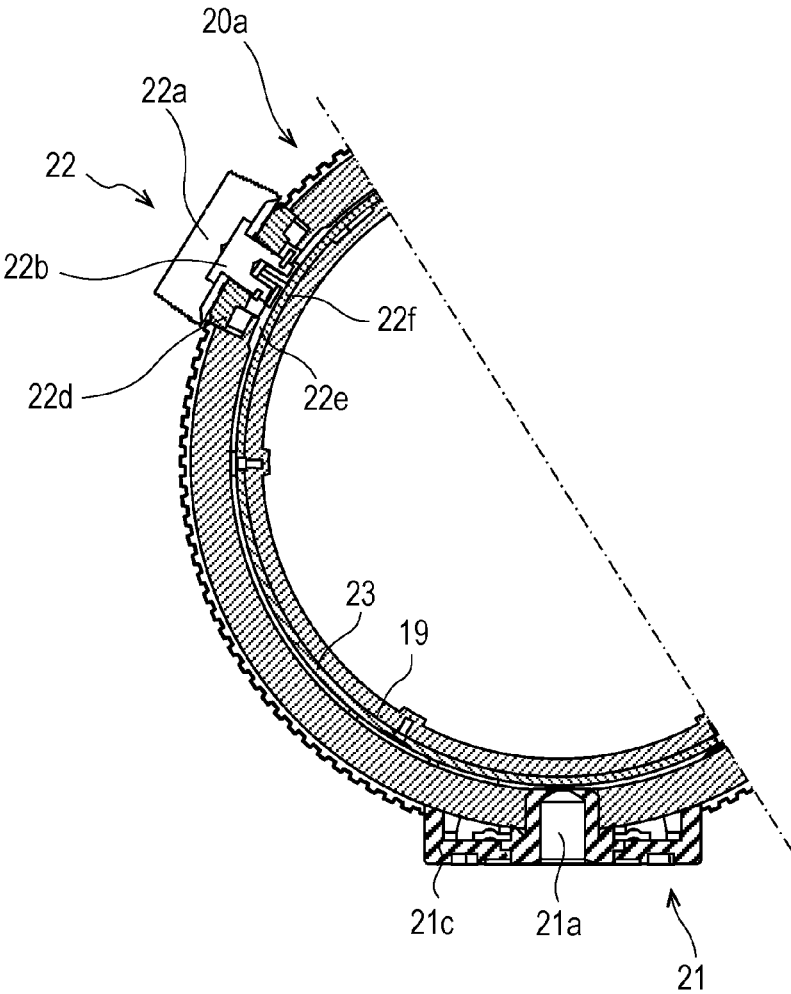


FIG. 10

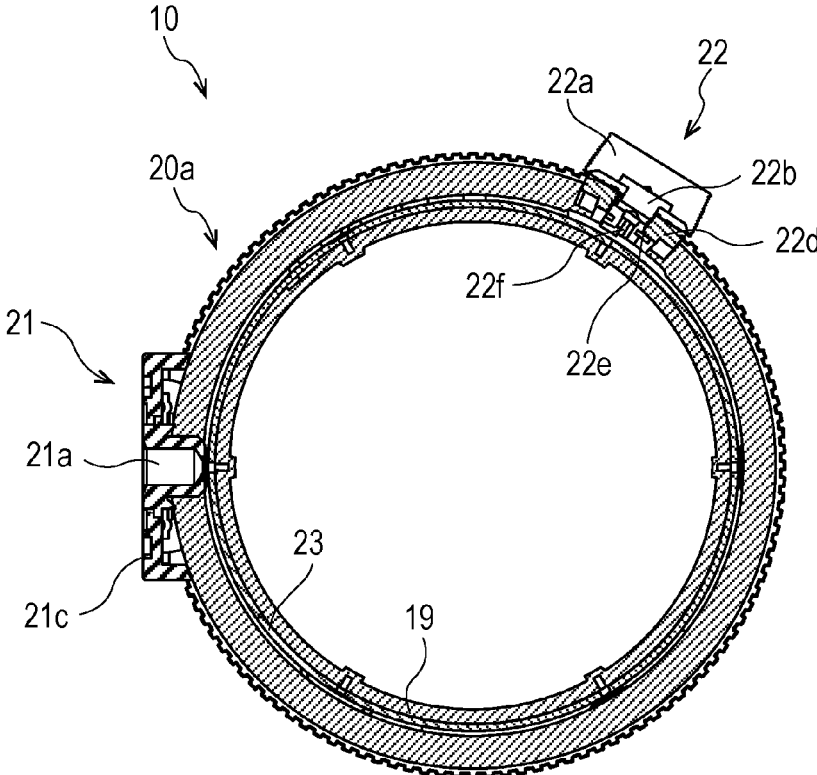


FIG. 11

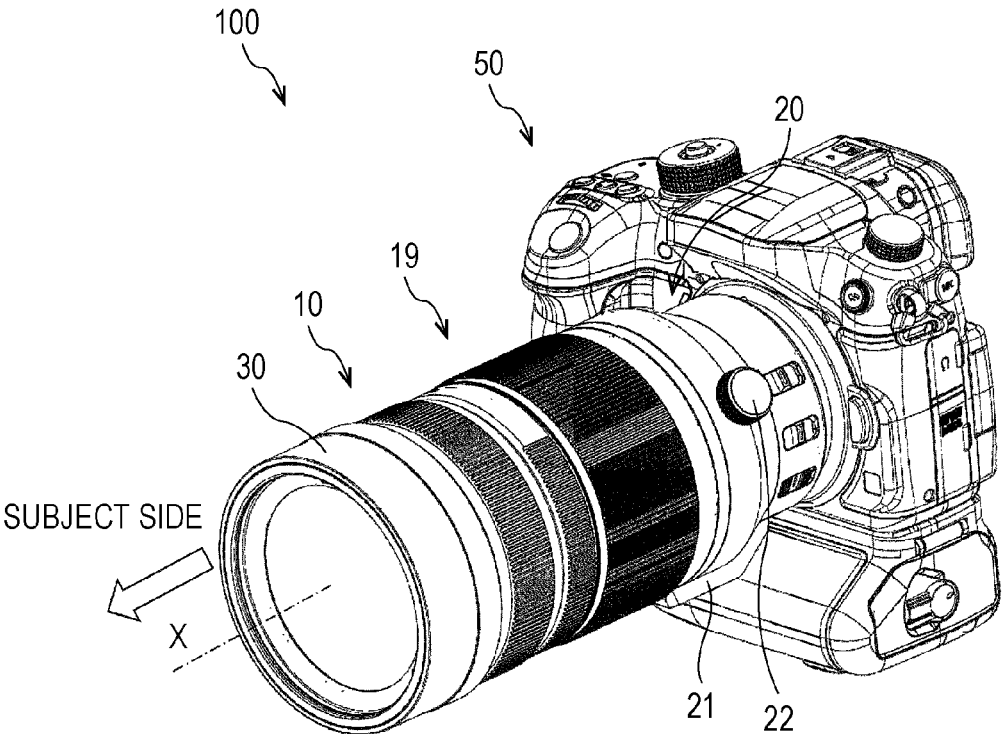


FIG. 12

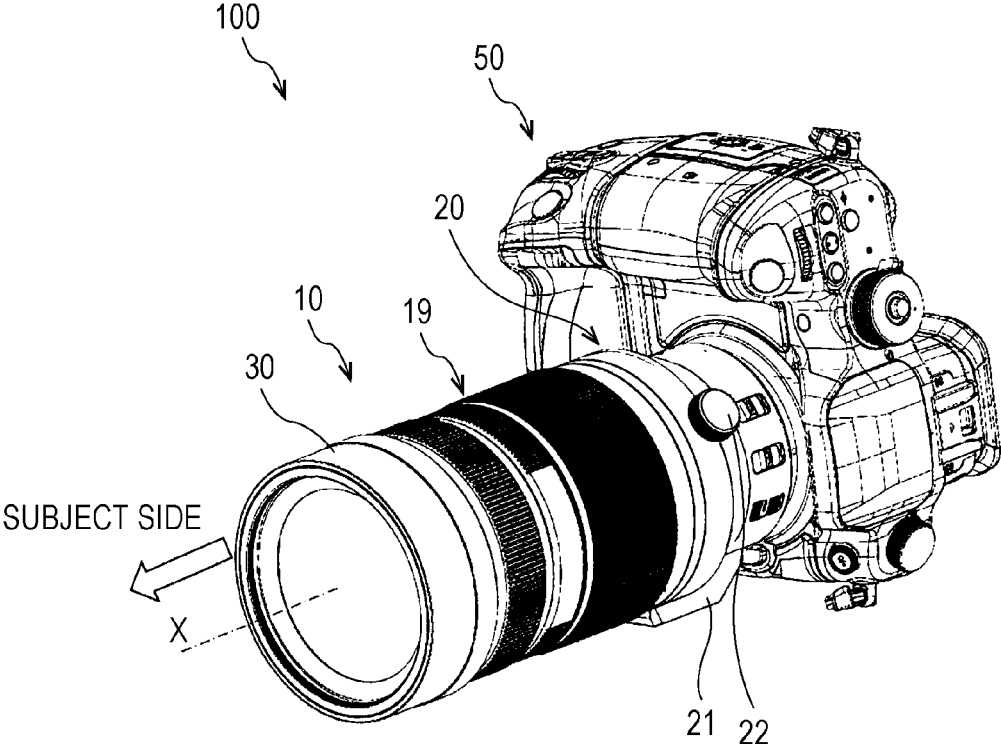
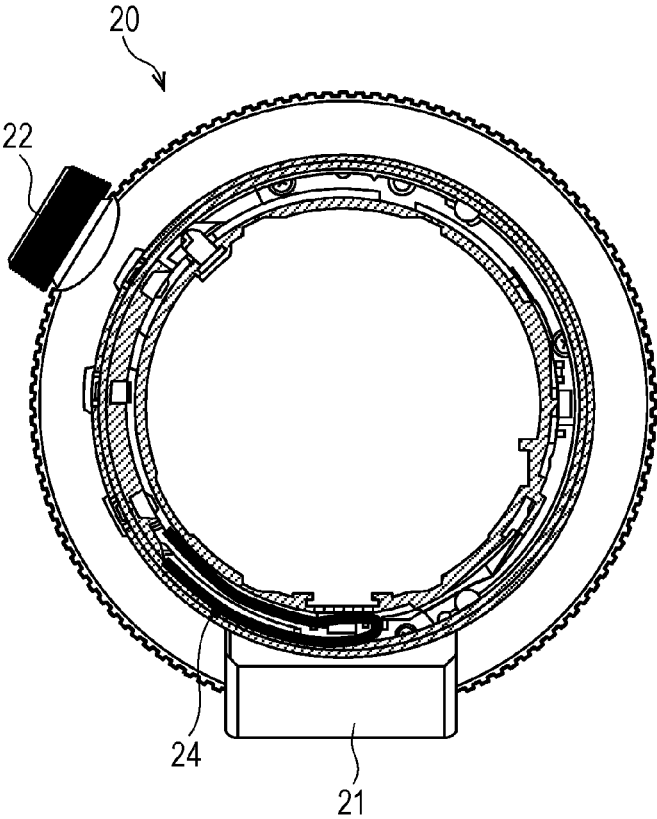
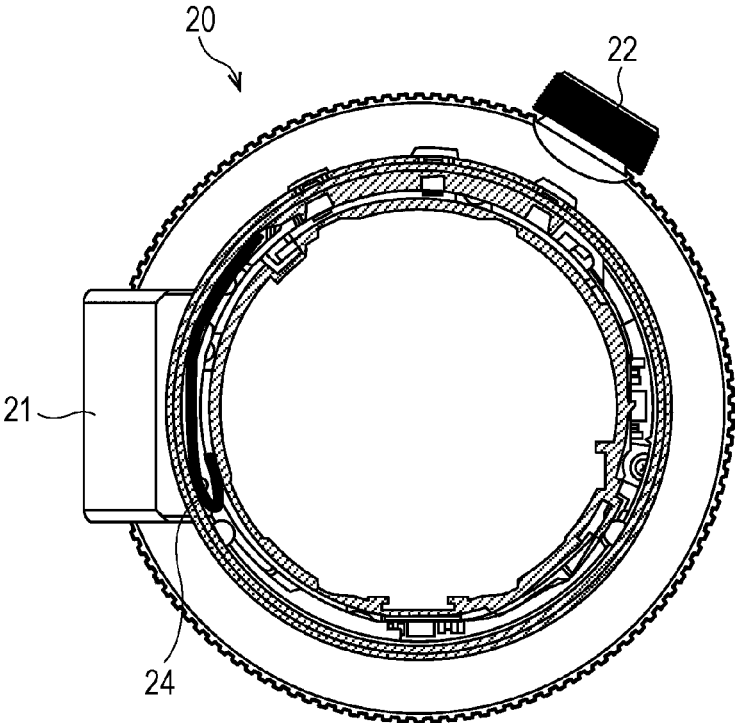


FIG. 13A



NORMAL ORIENTATION

FIG. 13B



90° ROTATION

FIG. 14

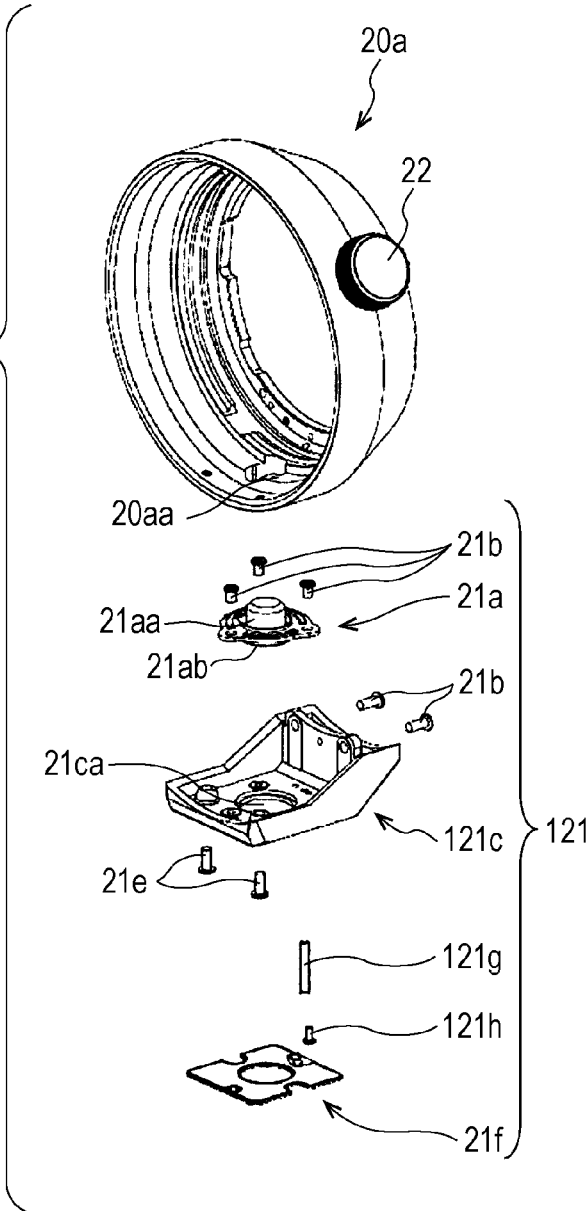
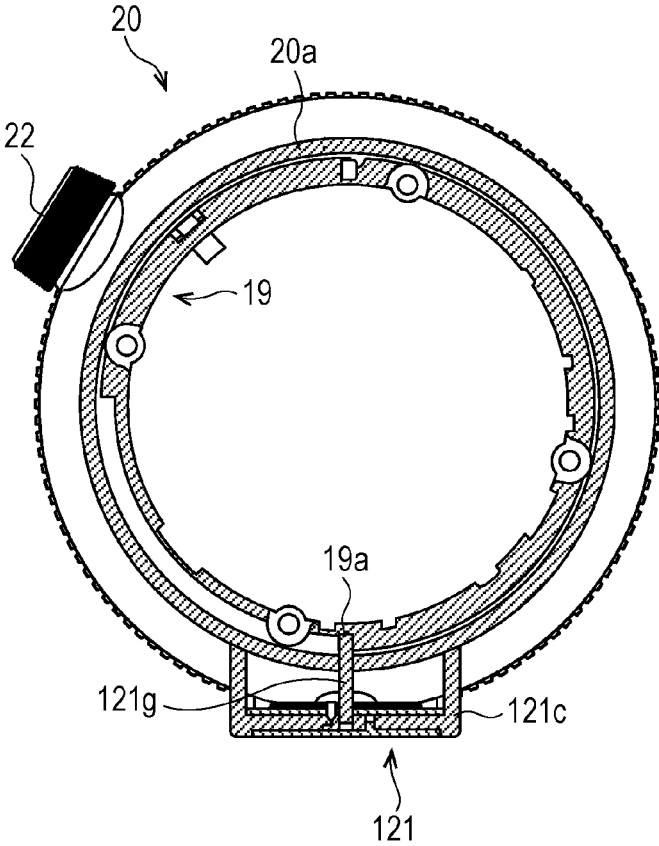
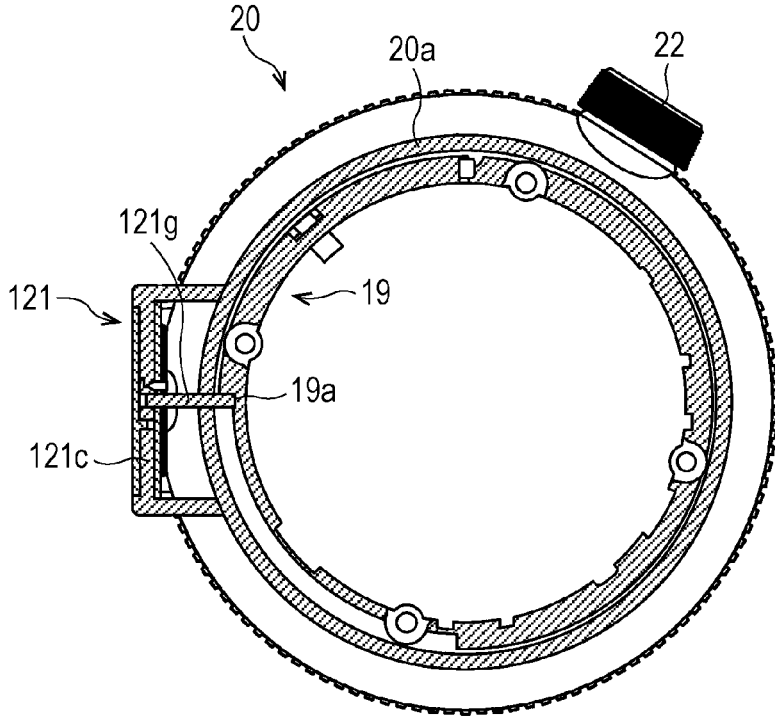


FIG. 15A



NORMAL ORIENTATION

FIG. 15B



90° ROTATION

LENS BARREL AND CAMERA PROVIDED WITH SAME

BACKGROUND

1. Technical Field

The present disclosure relates to a lens barrel and a camera provided with the same.

2. Description of the Related Art

A lens barrel having a long focal distance is larger in size and heavier in weight than a general lens barrel. Accordingly, when a lens barrel having a long focal distance is attached to a camera body, a gravity center position of a camera is moved to a subject side. As a result, when a tripod is connected to a camera body side, the camera may fall to the subject side due to the movement of the gravity center position of the camera to the subject side.

Therefore, a lens barrel provided with a tripod mount is used, so that a camera attached with a lens barrel having a long focal distance is supported by a tripod in a balanced manner.

PTL 1 discloses a lens barrel in which a tripod mount is mounted to an exterior ring via a tripod ring.

CITATION LIST

Patent Literature

PTL 1: Unexamined Japanese Patent Publication No. 2012-37693

SUMMARY

In a lens barrel having a ring-type rotational tripod mount, it is difficult to miniaturize the lens barrel and to reduce a number of components.

A lens barrel according to the present disclosure is a lens barrel detachably attached to a camera body. The lens barrel includes a front frame, a rear frame, a tripod mount, and a fixing member. The front frame includes an optical system. The rear frame is mounted to the front frame so as to be rotatable around an optical axis. An outer peripheral surface of the lens barrel is configured with the front frame and the rear frame. The tripod mount is provided on the rear frame to be fixed to a tripod. The fixing member that fixes the rear frame to the camera body at a predetermined rotational position to rotate around the optical axis, when the rear frame is attached to the camera body.

The lens barrel according to the present disclosure can attain miniaturization of the lens barrel and reduction of a number of components.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a perspective view illustrating a state in which an optical system of a lens barrel including a holding structure of a lens hood according to an exemplary embodiment of the present disclosure is located on a wide-angle side (a WIDE position);

FIG. 1B is a perspective view illustrating a state in which the optical system of the lens barrel in FIG. 1A is moved to a telephoto side (a TELE position);

FIG. 2A is a sectional view of the lens barrel in FIG. 1A;

FIG. 2B is a sectional view of the lens barrel in FIG. 1B;

FIG. 3 is an exploded perspective view of components that constitute the lens barrel in FIG. 1A;

FIG. 4 is an exploded perspective view of a rear frame that constitutes an exterior part disposed farther than the lens barrel from a subject in FIG. 1A;

FIG. 5 is a more detailed exploded perspective view of the rear frame in FIG. 4;

FIG. 6 is an exploded perspective view illustrating a configuration of a tripod mount mounted to the rear frame in FIG. 4;

FIG. 7 is an exploded perspective view illustrating a configuration of a tripod lock screw mounted to the rear frame in FIG. 4;

FIG. 8 is an exploded perspective view illustrating a configuration of the tripod lock screw mounted to the rear frame in FIG. 4;

FIG. 9 is a sectional view illustrating a state in which the tripod mount of the lens barrel in FIG. 1A is in a normal orientation;

FIG. 10 is a sectional view illustrating a state in which the tripod mount of the lens barrel in FIG. 1A is rotated by 90 degrees from the normal orientation;

FIG. 11 is a perspective view illustrating the state in which the tripod mount is in the normal orientation in a state in which the lens barrel in FIG. 1A is attached to a camera body;

FIG. 12 is a perspective view illustrating the state in which the tripod mount is rotated by 90 degrees from the normal orientation in the state in which the lens barrel in FIG. 1A is attached to the camera body;

FIG. 13A is a view illustrating a switch flexible part when the tripod mount is in the normal orientation in the state in which the lens barrel in FIG. 1A is attached to the camera body;

FIG. 13B is a view illustrating the switch flexible part when the tripod mount is rotated by 90 degrees from the normal orientation in the state in which the lens barrel in FIG. 1A is attached to the camera body;

FIG. 14 is an exploded perspective view illustrating a configuration of a tripod mount mounted to a rear frame included in a lens barrel according to another exemplary embodiment of the present disclosure;

FIG. 15A is a sectional view illustrating a state in which the tripod mount is in a normal orientation in a state in which the lens barrel in FIG. 14 is attached to a camera body; and

FIG. 15B is a sectional view illustrating a state in which the tripod mount is rotated by 90 degrees from the normal orientation in the state in which the lens barrel in FIG. 14 is attached to the camera body.

DETAILED DESCRIPTION

Exemplary embodiments will be described in detail below with reference to the drawings as appropriate. However, descriptions in more detail than necessary may be omitted. For example, a detailed description of a matter which is already well-known, or an overlapped description for a substantially identical configuration may be omitted. This is to avoid unnecessary redundancy of the following description and facilitate the understanding of one skilled in the art.

The applicant provides the attached drawings and the following description such that one skilled in the art can sufficiently understand the present disclosure, and therefore, they do not intend to restrict the subject matters of claims.

In a conventional lens barrel, it is necessary to separately prepare a member (a tripod ring) for providing a tripod mount to mount a tripod that supports the lens barrel.

Accordingly, a number of components that constitute the lens barrel may be increased, and the lens barrel may be enlarged.

First Exemplary Embodiment

A lens barrel according to an exemplary embodiment of the present disclosure is described below with reference to FIGS. 1A to 15B.

(Overall Configuration of Lens Barrel 10)

Lens barrel 10 according to the present exemplary embodiment is a lens barrel attached to a mount part of camera body 50 (see FIGS. 11 and 12).

Camera 100 includes lens barrel 10 and camera body 50. Lens barrel 10 has an optical system (lenses L1 to L18 (see FIG. 2A etc.)) that guides a subject image to an imaging element provided in camera body 50.

Further, as illustrated in FIG. 1A etc., lens hood 30 is mounted, at a tip part on a subject side of lens barrel 10, so as to be extendable to the subject side. Furthermore, as illustrated in FIGS. 1A and 1B, since the built-in optical system moves between a wide-angle side (a WIDE position) and a telephoto side (a TELE position) in lens barrel 10, photographing can be performed by changing a magnification.

In a state in which lens barrel 10 is at the WIDE position illustrated in FIG. 1A, first group unit 11 is stored in an inner peripheral surface side of exterior unit 19, as illustrated in FIG. 2A.

Meanwhile, in a state in which lens barrel 10 is at the TELE position illustrated in FIG. 1B, first group unit 11 advances to the subject side along optical axis X and protrudes from exterior unit 19 toward the subject, as illustrated in FIG. 2B.

Moreover, as illustrated in FIG. 3, lens barrel 10 includes first group unit 11, second group unit 12, cam frame 13, fixed frame 14, third group unit 15, fourth group unit 16, fifth group unit 17, mount base 18, exterior unit (front frame) 19, rear frame 20, and the optical system having a plurality of lenses L1 to L18.

As illustrated in FIG. 3, first group unit 11 is a cylindrical member disposed closest to the subject side in lens barrel 10. As illustrated in FIGS. 2A, 2B, and the like, first group unit 11 advances or retreats along optical axis X in a state of holding lenses L1 to L3 on the subject side. With this configuration, the magnification of the optical system can be changed by changing a distance between lenses L1 to L18. In other words, wide-angle photography, telephotography, or the like can be performed.

Further, first group unit 11 in the present exemplary embodiment has lens hood 30 provided at the tip part on the subject side to suppress incidence of unnecessary light during photographing.

As illustrated in FIG. 3, lens hood 30 is a cylindrical member. When lens hood 30 is used, lens hood 30 is mounted so as to be extendable to the subject side along optical axis X.

As illustrated in FIGS. 2A, 2B, and the like, second group unit 12 is a cylindrical member disposed on an inner peripheral surface side of first group unit 11 to hold lenses L4 to L9.

As illustrated in FIG. 3, cam frame 13 is a cylindrical member, and is disposed on an outer peripheral surface side of fourth group unit 16. Moreover, cam frame 13 is formed with a cam groove to be fitted with a cam pin (not illustrated) provided on an outer peripheral surface of fourth group unit 16. Cam frame 13 is engaged with a zoom ring to be

rotationally operated by a user. Cam frame 13 is rotationally driven in association with the rotation of the zoom ring.

When cam frame 13 rotates, the cam pin moves along the cam groove. With this configuration, positions of first group unit 11 to fifth group unit 17 in optical axis X direction can be adjusted by rotating cam frame 13. Hence, wide-angle photography, telephotography, or the like can be performed by adjusting distances between lenses L1 to L18 included in first group unit 11 to fifth group unit 17.

As illustrated in FIG. 3, fixed frame 14 is a cylindrical member disposed on outer peripheral sides of second group unit 12 and fourth group unit 16, which each have a cylindrical shape. Fixed frame 14 is disposed so as to cover outer peripheral surfaces of second group unit 12 to fourth group unit 16.

As illustrated in FIG. 3, third group unit 15 is disposed on an inner peripheral side of fourth group unit 16 having a cylindrical shape in a movable manner along optical axis X. As illustrated in FIGS. 2A, 2B, third group unit 15 holds lenses L10 to L15. Moreover, third group unit 15 moves along optical axis X in association with the rotation of cam frame 13.

Fourth group unit 16 is substantially cylindrical, and fourth group unit 16 holds lens L16. As illustrated in FIG. 3, fourth group unit 16 is disposed downstream of third group unit 15, as viewed from the subject side in optical axis X direction. Fourth group unit 16 moves along optical axis X in association with the rotation of cam frame 13. An auto-focus actuator moves lens L16 of fourth group unit 16 relatively to cam frame 13 along optical axis X.

As illustrated in FIG. 3, fifth group unit 17 is disposed on the inner peripheral side of fourth group unit 16 having a cylindrical shape in a movable manner in optical axis X direction. As illustrated in FIGS. 2A, 2B, fifth group unit 17 holds lenses L17, L18. Moreover, fifth group unit 17 moves along optical axis X in association with the rotation of cam frame 13.

As illustrated in FIG. 3, mount base 18 is a substantially cylindrical member serving as a base for lens barrel 10. Cam frame 13 is mounted to mount base 18 in a relatively rotatable manner. Fourth group unit 16 is held on inner peripheries of cam frame 13 and fixed frame 14.

As illustrated in FIGS. 1A, 4, and the like, exterior unit (front frame) 19 is a cylindrical member that constitutes an exterior part (an outer peripheral surface) of lens barrel 10. An annular focus ring, zoom ring, or the like is mounted to an outer peripheral surface of exterior unit 19 in a rotatable manner.

Rear frame 20 is mounted to a farther-end of exterior unit 19 from the subject. Both rear frame 20 and exterior unit 19 constitute the exterior part of lens barrel 10. Moreover, rear frame 20 is mounted to mount base 18 and exterior unit 19 in a relatively rotatable manner.

Further, rear frame 20 has switch member 20c operated by a user on an outer peripheral surface. Rear frame 20 includes circuit board 25 (see FIG. 2B etc.) and switch flexible part (flexible board) 24 (see FIG. 5 etc.). Circuit board 25 detects operation of switch member 20c by a user. Switch flexible part 24 is electrically connected to circuit board 25. Furthermore, as illustrated in FIG. 4, rear frame 20 has tripod base ring 20a and switch unit frame 20b.

As illustrated in FIG. 4, tripod mount 21 for connecting a tripod is mounted to an outer peripheral part of tripod base ring 20a. Further, as illustrated in FIG. 5, tripod base ring 20a is mounted to a farther-end of mount base 18 from the subject, via tripod reinforcing ring 23.

5

As illustrated in FIG. 4, mounting part **20aa** is an opening part formed so as to penetrate from an outer peripheral surface to an inner peripheral surface side of tripod base ring **20a**. Tripod mount **21** is mounted to mounting part **20aa**.

As illustrated in FIG. 4, switch unit frame **20b** is a cylindrical member mounted to a farther-end of tripod base ring **20a** from the subject. Note that, as illustrated in FIG. 5, switch unit frame **20b** is fixed to tripod base ring **20a** by using a plurality of screws (not illustrated). Moreover, various switches (switch member **20c**) including a switch that switches between auto focus (AF) and manual focus (MF) are provided on an outer peripheral surface of switch unit frame **20b**.

Tripod mount **21** is a pedestal to which a tripod (not illustrated) is connected. Tripod mount **21** is mounted on the outer peripheral surface of tripod base ring **20a** that constitutes the exterior part of lens barrel **10**. Moreover, as illustrated in FIG. 6, tripod mount **21** has tripod screw **21a**, screws **21b**, tripod base **21c**, screws **21d**, screws **21e**, and cover **21f**.

Tripod screw **21a** is a member made of metal into which a male screw part on a tripod side is screwed. With this configuration, the tripod is fixed to tripod mount **21**. As illustrated in FIG. 6, tripod screw **21a** has column part **21aa** and screw part **21ab**.

Column part **21aa** is mounted to the opening part (mounting part **20aa**) formed in tripod base ring **20a** in an inserted manner.

Screw part **21ab** is a female screw part into which the male screw part on the tripod side is screwed. As illustrated in FIG. 6, screw part **21ab** is formed on a surface on a side opposite to column part **21aa** in tripod screw **21a**.

As illustrated in FIG. 6, screws **21b** are used to fix tripod screw **21a** to tripod base **21c**.

As illustrated in FIG. 6, tripod base **21c** is mounted to tripod base ring **20a**. Tripod base **21c** is fixed to the outer peripheral surface of tripod base ring **20a** at four places by using screws **21d** and screws **21e**. Tripod screw **21a** is mounted to tripod base **21c**. With this configuration, tripod base ring **20a** is fixed to tripod screw **21a**. In other words, tripod base ring **20a** is fixed to the tripod in a state in which the tripod is mounted to tripod screw **21a**.

As illustrated in FIG. 6, cover **21f** is a plate-shaped member made of resin that constitutes a surface on a side to which the tripod is connected (a lower side in FIG. 6) in tripod base **21c**. Cover **21f** is formed with screw holes into which screws **21e** are inserted. Note that the plate-shaped member may be made of metal.

As illustrated in FIG. 6, and the like, tripod lock screw (fixing member) **22** is mounted on the outer peripheral surface of tripod base ring **20a**. When tripod lock screw **22** is loosened, rear frame **20** is relatively rotatable to exterior unit **19** (front frame). When tripod lock screw **22** is fixed, tripod lock screw **22** regulates relative rotation of rear frame **20** and exterior unit **19**. With this configuration, the relative rotation of rear frame **20** and exterior unit **19** can be fixed at an arbitrary rotational position. Specifically, as illustrated in FIGS. 7 and 8, tripod lock screw **22** has rotary knob **22a**, lock screw **22b**, screws **22c**, screw base **22d**, fixing tool **22e**, holding pin **22f**, and screws **22g**. With this configuration, tripod lock screw **22** can apply pressing force in a direction crossing optical axis X and regulate relative rotation of rear frame **20** to exterior unit **19**.

Rotary knob **22a** is a rotary knob member that constitutes an exterior surface of tripod lock screw **22** and is rotationally operated by a user's finger.

6

As illustrated in FIG. 8, lock screw **22b** has male screw part **22ba** to be mounted to tripod base ring **20a**. Moreover, as illustrated in FIGS. 7 and 8, lock screw **22b** is fixed to a back surface side of rotary knob **22a** by using two screws **22c**.

As illustrated in FIGS. 7 and 8, screw base **22d** has female screw part **22da** into which male screw part **22ba** of lock screw **22b** is screwed. By screwing male screw part **22ba** into female screw part **22da**, screw base **22d** and rotary knob **22a** are mounted in a rotatable manner. Further, as illustrated in FIGS. 7 and 8, screw base **22d** is fixed to the outer peripheral surface of tripod base ring **20a** by using two screws **22g**.

As illustrated in FIGS. 7 and 8, fixing tool **22e** is disposed so as to be sandwiched between screw base **22d** and mounting part **20aa**. Fixing tool **22e** regulates a rotation range of male screw part **22ba**. With this configuration, fixing tool **22e** prevents male screw part **22ba** from coming out of female screw part **22da** into which male screw part **22ba** is screwed.

Holding pin **22f** is fixed to a tip part of male screw part **22ba** of lock screw **22b**. When rotary knob **22a** is rotationally operated, holding pin **22f** moves in a radial direction. A fixed state of tripod lock screw **22** is a state in which holding pin **22f** is moved in a pushing direction, that is, a state in which holding pin **22f** is protruded from the opening of mounting part **20aa** to the inner peripheral surface side (an inner side in the radial direction) of tripod base ring **20a**. With this configuration, when tripod lock screw **22** is in the fixed state, holding pin **22f** can apply pressing force to a member disposed on the inner peripheral surface side of tripod base ring **20a** (tripod reinforcing ring **23**).

As illustrated in FIGS. 9 and 10, tripod reinforcing ring **23** is a ring-shaped member made of metal (an aluminum material (A5052), a stainless steel material (SUS), etc.) disposed on an inner peripheral side of holding pin **22f** of tripod lock screw **22**. When tripod lock screw **22** is rotationally operated and pushed into the inner peripheral side (the inner side in the radial direction) of tripod base ring **20a**, holding pin **22f** applies pressing force to an outer peripheral surface of tripod reinforcing ring **23**. With this configuration, frictional force is generated between holding pin **22f** and tripod reinforcing ring **23**. Tripod reinforcing ring **23** is fixed to a member disposed on an inner peripheral side (a rear end of exterior unit **19**) with a screw. With this configuration, rotation of exterior unit **19** to rear frame **20** can be regulated.

When the pressing force applied from holding pin **22f** is applied to exterior unit **19** at this time, the rear end of exterior unit **19** may be deformed. Since tripod reinforcing ring **23** has higher rigidity than exterior unit **19**, the pressing force applied from holding pin **22f** can be dispersed. With this configuration, deformation of the rear end of exterior unit **19** caused by the pressing force applied from holding pin **22f** can be prevented.

By regulating the rotation of exterior unit **19** to rear frame **20** as above, rotation of rear frame **20** to mount base **18** (camera body **50**) can be regulated. As a result, a rotational position of camera body **50** to tripod mount **21** can be fixed at a desired rotational position. In other words, a photographing orientation of camera **100** can be changed, and the photographing orientation can be held, in a state in which lens barrel **10** is fixed to the tripod.

When photographing using a tripod is performed in a state in which camera body **50** is placed in a normal orientation to a subject, as illustrated in FIG. 11, tripod mount **21** and a bottom surface of camera body **50** are at the same rotational position. Accordingly, when photographing is

performed in the normal orientation illustrated in FIG. 11, tripod lock screw 22 is rotated clockwise at the rotational position illustrated in FIG. 9 and fixed, thereby regulating rotation of rear frame 20.

With this configuration, relative rotational positions of tripod mount 21 and camera body 50 in the normal orientation can be held. In other words, photographing can be performed while preventing camera body 50 from rotating during the photographing.

Meanwhile, as illustrated in FIG. 12, when photographing using the tripod is performed in a state in which camera body 50 is rotated by 90 degrees to the subject, tripod mount 21 is fixed at a position rotated by 90 degrees to the bottom surface of camera body 50. When photographing is performed in a rotated orientation illustrated in FIG. 12 (an orientation rotated by 90 degrees), tripod lock screw 22 is rotated clockwise at a rotational position illustrated in FIG. 10 and fixed, thereby regulating rotation of rear frame 20.

With this configuration, relative rotational positions of tripod mount 21 and camera body 50 in the orientation rotated by 90 degrees can be held. In other words, photographing can be performed while preventing camera body 50 from rotating during the photographing.

Note that the bottom surface of camera body 50 is a surface on a side opposite to an upper part of camera body 50 to which a shutter or an electronic flash is attached in the normal orientation.

Switch flexible part (flexible board) 24 is a flexible board electrically connecting various switches of switch unit frame 20b and circuit board 25 (see FIG. 2A etc.) that constitute a farther-side of rear frame 20 from the subject. As illustrated in FIG. 5, switch flexible part 24 is disposed along an inner peripheral surface of switch unit frame 20b.

In lens barrel 10 of the present exemplary embodiment, as described above, rear frame 20 mounted with tripod mount 21 is rotatable to mount base 18. At this time, circuit board 25, to which one terminal of switch flexible part 24 is connected, is fixed to a member on a side of mount base 18. Meanwhile, the various switches, to which another terminal of switch flexible part 24 is connected, rotate together with switch unit frame 20b.

Accordingly, in the normal orientation illustrated in FIG. 11 and the orientation rotated by 90 degrees illustrated in FIG. 12, switch flexible part 24 is disposed on an inner peripheral surface side of switch unit frame 20b in a bent manner.

Specifically, when camera 100 is in the normal orientation illustrated in FIG. 11, switch flexible part 24 is bent at a substantially center in a longitudinal direction along the inner peripheral surface of switch unit frame 20b, as illustrated in FIG. 13A.

Meanwhile, when camera 100 is in the orientation rotated by 90 degrees illustrated in FIG. 12, switch flexible part 24 is bent near one end in the longitudinal direction along the inner peripheral surface of switch unit frame 20b, as illustrated in FIG. 13B.

With this configuration, even when an orientation of camera 100 is changed in a state in which the tripod is connected, a bending degree of switch flexible part 24 is changed following rotation of rear frame 20 mounted with tripod mount 21. As a result, even when rear frame 20 is rotated, electrical connection between various switches of switch unit frame 20b and circuit board 25 can be secured.

With this configuration, while switch member 20c is provided on rear frame 20, exterior unit (front frame) 19 can be relatively rotated to rear frame 20. By providing switch member 20c on rear frame 20, even when a photographing

orientation of camera body 50 is rotated, position of switch member 20c to the tripod is not changed. With this configuration, operation positions of the various switches can be fixed when camera body 50 is in the normal orientation and in the orientation rotated by 90 degrees.

Next, description is given of a configuration that can facilitate positioning in a state in which the photographing position of camera 100 is in the normal orientation as illustrated in FIG. 11 and in a state in which camera 100 is rotated by 90 degrees as illustrated in FIG. 12.

In this configuration, as illustrated in FIG. 14, locking pin 121g and fixing screw 121h are provided in tripod mount 121. Locking pin 121g is inserted into a through-hole that penetrates tripod base 121c. Fixing screw 121h advances and retreats locking pin 121g along a radial of the rear frame. As illustrated in FIGS. 15A and 15B, abutting part 19a serving as a step is formed at two places in exterior unit 19. Herein, the two steps are formed at positions where a central angle is 90 degrees on a circumference. When tripod mount 121 moves along with rotation of rear frame 20, locking pin 121g abuts on abutting part 19a at a predetermined position. Accordingly, a rotation range of rear frame 20 is regulated. In each end of the rotation range of rear frame 20, locking pin 121g of tripod mount 121 abuts on abutting part 19a of exterior unit 19. By rotating tripod lock screw 22 in this state to regulate the rotation of rear frame 20, exterior unit 19 and rear frame 20 can be fixed at predetermined rotational positions. With such a configuration, locking pin 121g and abutting part 19a can easily fix rear frame 20 at rotational positions in the normal orientation and the orientation rotated by 90 degrees.

Other Exemplary Embodiments

One exemplary embodiment of the present disclosure has been described above, but the present disclosure is not limited thereto, and various modifications may be made without departing from the scope of the present disclosure. (A)

As illustrated in FIG. 4, the above-described exemplary embodiment has been described by way of an example in which rear frame 20 mounted with tripod mount 21 is divided into tripod base ring 20a and switch unit frame 20b. However, the present disclosure is not limited to this example.

For example, a tripod mount may be provided on a rear frame which is indivisible and in which tripod base ring 20a and switch unit frame 20b are integrated with each other.

(B) As illustrated in FIG. 4 etc., the above-described exemplary embodiment has been described by way of an example in which tripod mount 21 is mounted to rear frame 20 that constitutes a part of the exterior part of lens barrel 10. However, the present disclosure is not limited to this example.

For example, if a rotating member is mounted so as to be rotatable to a mount base mounted to a camera body, a lens barrel in which a tripod mount is mounted to another exterior part may be used.

(C) As illustrated in FIG. 6, the above-described exemplary embodiment has been described by way of an example in which tripod mount 21 is mounted to the outer peripheral surface of rear frame 20 (tripod base ring 20a) by using the plurality of screws 21d, 21e. However, the present disclosure is not limited to this example.

For example, a lens barrel in which a tripod mount is integrally molded with a rear frame may be used.

(D)

The above-described exemplary embodiment has been described by way of an example in which tripod lock screw **22** is rotationally operated to regulate rotation of rear frame **20**, in a state in which camera **100** is in the normal orientation (FIG. **11**) and in the orientation rotated by 90 degrees (FIG. **12**). However, the present disclosure is not limited to this example.

For example, when photographing is performed in a state in which a camera fixed to a tripod is inclined by 45 degrees to a subject, a tripod lock screw may be rotationally operated so as to regulate rotation of a rear frame in an orientation at a desired rotation angle.

In other words, the tripod lock screw may be rotationally operated in the other camera orientation, without being limited to the normal orientation and the orientation rotated by 90 degrees, to regulate rotation of the rear frame.

(E)

The above-described exemplary embodiment has been described by way of an example in which, when rotation of rear frame **20** is regulated in the desired orientation to fix rear frame **20**, tripod lock screw **22** is rotationally operated to apply pressing force to the inner peripheral side (the inner side in the radial direction). However, the present disclosure is not limited to this example.

For example, a fixing member, such as a tripod lock screw, is not limited to a rotationally operated member, and a pushing member may be used.

In this case, in order to regulate rotation of rear frame **20** in a desired orientation and fix rear frame **20**, pressing force can be applied to the inner peripheral side by pushing the fixing member at a desired rotational position. As a result, an effect similar to the effect of the above-described exemplary embodiment can be obtained.

Meanwhile, rotation of the rear frame can be regulated by frictional force according to a configuration that applies pressing force. With this configuration, a rotational position of the rear frame can be prevented from becoming unstable caused by vibration etc. applied to camera **100**.

A lens barrel of the present disclosure does not require a ring-type rotational tripod mount and can effectively attain miniaturization and reduction of a number of components. Accordingly, the present disclosure is widely applicable to a lens barrel provided with a tripod mount.

What is claimed is:

1. A lens barrel detachably attached to a camera body, the lens barrel comprising:

a front frame to hold an optical system;
 a rear frame that constitutes an outer peripheral surface of the lens barrel together with the front frame, the rear frame being mounted to the front frame so as to be rotatable around an optical axis;

a tripod mount provided on the rear frame to be fixed to a tripod;

a fixing member that fixes the rear frame to the camera body at a predetermined rotational position to rotate around the optical axis, when the front frame is attached to the camera body; and

a locking pin extending from the tripod mount and along a radial of the rear frame that is at the predetermined rotational position, the locking pin restricts a rotation range of the rear frame by abutting on abutting parts at both ends of an arc-shaped groove on an inner peripheral surface of the front frame.

2. The lens barrel according to claim 1, wherein the rear frame has a switch member for operation, and when the camera body is rotated in a state in which the tripod mount is fixed to the tripod, relative rotation of the switch member to the tripod is regulated.

3. The lens barrel according to claim 2, wherein the rear frame has a flexible board to electrically connect the switch members and the front frame, and the locking pin is located on a subject side along an optical axis direction to the flexible board.

4. The lens barrel according to claim 3, wherein the fixing member regulates rotation of the rear frame by pressing force to the front frame.

5. The lens barrel according to claim 4, wherein the fixing member has a screw part formed to advance and retreat, crossing the optical axis.

6. The lens barrel according to claim 2, wherein the fixing member regulates rotation of the rear frame by pressing force to the front frame.

7. The lens barrel according to claim 6, wherein the fixing member has a screw part formed to advance and retreat, crossing the optical axis.

8. The lens barrel according to claim 1, wherein the fixing member regulates rotation of the rear frame by pressing force to the front frame.

9. The lens barrel according to claim 8, wherein the fixing member has a screw part formed to advance and retreat, crossing the optical axis.

10. A camera comprising:
 the lens barrel according to claim 1; and
 a camera body to which the lens barrel is attached.

* * * * *