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

(10) **Patent No.: US 12,393,099 B2**
(45) **Date of Patent: *Aug. 19, 2025**

(54) **CAMERA MODULE AND CAMERA APPARATUS INCLUDING SAME**

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(73) Assignee: **LG INNOTEK CO., LTD.**, Seoul (KR)

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

This patent is subject to a terminal disclaimer.

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(22) Filed: **Apr. 8, 2024**

(65) **Prior Publication Data**

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**Related U.S. Application Data**

(63) Continuation of application No. 17/606,638, filed as application No. PCT/KR2020/005454 on Apr. 24, 2020, now Pat. No. 11,982,933.

(30) **Foreign Application Priority Data**

Apr. 26, 2019 (KR) ........................ 10-2019-0049196

(51) **Int. Cl.**

***G03B 5/00*** (2021.01)
***G03B 17/12*** (2021.01)

(Continued)

(52) **U.S. Cl.**

CPC ............... ***G03B 5/00*** (2013.01); ***G03B 17/12*** (2013.01); ***H04N 23/54*** (2023.01); ***H04N 23/55*** (2023.01);

(Continued)

(58) **Field of Classification Search**

None

See application file for complete search history.

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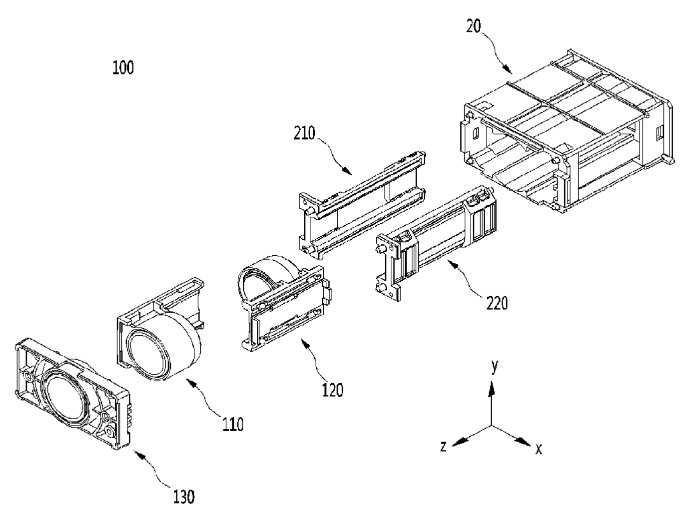
*Primary Examiner* — Clayton E. LaBalle
*Assistant Examiner* — Diana Hancock
(74) *Attorney, Agent, or Firm* — Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

A camera module including a base, and a first lens assembly and a second lens assembly disposed in the base and configured to move in an optical axis direction, a first yoke disposed on the first lens assembly, a second yoke on the second lens assembly, a first magnet on the first yoke, a second magnet disposed on the second yoke, a first coil in the base and opposite to the first magnet, and a second coil disposed in the base and opposite to the second magnet. The first lens assembly includes a first lens barrel and a first driving part housing extended from the first lens barrel in the optical axis direction. The first yoke is on the first driving part housing and extended along the optical axis direction. At least one first portion of the first yoke is overlapped by the first magnet in the optical axis direction.

**20 Claims, 27 Drawing Sheets**



(51) **Int. Cl.**
***H04N 23/54*** (2023.01)
***H04N 23/55*** (2023.01)
***H04N 23/68*** (2023.01)

(52) **U.S. Cl.**
CPC ... ***H04N 23/687*** (2023.01); *G03B 2205/0007* (2013.01); *G03B 2205/0046* (2013.01); *G03B 2205/0069* (2013.01)

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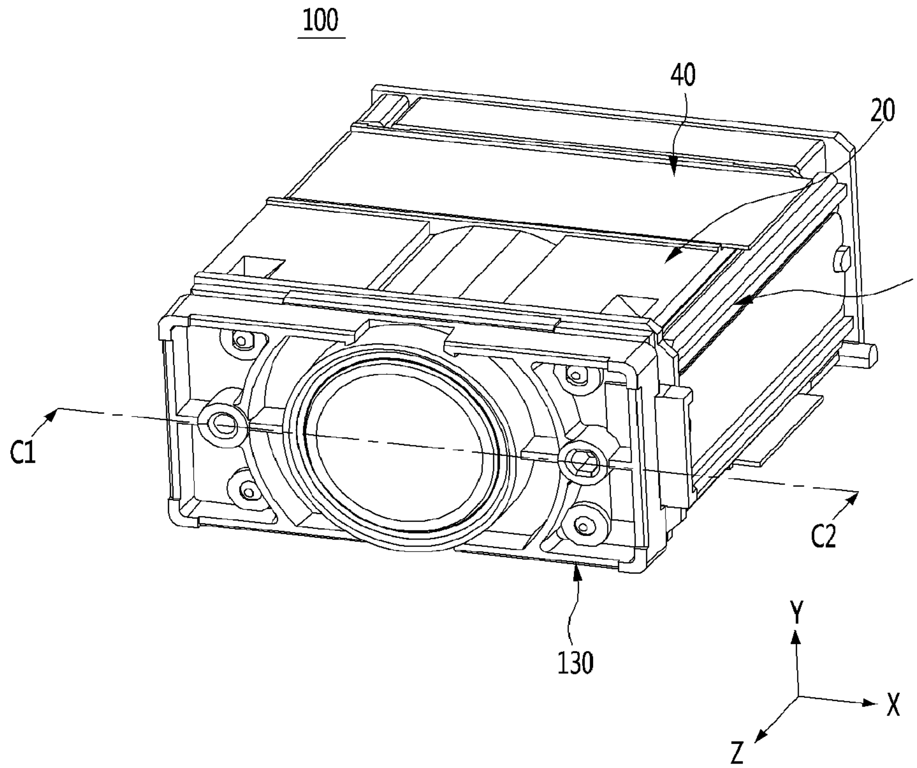
[Fig. 1]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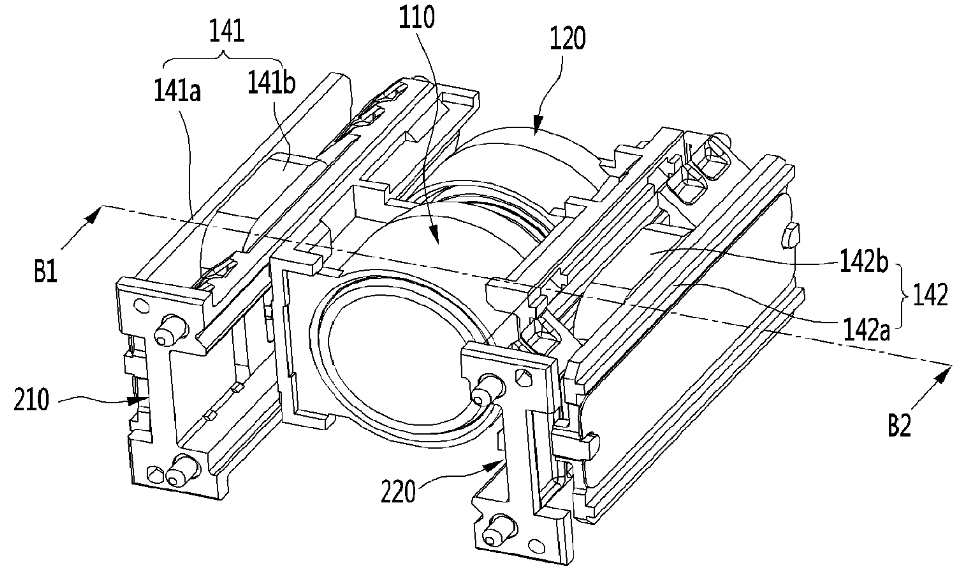
C2
130
Y
X
Z

[Fig. 2]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142b
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142a
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B2
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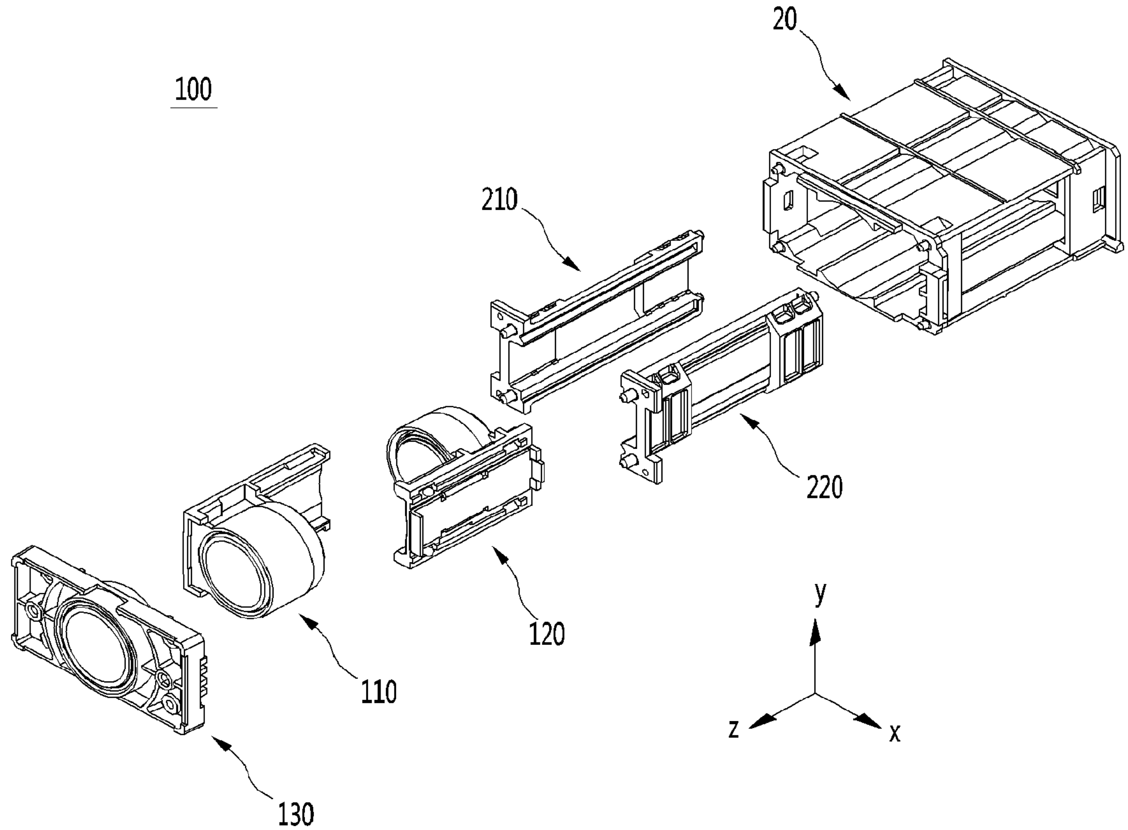
[Fig. 3]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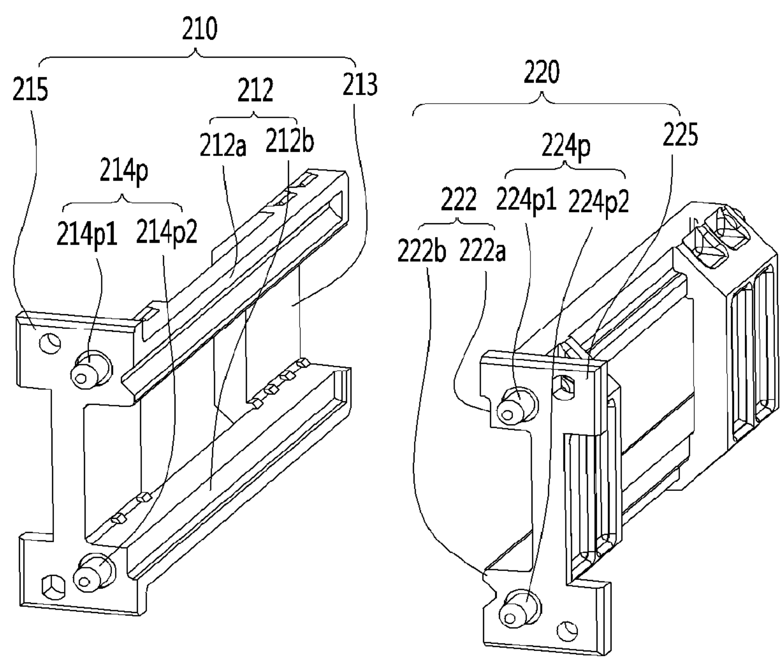
y
z
x

[Fig. 4]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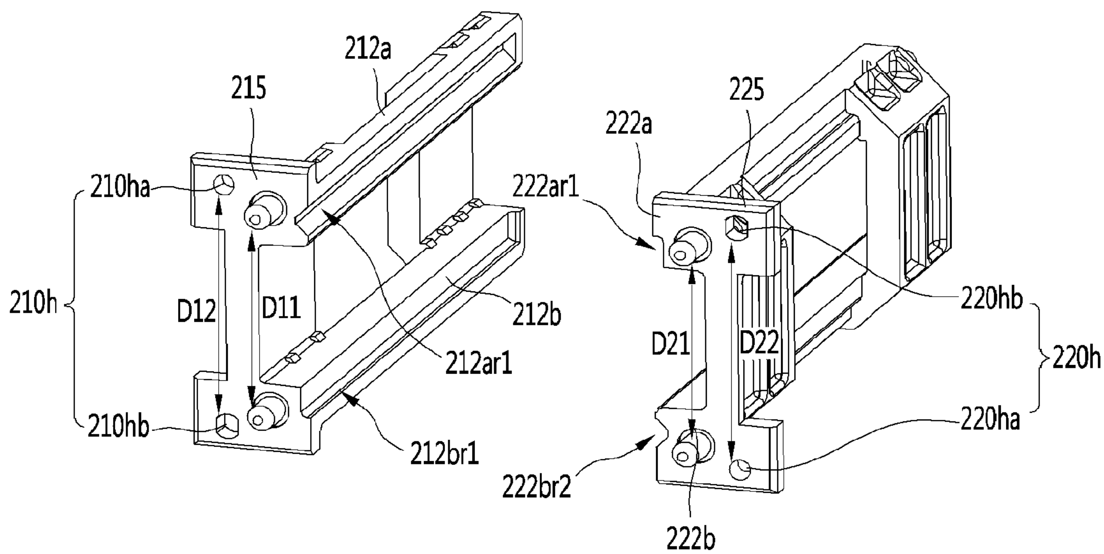
224p1
224p2
222b
222a

[Fig. 5]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210h
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D11
212b
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210hb
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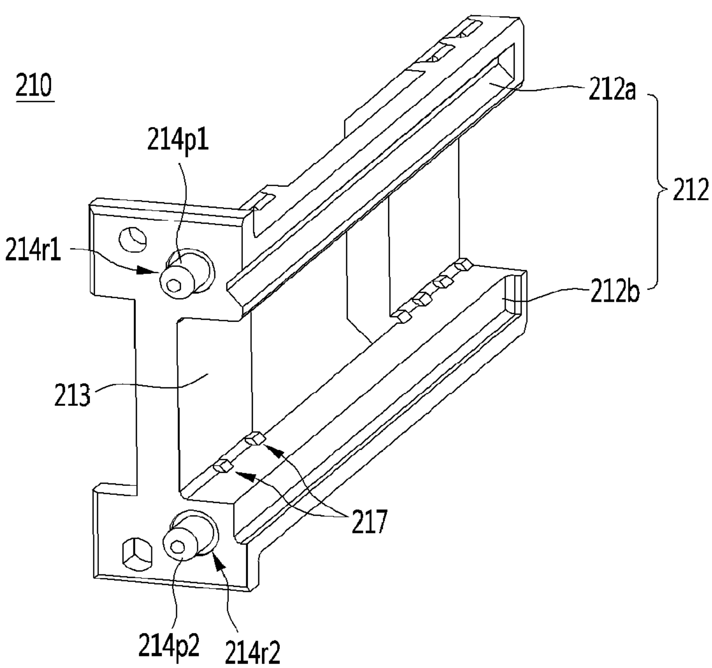
222br2
222b

[Fig. 6a]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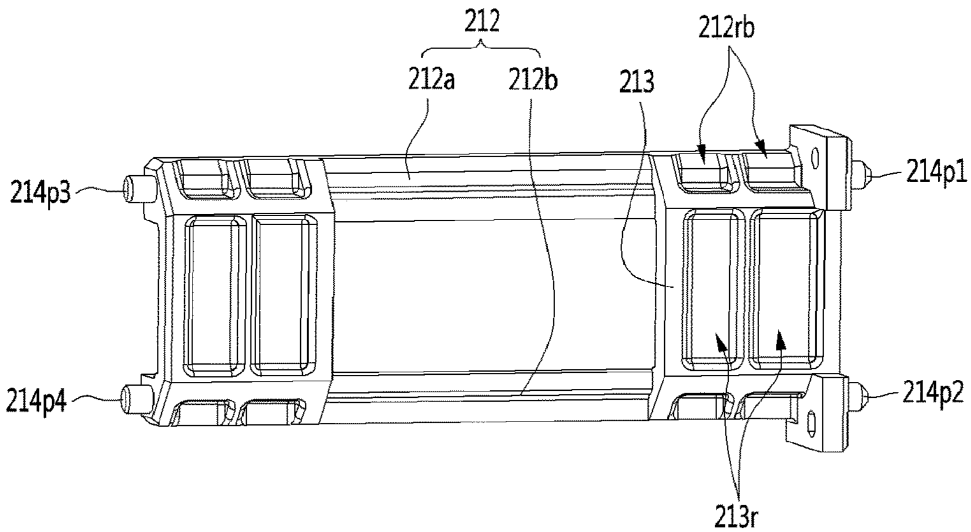
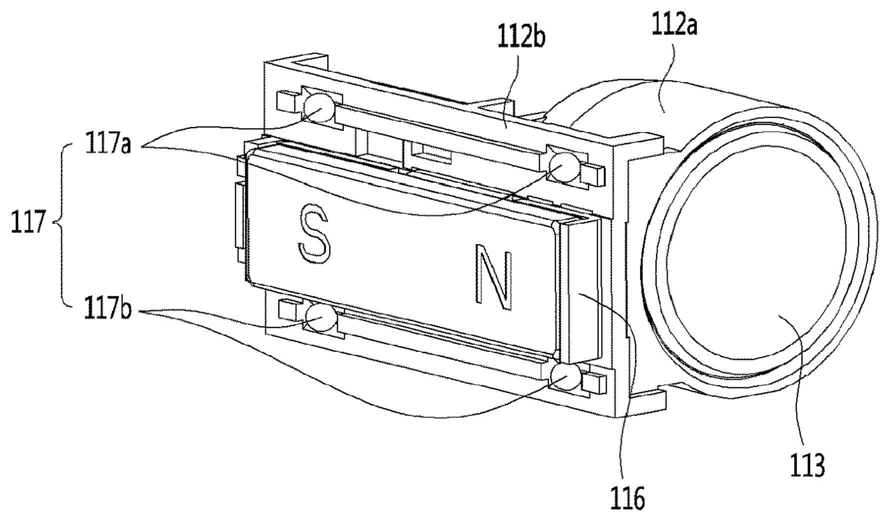
214r2

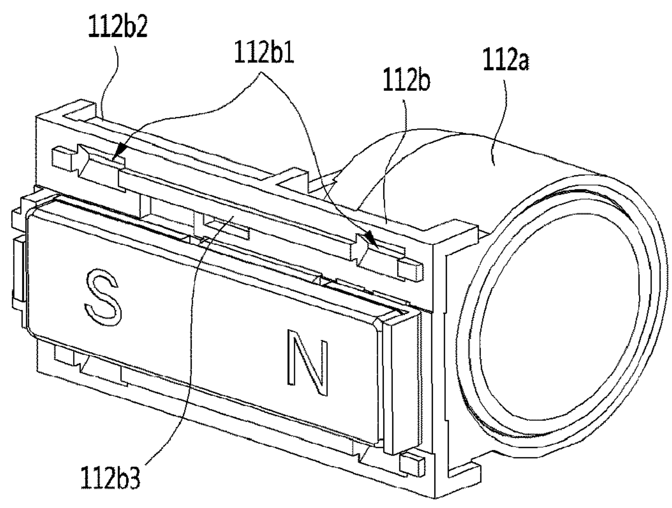
[Fig. 6b]



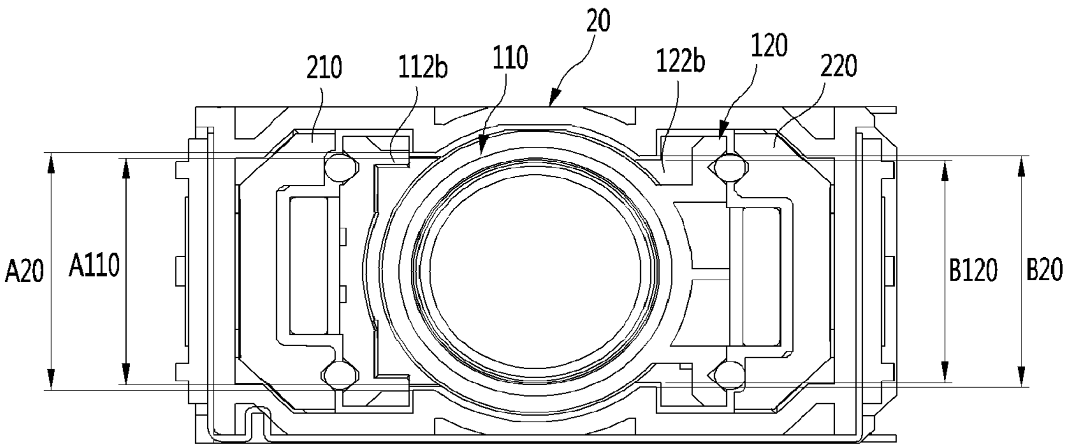

[Fig. 7a]




[Fig. 7b]



[Fig. 8a]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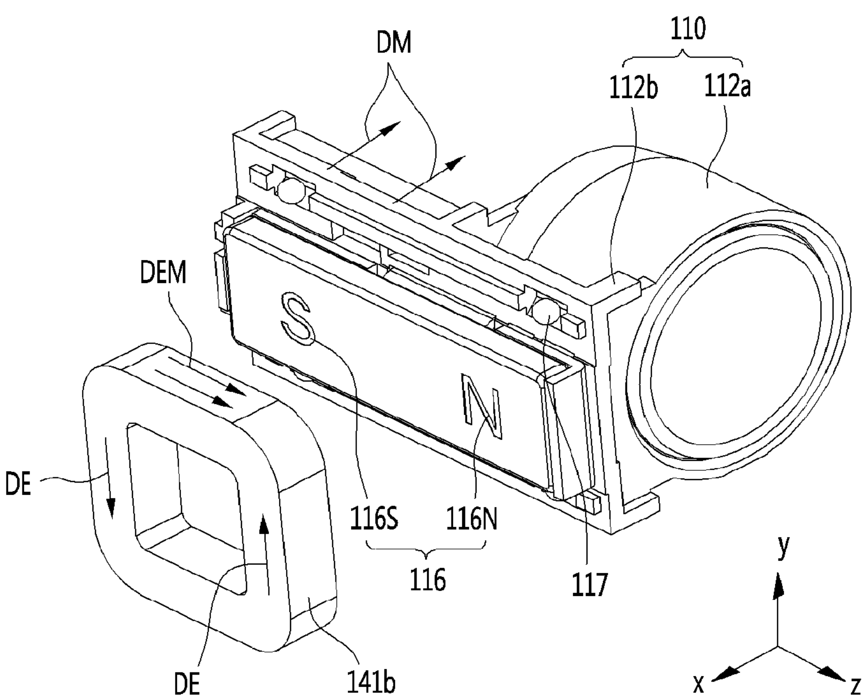
B20

[Fig. 8b]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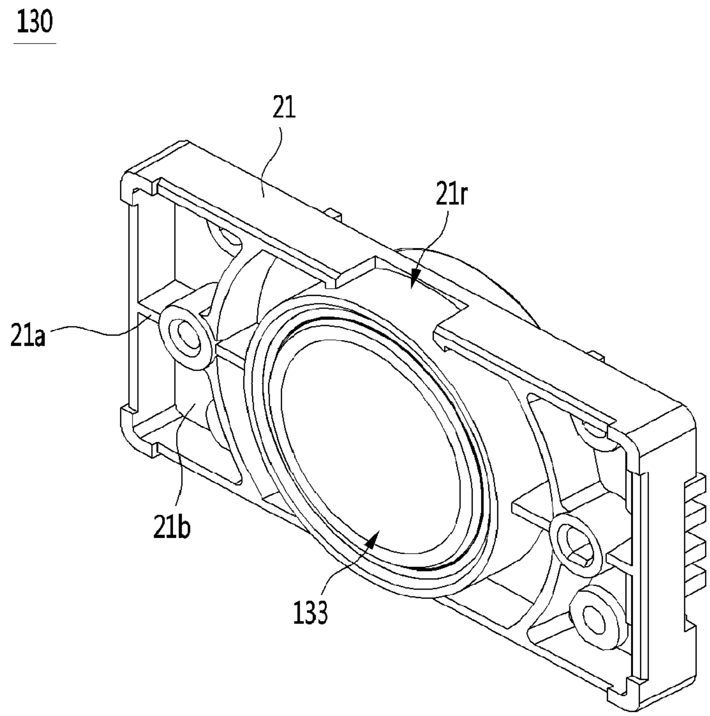
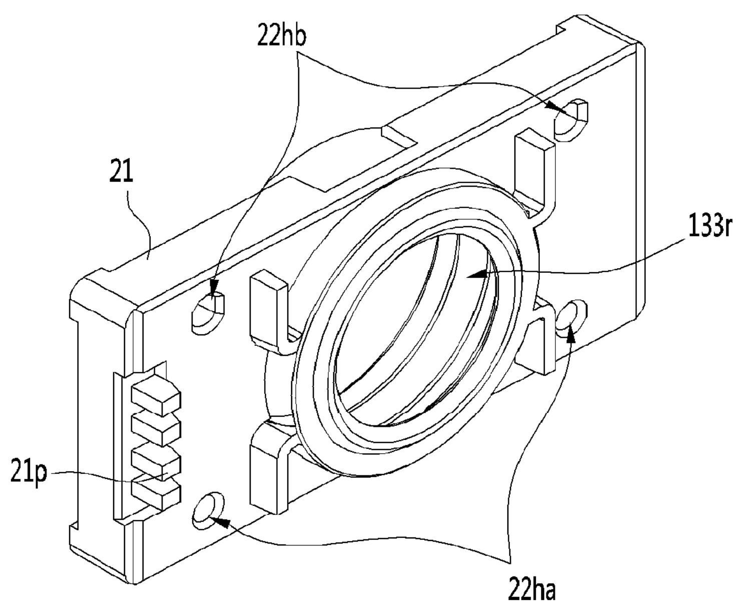
y
x
z

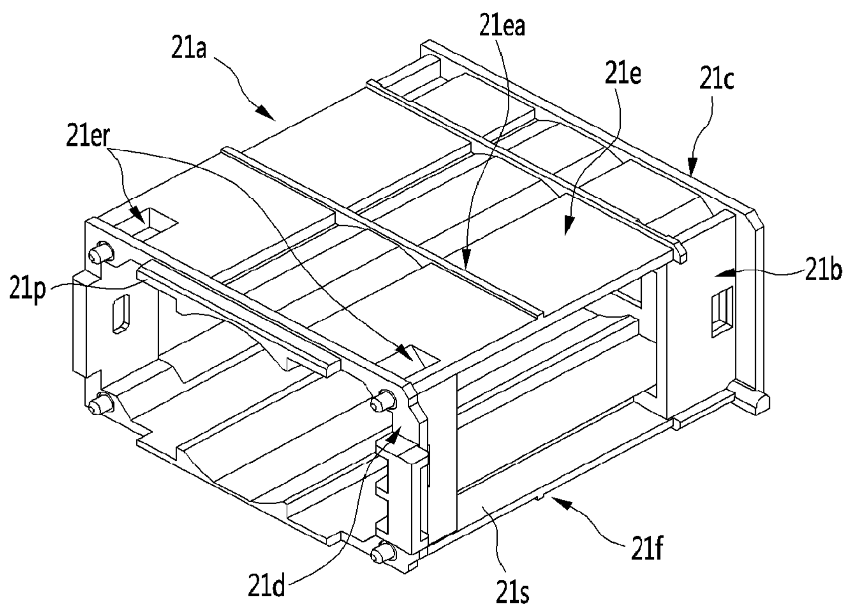
[Fig. 9]



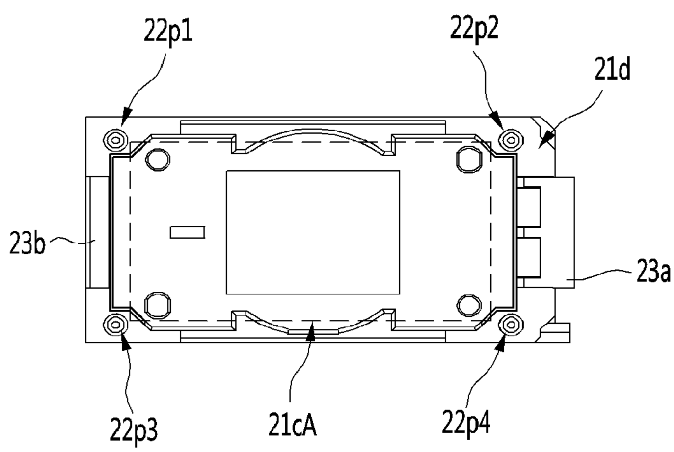

[Fig. 10]



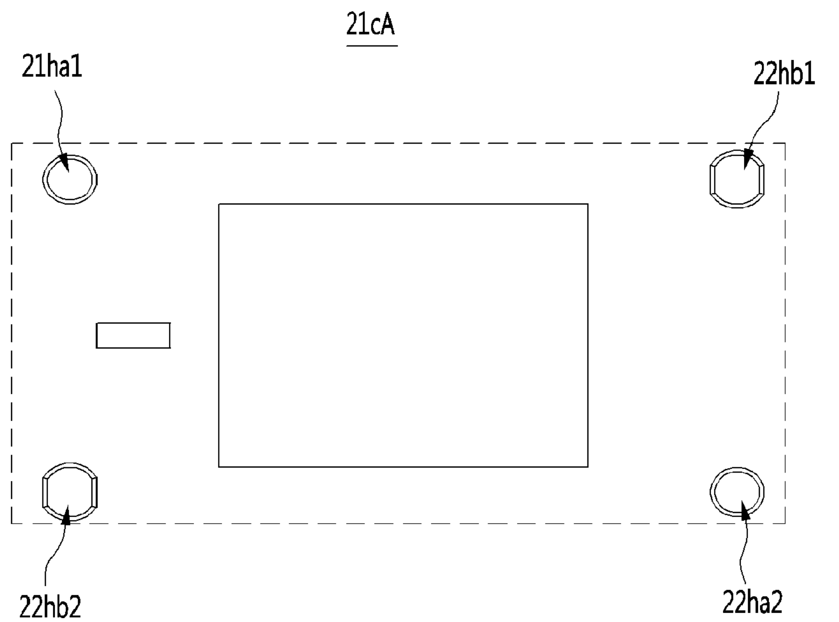
[Fig. 11a]




[Fig. 11b]



[Fig. 12]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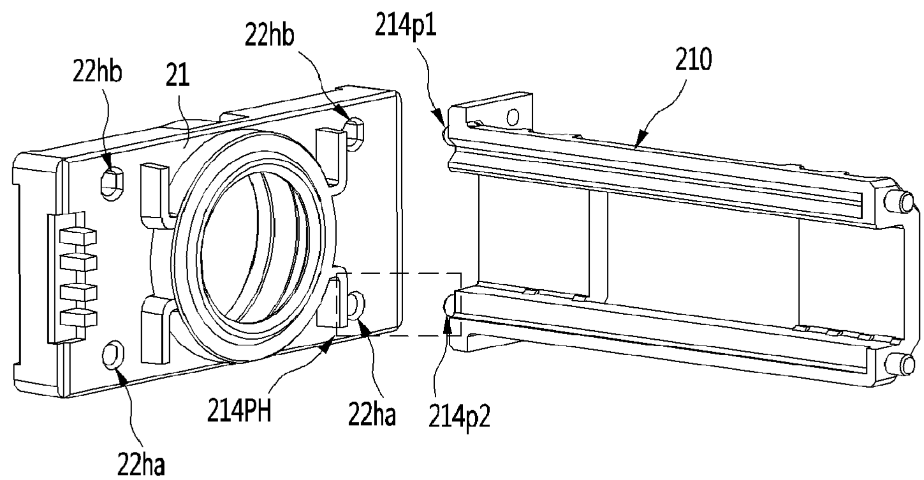
22hb2
22ha2

[Fig. 13]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22hb
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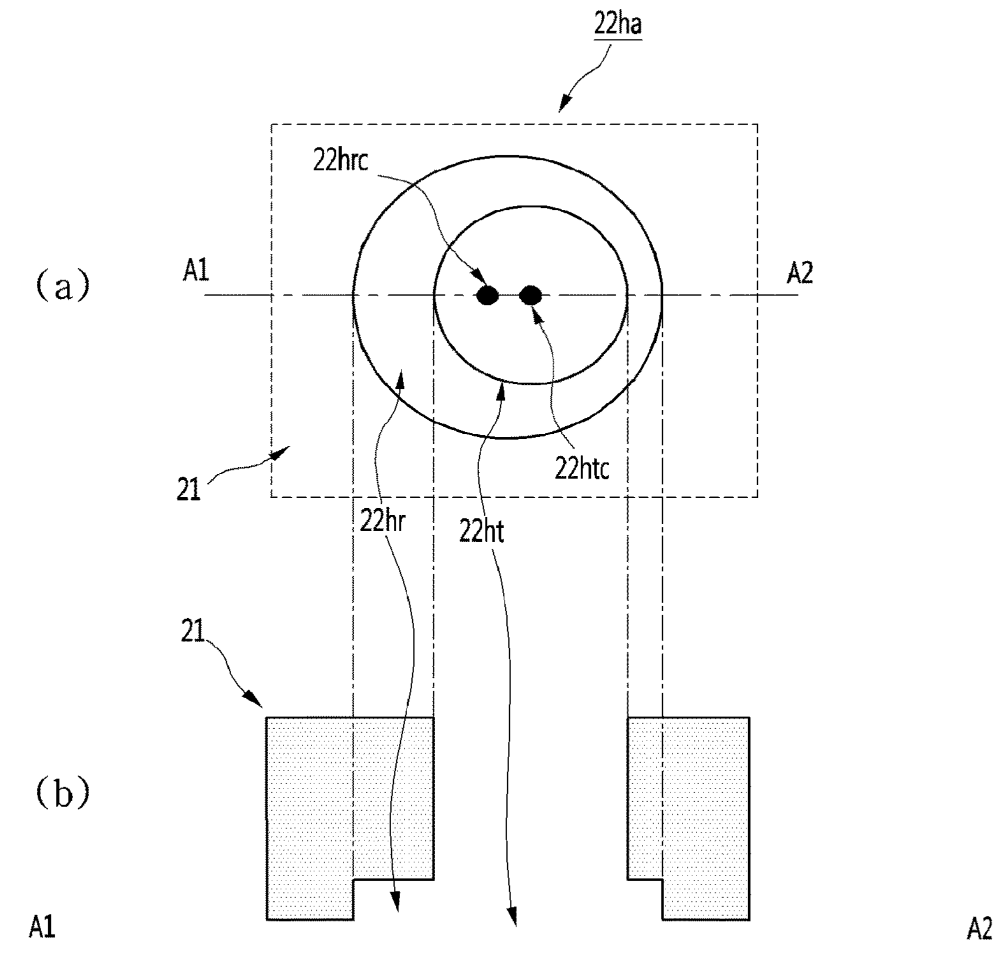
214PH
22ha
214p2
22ha

[Fig. 14]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(a)
A1
A2
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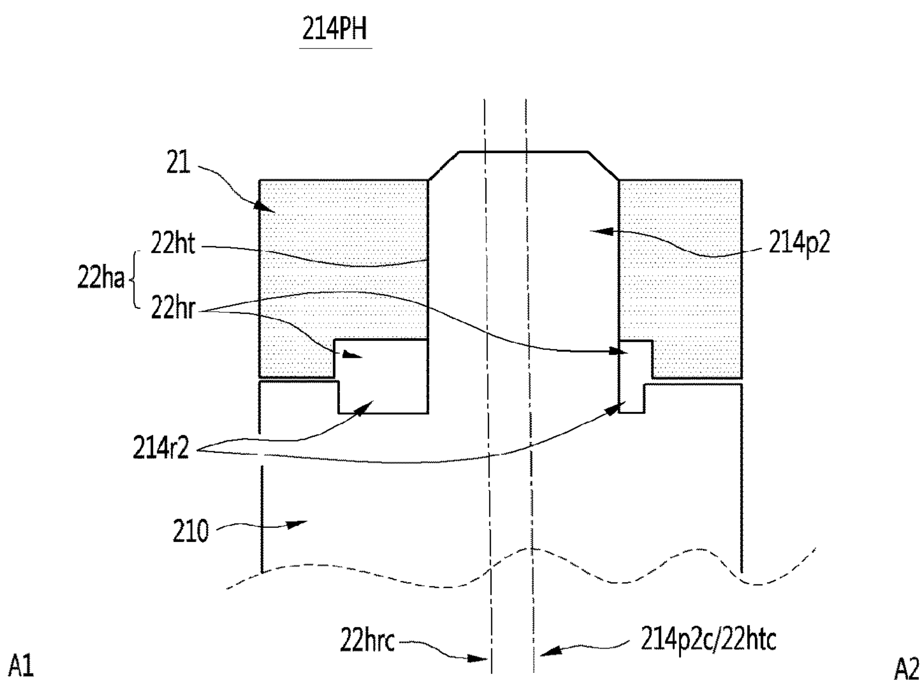
22htc
22hr
22ht
21
(b)
A1
A2

[Fig. 15]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22hrc
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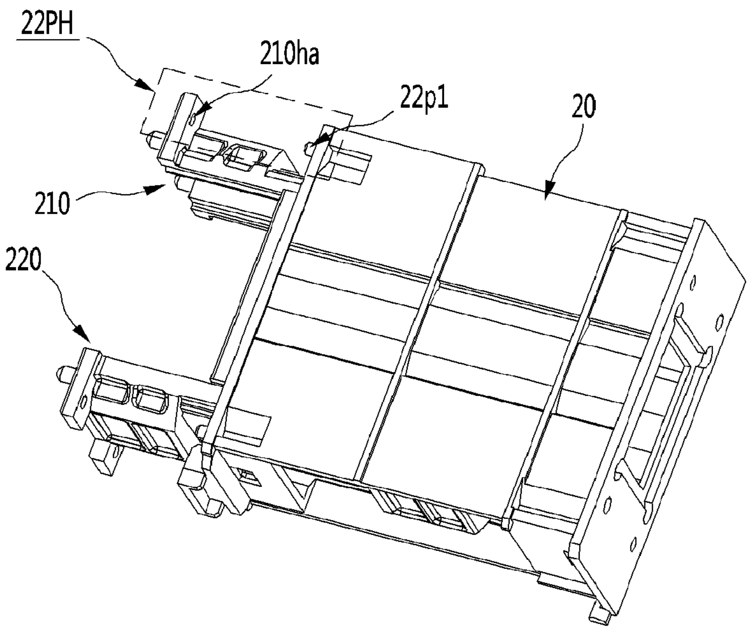
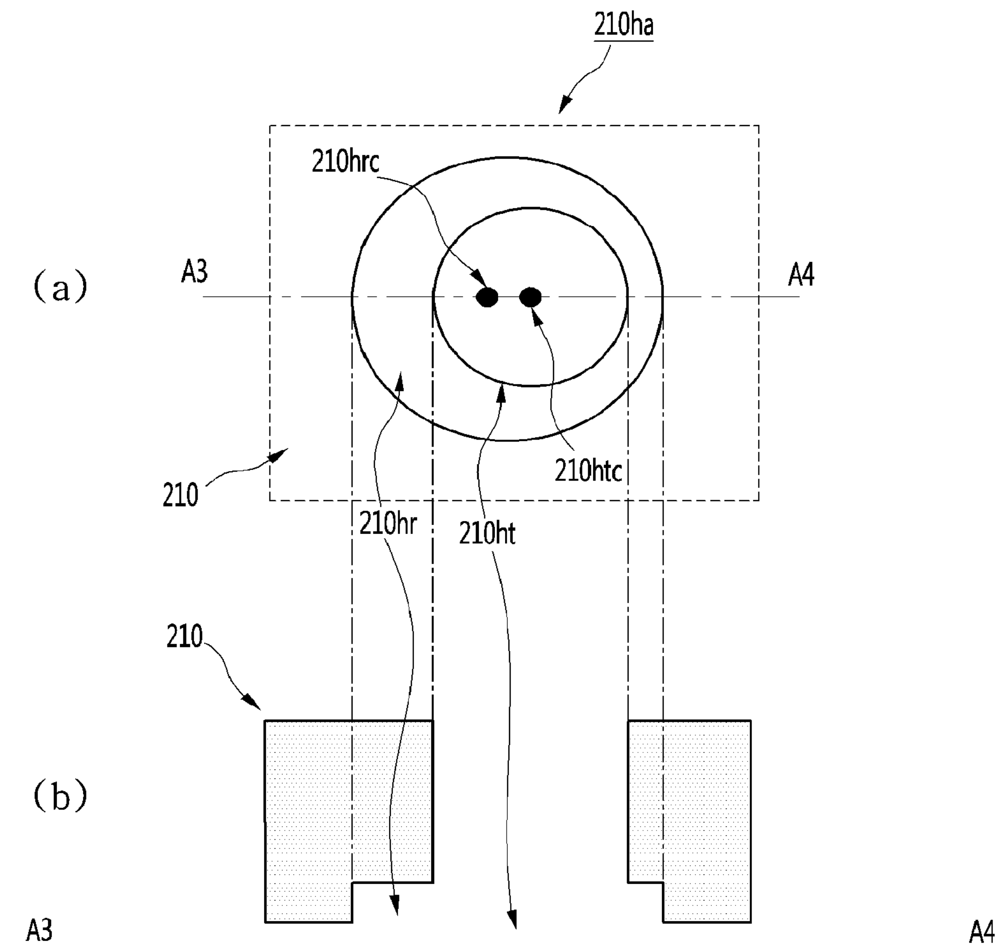
A2

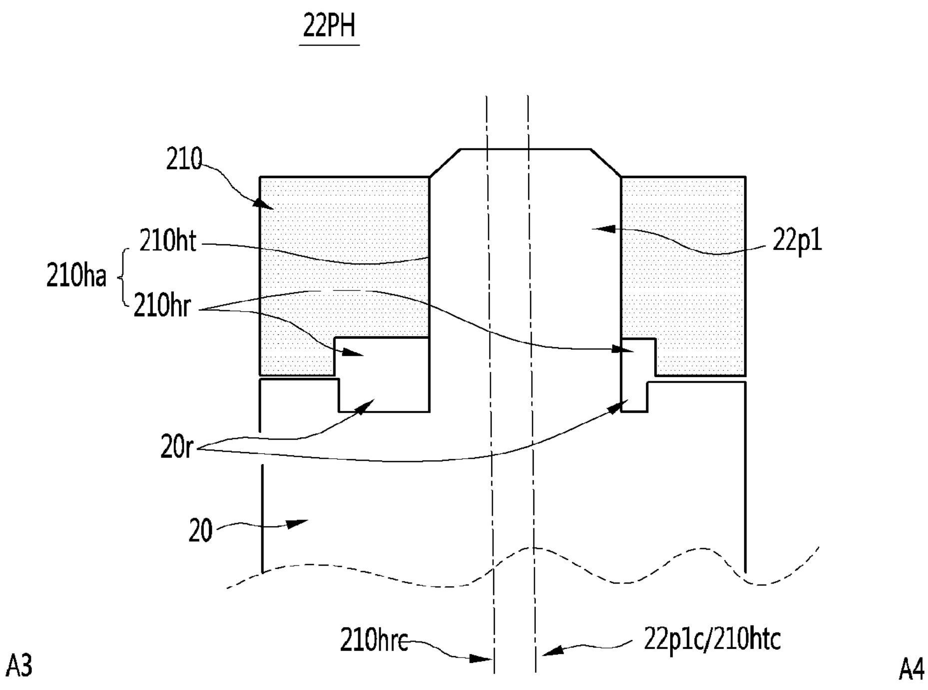
[Fig. 16a]




[Fig. 16b]



[Fig. 16c]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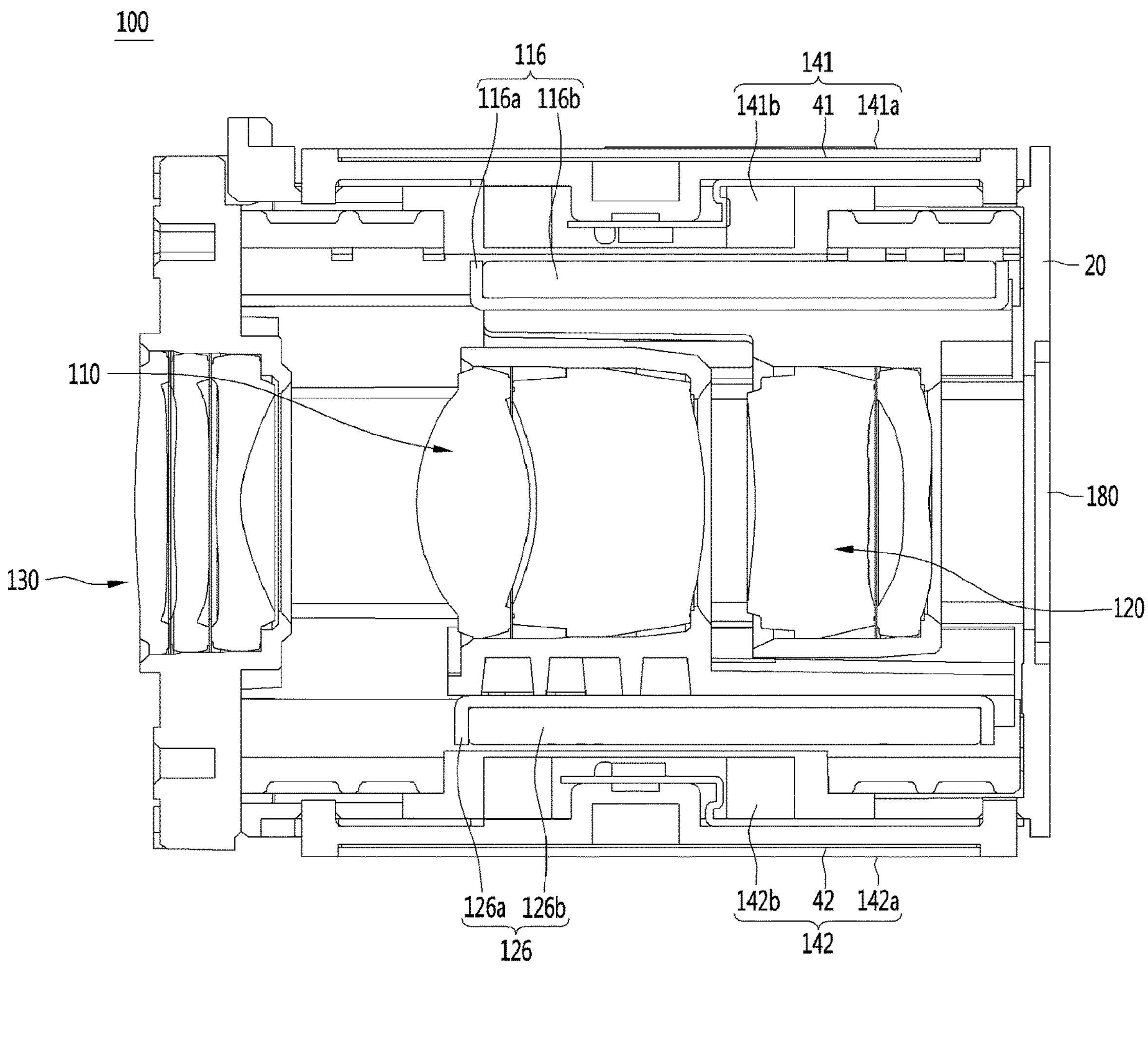
A3
A4

[Fig. 17a]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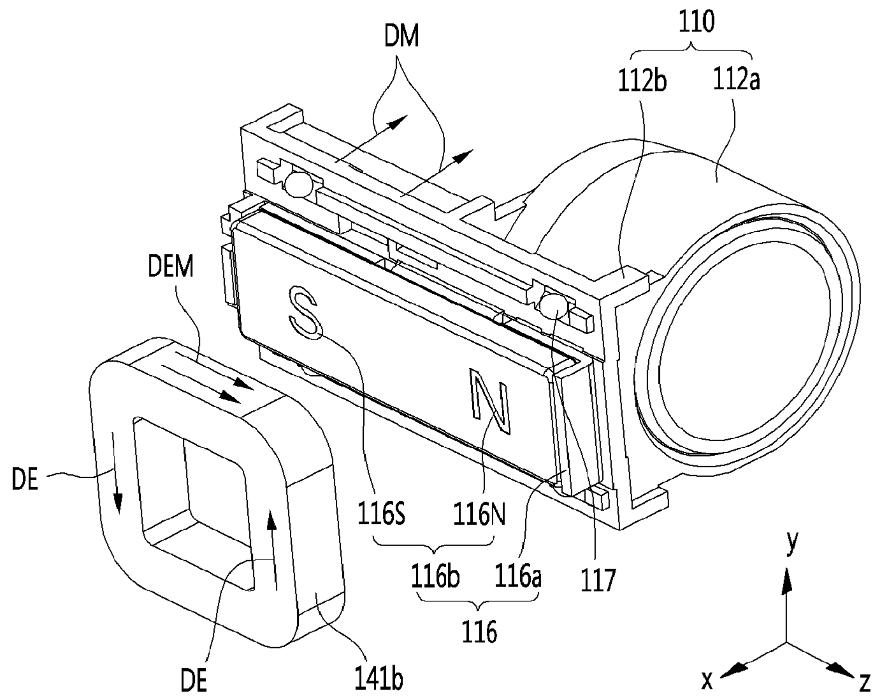
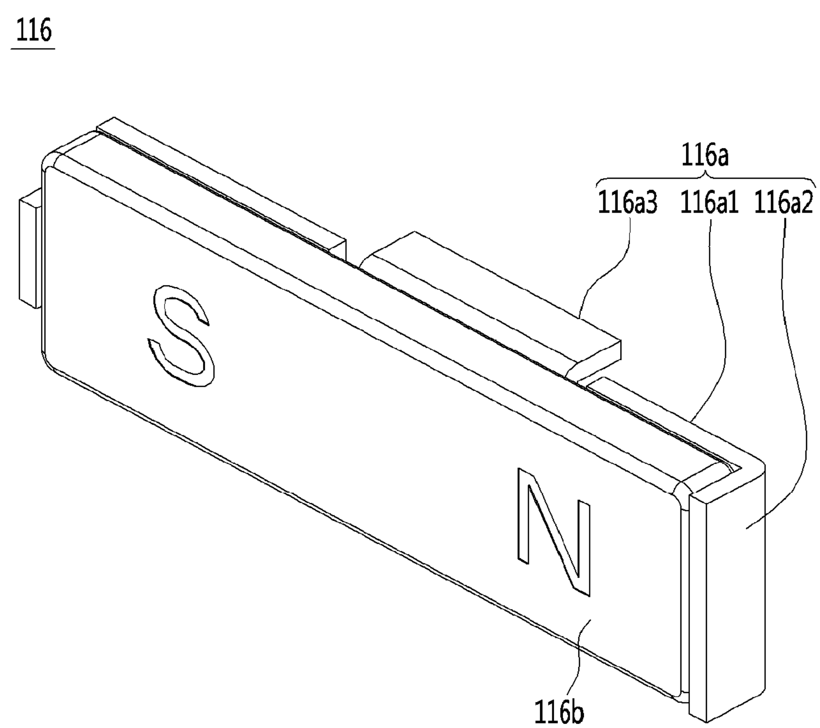
42
142a
142

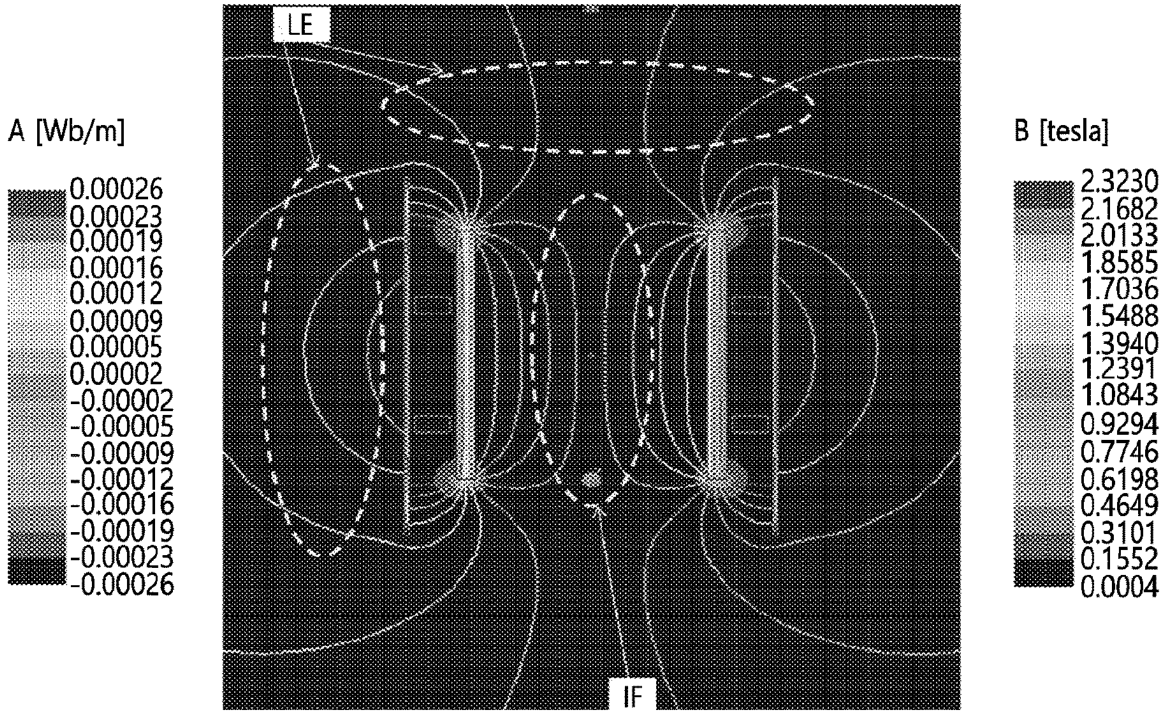
[Fig. 17b]



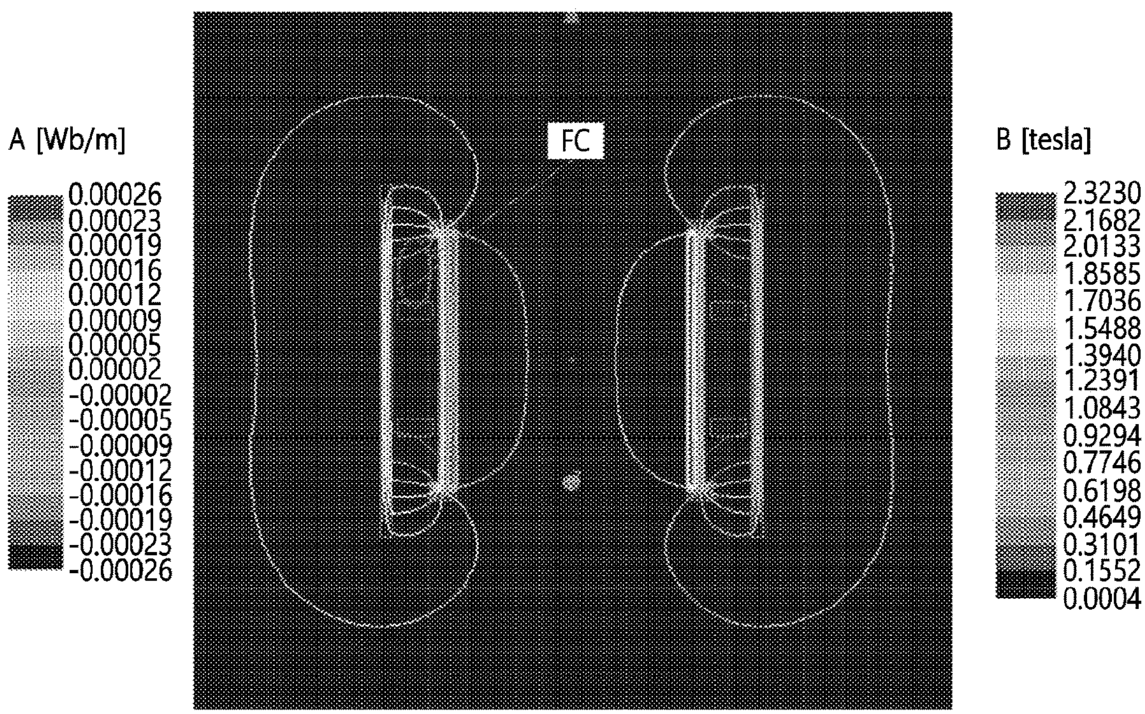

[Fig. 17c]



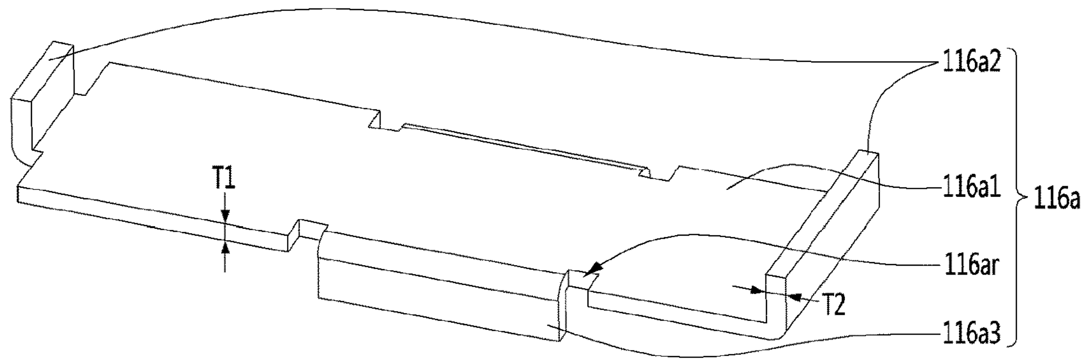
[Fig. 17d]



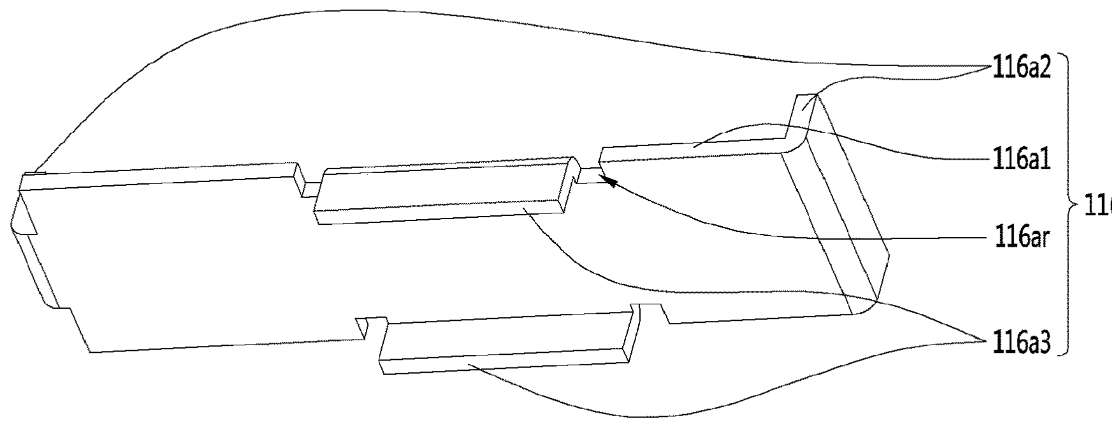

[Fig. 17e]



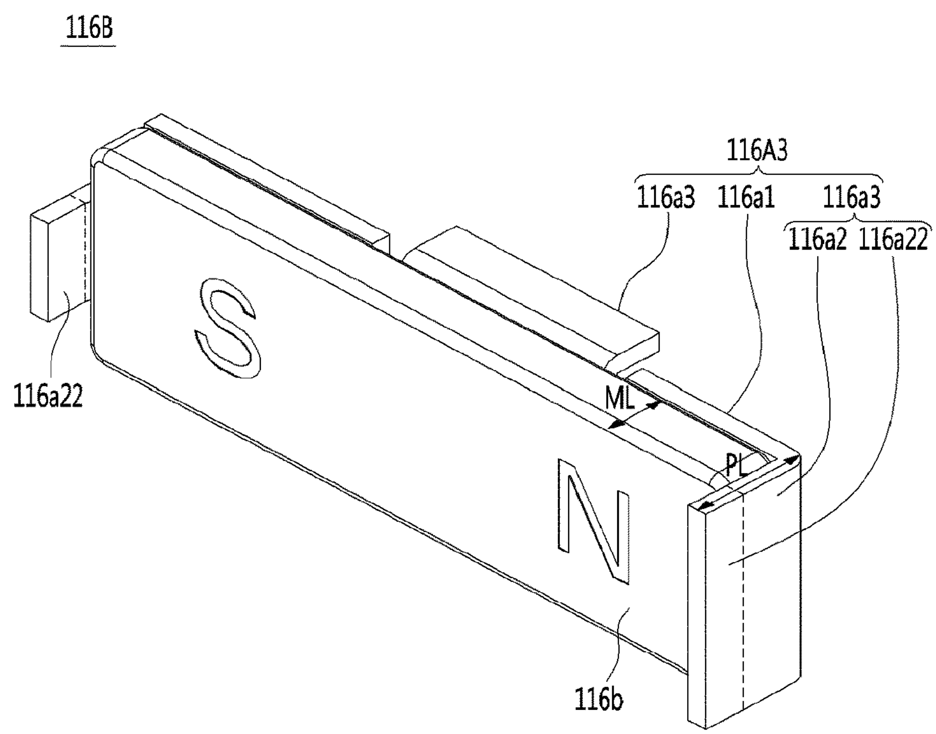
[Fig. 17f]



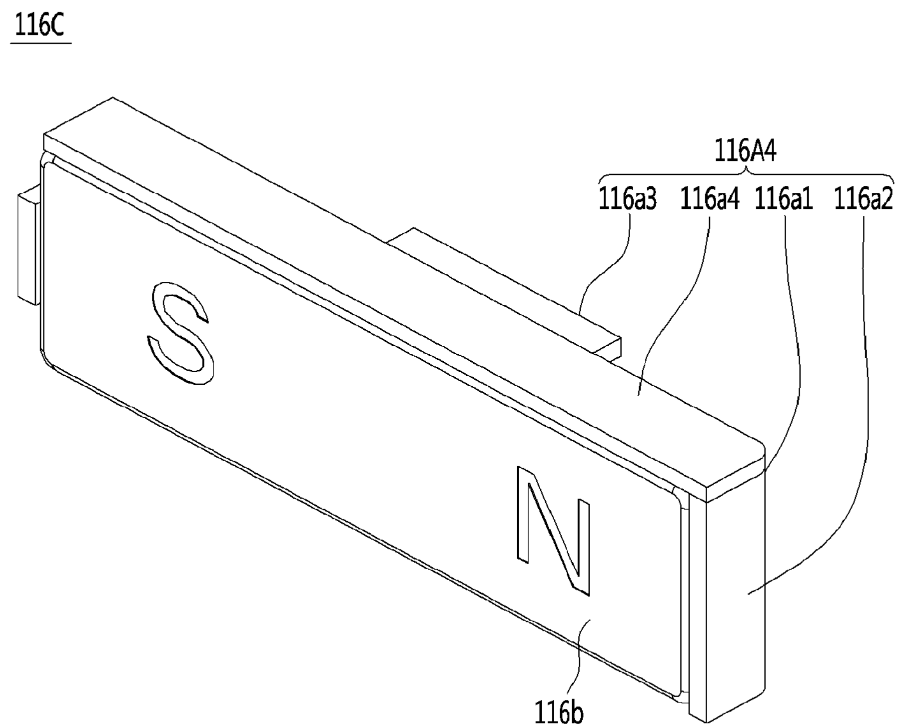

[Fig. 17g]



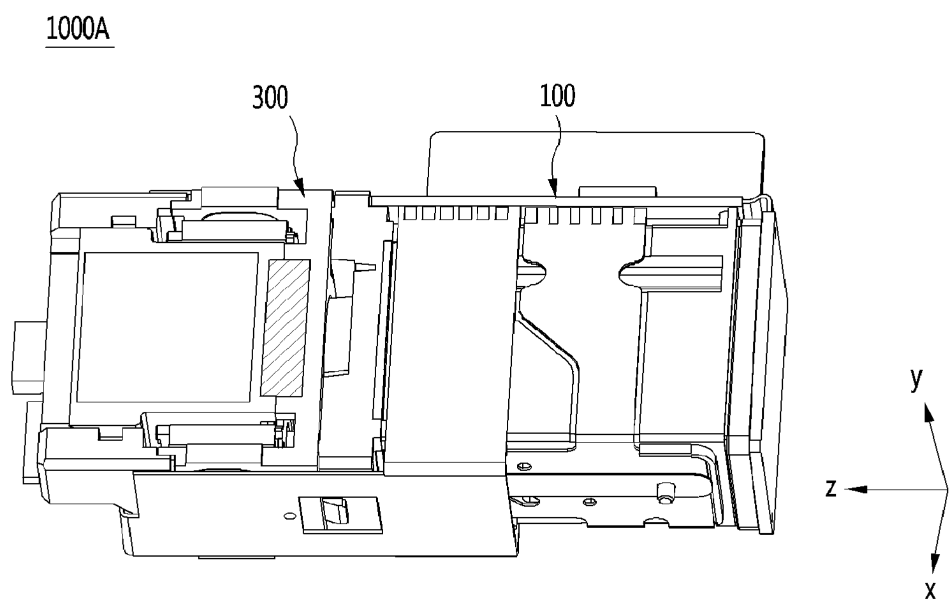

[Fig. 18a]



[Fig. 18b]




[Fig. 19]



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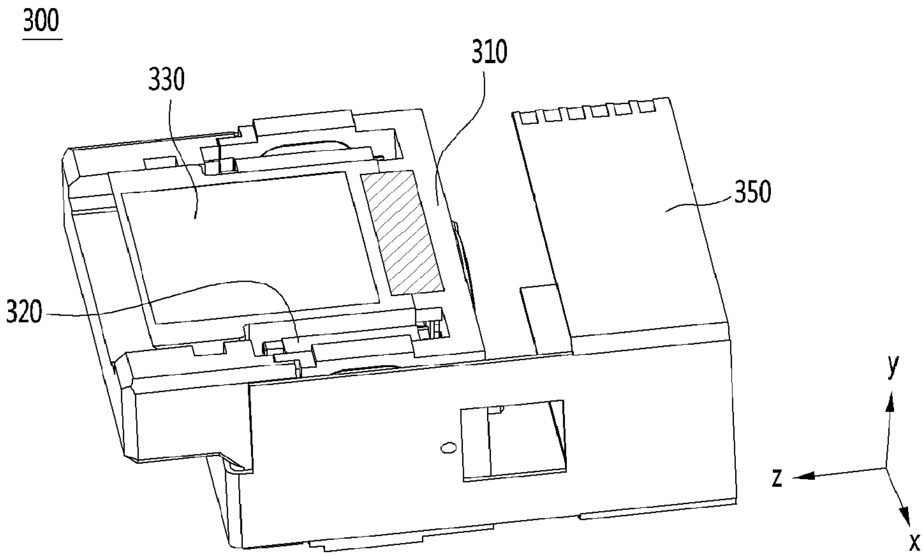
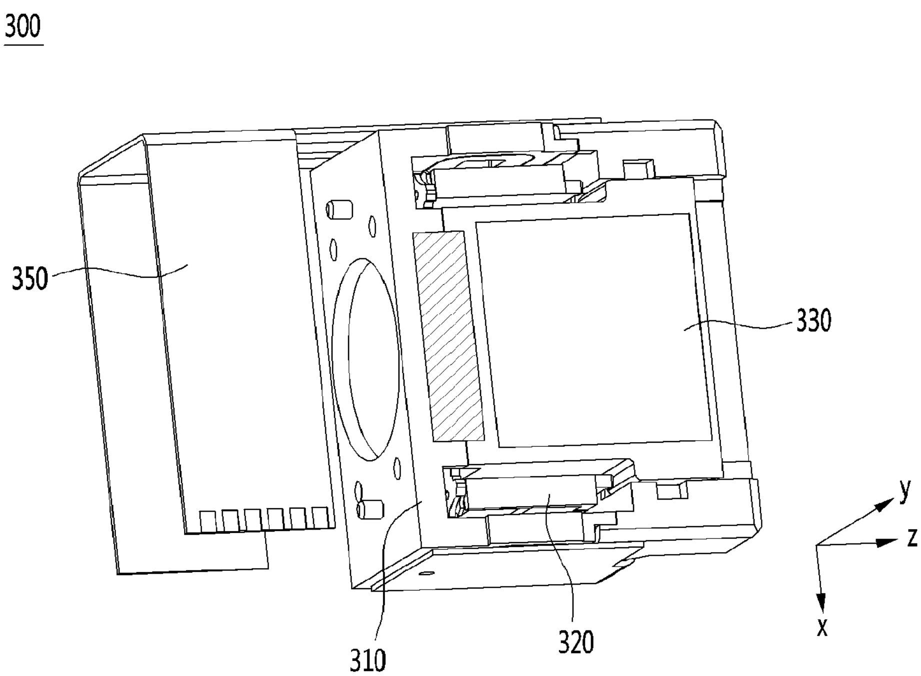
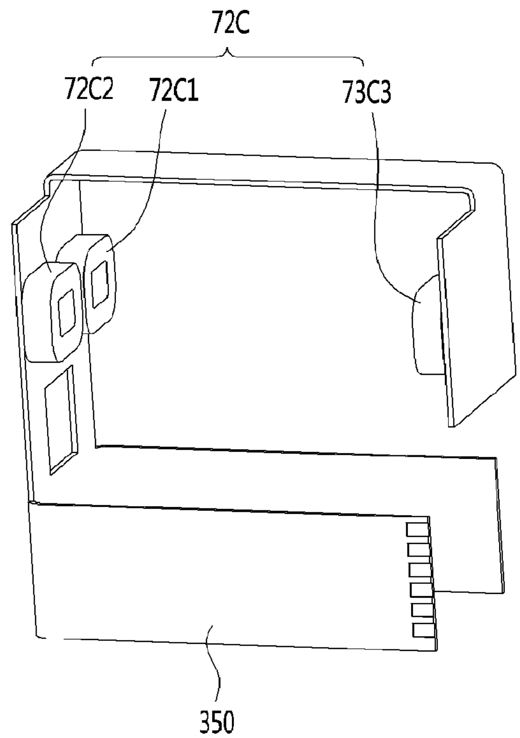


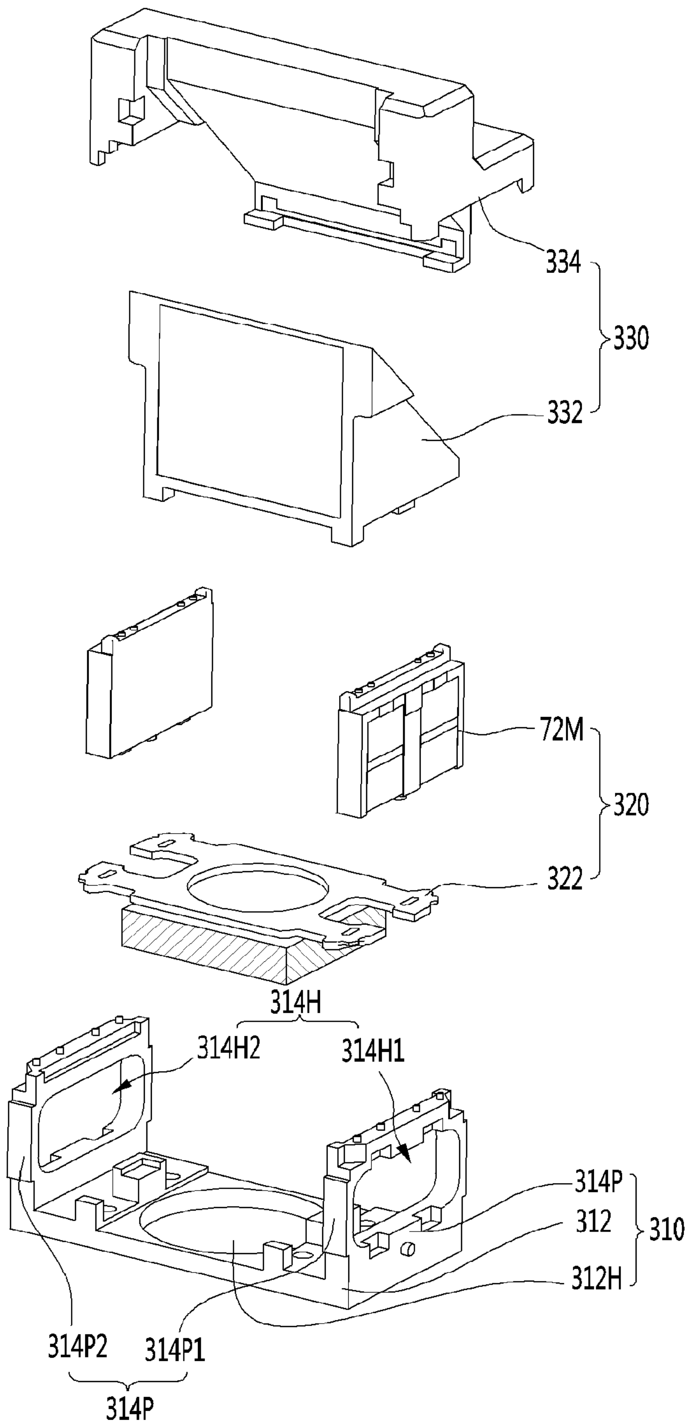

[Fig. 20b]



[Fig. 21a]



[Fig. 21b]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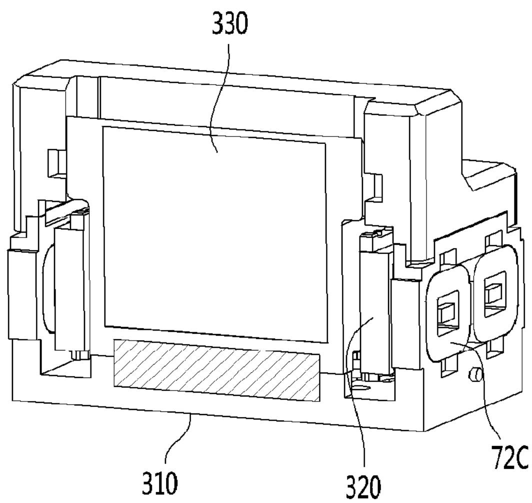
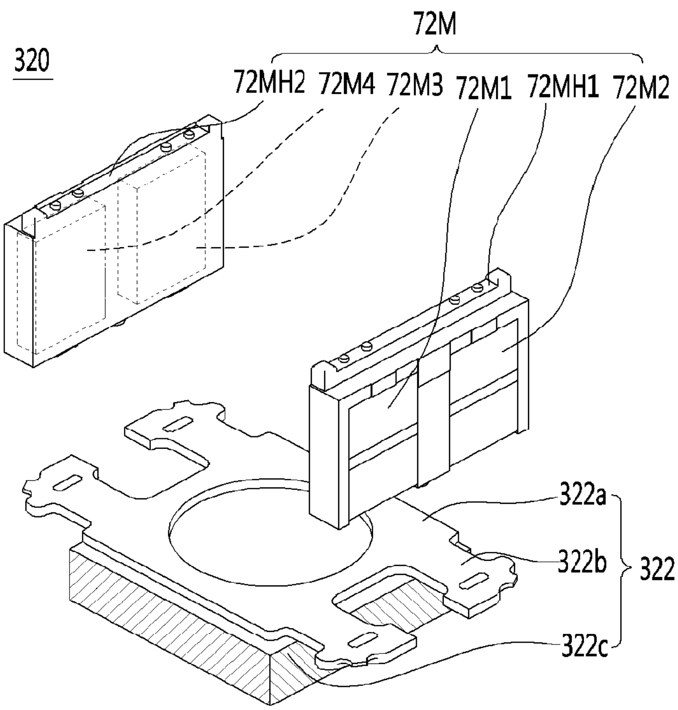
314P

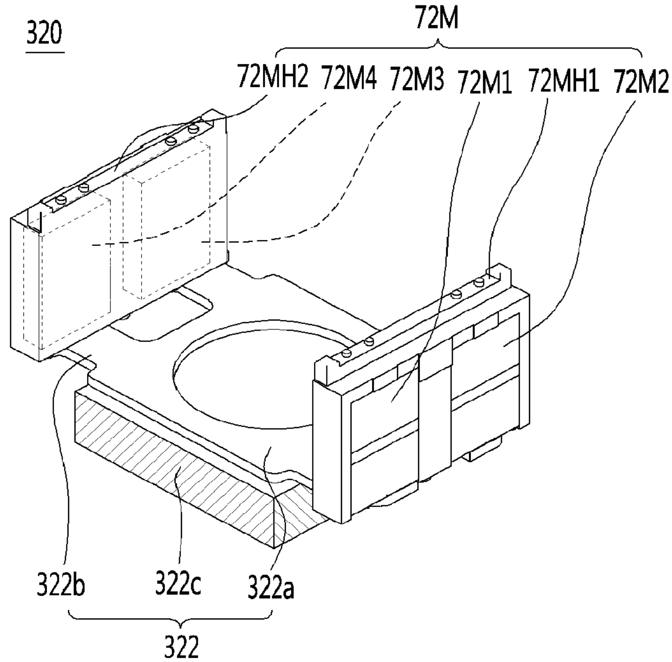
[Fig. 21c]



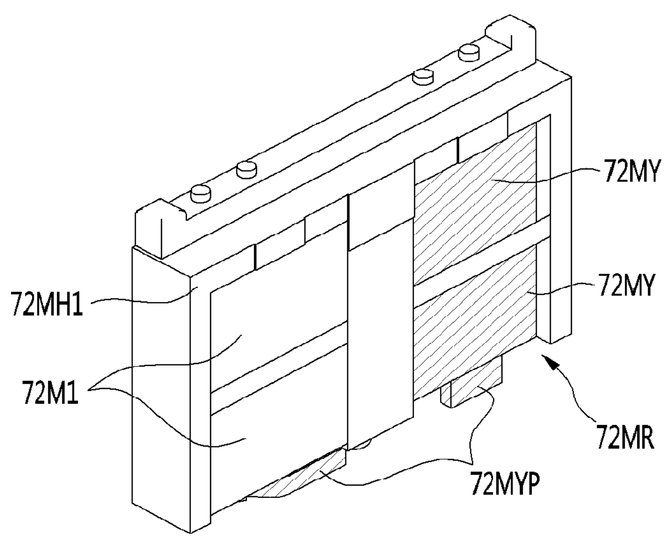

[Fig. 22a]



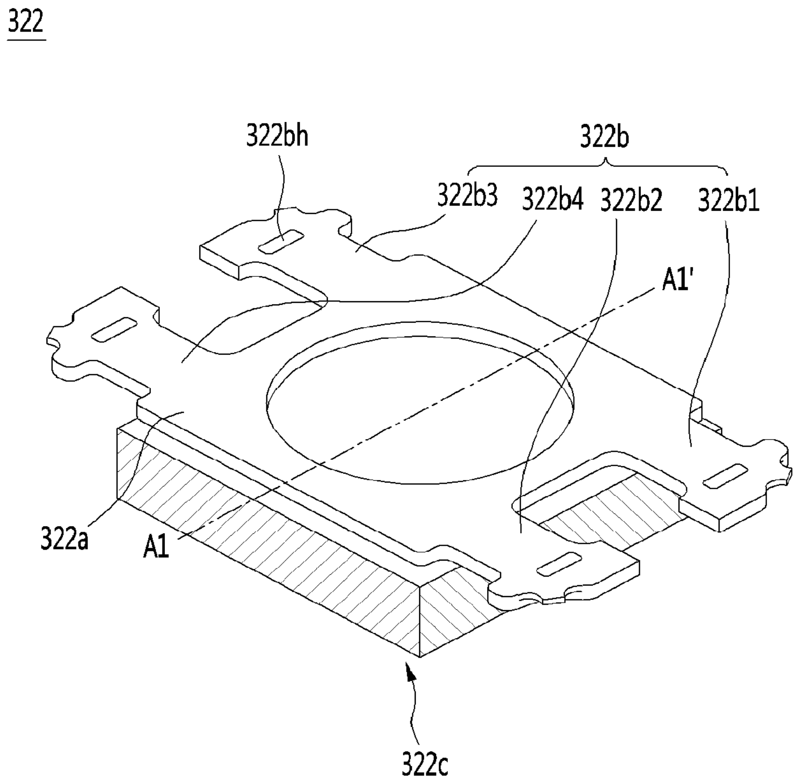
[Fig. 22b]




[Fig. 22c]



[Fig. 23]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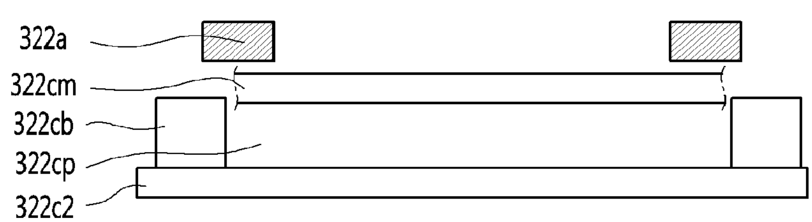
A1'
322a
A1
322c

[Fig. 24]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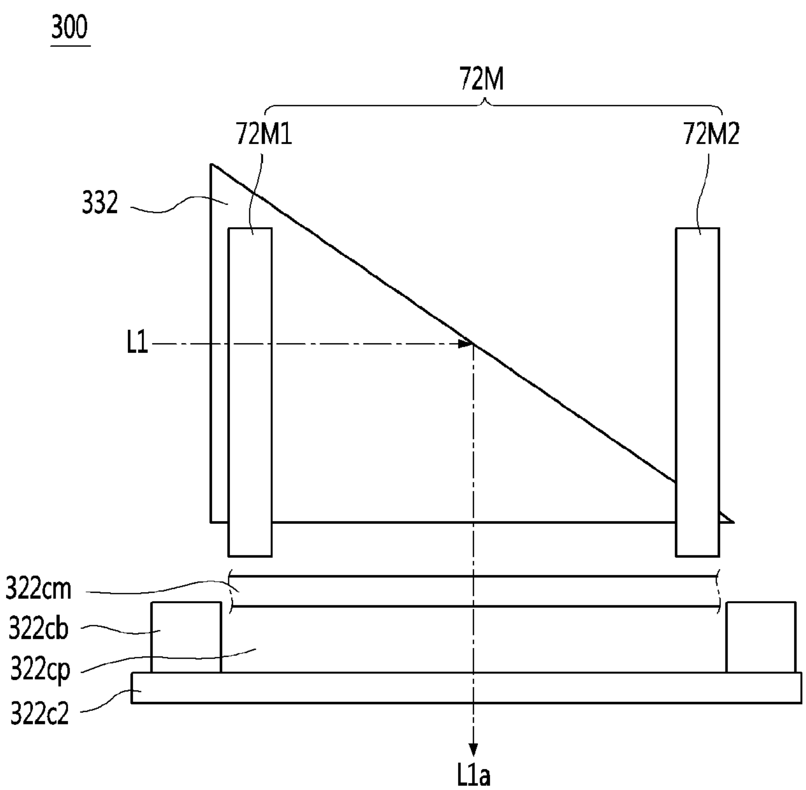
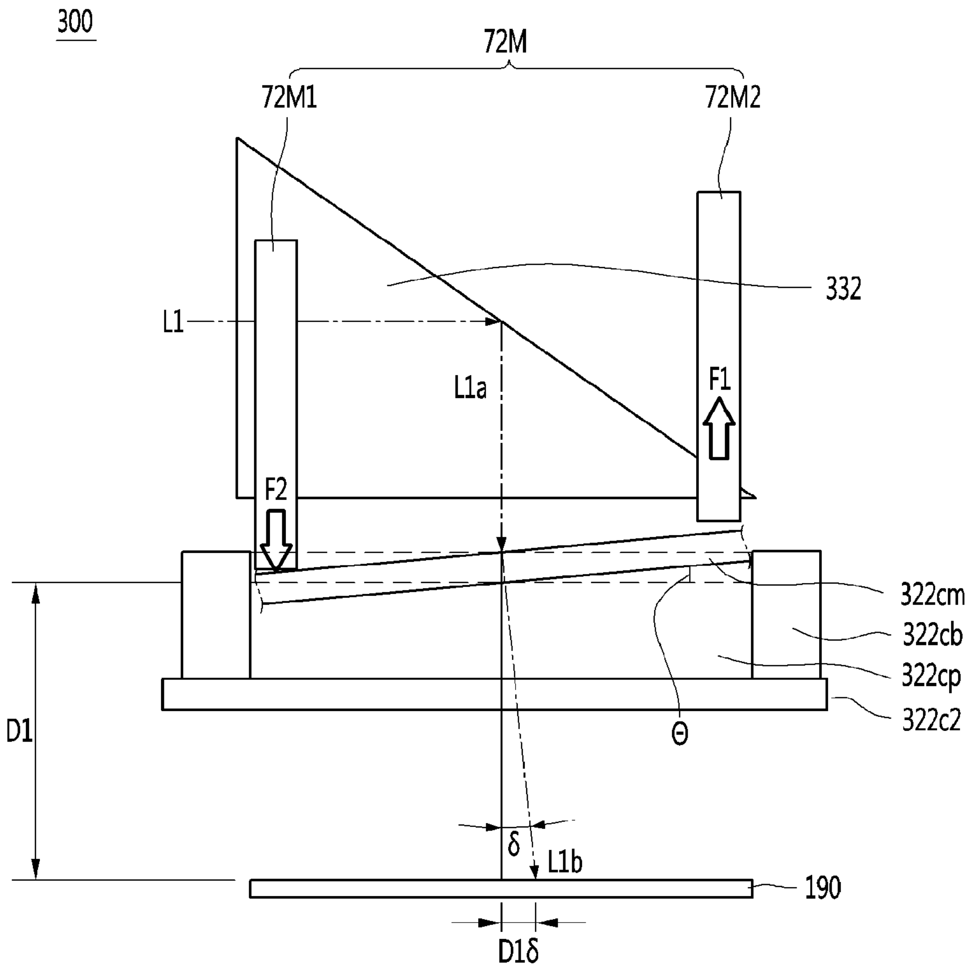
[Fig. 25a]



[Fig. 25b]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Θ
D1
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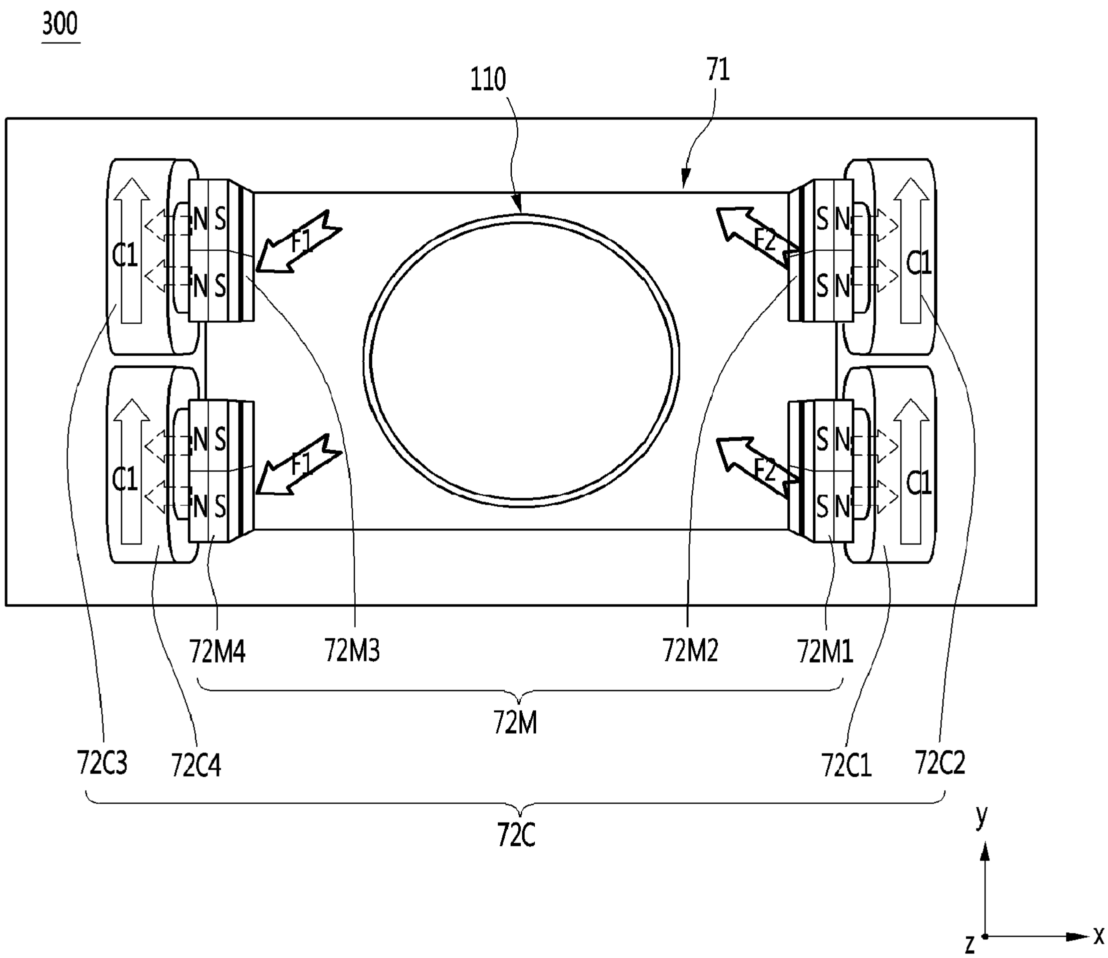
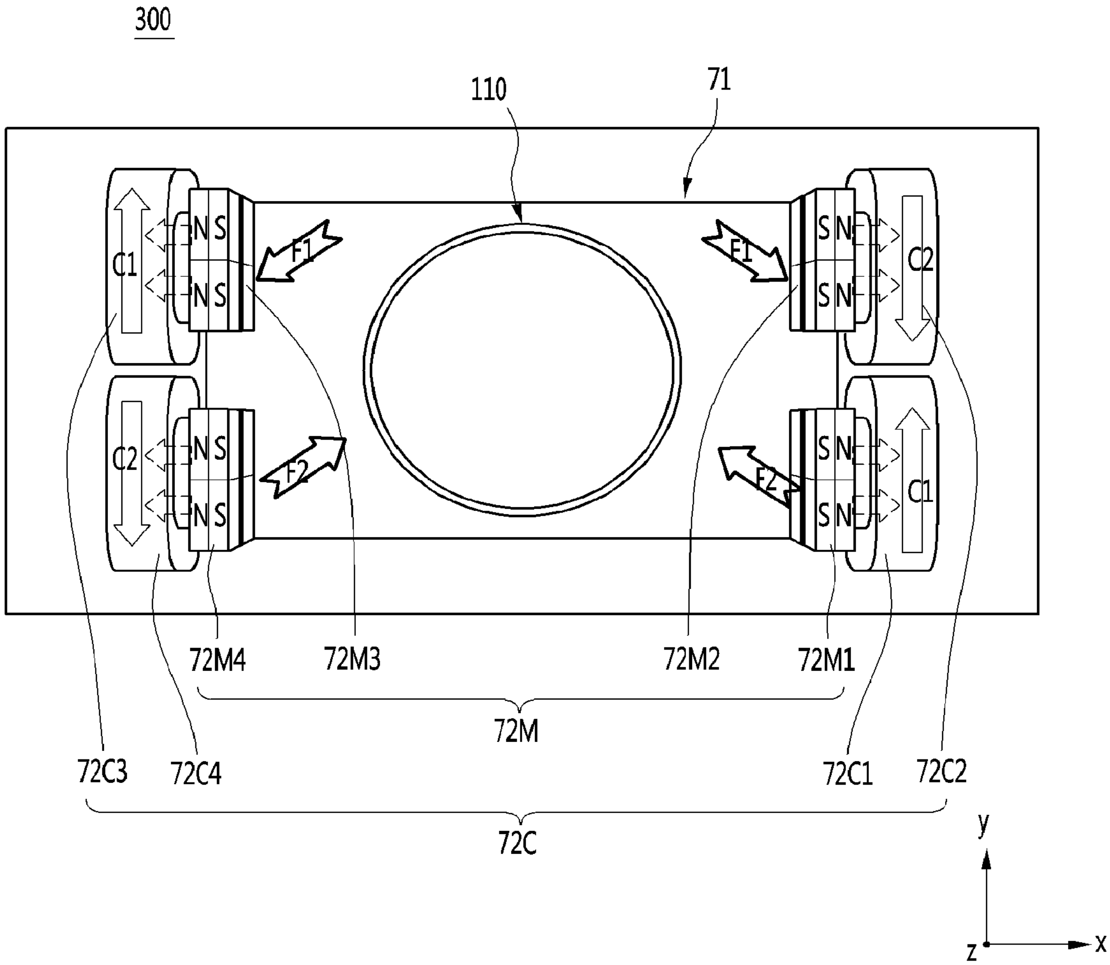
L1b
190
D1δ

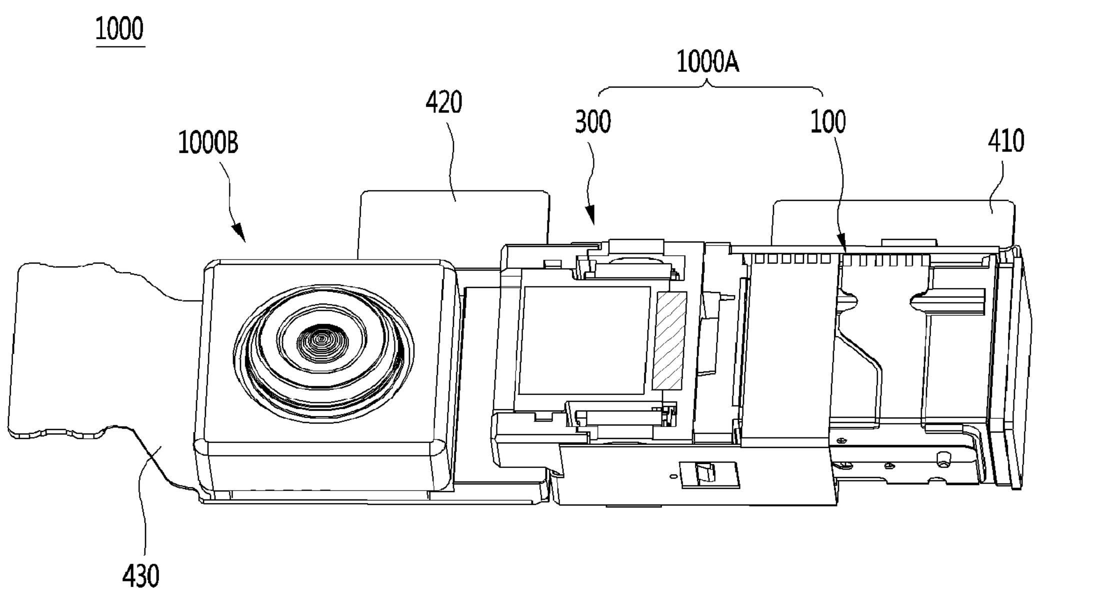
[Fig. 26]


300
110
71
N
S
F1
F2
C1
72M4
72M3
72M2
72M1
72M
72C3
72C4
72C1
72C2
72C
y
x
z

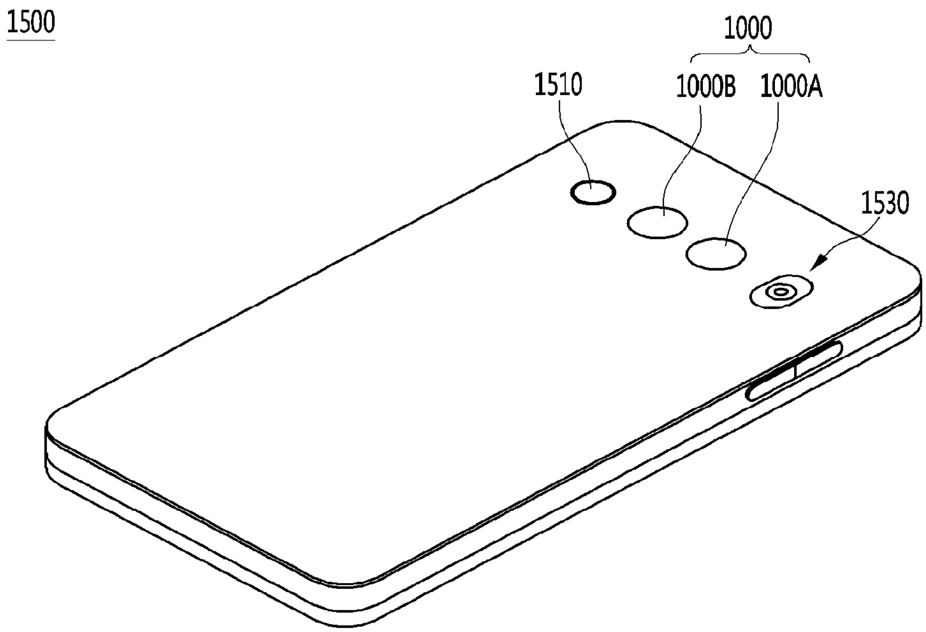
[Fig. 27]


300
110
71
C1
N S
N S
F1
S N
S N
C2
C2
F2
C1
72M4
72M3
72M2
72M1
72M
72C3
72C4
72C1
72C2
72C
y
z
x

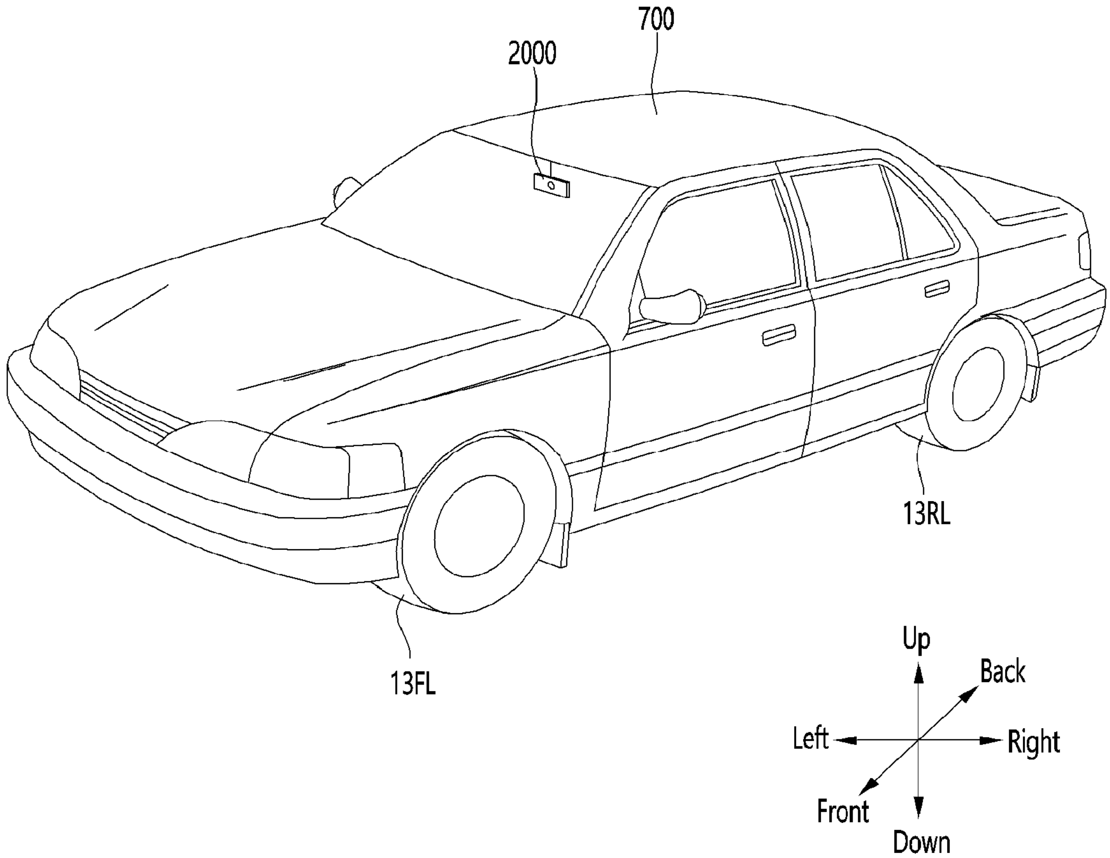
[Fig. 28]


1000
1000A
420
300
100
410
1000B
430

[Fig. 29]


1500
1000
1510
1000B
1000A
1530

[Fig. 30]


700
2000
13RL
13FL
Up
Back
Left
Right
Front
Down

# CAMERA MODULE AND CAMERA APPARATUS INCLUDING SAME

## CROSS REFERENCE TO RELATED APPLICATIONS

This application is a Continuation of U.S. application Ser. No. 17/606,638, filed on Oct. 26, 2021, which is the National Phase of PCT International Application No. PCT/KR2020/005454, filed on Apr. 24, 2020, which claims priority under 35 U.S.C. 119(a) to Patent Application No. 10-2019-0049196, filed in the Republic of Korea on Apr. 26, 2019, all of which are hereby expressly incorporated by reference into the present application.

## TECHNICAL FIELD

An embodiment relates to a camera module and a camera device including the same.

## BACKGROUND ART

A camera module performs a function of photographing a subject and storing it as an image or a moving image, and is mounted on a mobile terminal such as a mobile phone, a laptop a drone, a vehicle, and the like.

Meanwhile, an ultra-small camera module is built into a portable device such as a smartphone, a tablet PC, and a notebook, and such a camera module may perform an autofocus (AF) function adjusting automatically a distance between an image sensor and a lens to adjust a focal length of the lens.

In addition, recently, a camera module may perform a zooming function of zooming up or zooming out photographing a subject by increasing or decreasing a magnification of a long-distance subject through a zoom lens.

Further, recently, a camera module adopts an image stabilization (IS) technology to correct or prevent image shake caused by camera movement due to an unstable fixing device or user movement.

Such an image stabilization (IS) technology includes an optical image stabilizer (OIS) technology and an image stabilization technology using an image sensor.

The OIS technology is a technology that corrects movement by changing a light path, and the image stabilization technology using the image sensor is a technology that corrects movement by mechanical and electronic methods, but the OIS technology is often used.

In addition, a camera module for a vehicle is a product for transmitting images around a vehicle or inside a vehicle to a display, and may be mainly used for a parking assistance system and a traveling assistance system.

In addition, the camera module for the vehicle detects a lane, a vehicle, and the like around the vehicle, collects, and transmits related data, and thus it is possible to warn from an ECU or control the vehicle.

Meanwhile, a zoom actuator is used for a zooming function of a camera module, but frictional torque is generated when a lens is moved by mechanical movement of the actuator, and there are technical problems such as a decrease in driving force, an increase in power consumption, or a deterioration in control characteristics due to the friction torque.

Specifically, in order to achieve the best optical characteristics by using a plurality of zoom lens groups in a camera module, an alignment between the plurality of lens groups and an alignment between the plurality of lens groups and an image sensor should be well matched, but when a decentering in which a spherical center between the lens groups deviates from an optical axis, a tilt which is a phenomenon of lens tilt, or a phenomenon in which central axes of the lens groups and the image sensor are not aligned occurs, an angle of view changes or defocus occurs, which adversely affects image quality or resolution.

Meanwhile, when increasing a separation distance in a region in which friction occurs in order to reduce a friction torque resistance while moving a lens for a zooming function in a camera module, there is a contradiction in technical problems in which a lens decentering or a lens tilt are deepened when zoom movement or reversal of the zoom movement is performed.

Meanwhile, in an image sensor, as a pixel is higher, a resolution increases and a size of the pixel becomes smaller, and when the size of the pixel becomes smaller, an amount of light received at the same time will be reduced. Therefore, in a darker environment, in a high-pixel camera, image shake due to camera shake that occurs while a shutter speed is slower occurs more seriously.

Accordingly, recently, an OIS function has been indispensable for photographing an image without deformation using a high-pixel camera in dark nights or moving images.

Meanwhile, OIS technology is a method to correct image quality by changing an optical path by moving a lens or an image sensor of a camera. In particular, in the OIS technology, movement of the camera is sensed through a gyro sensor, and a distance that the lens or the image sensor should move based on the movement is calculated.

For example, an OIS correction method includes a lens moving method and a module tilting method. In the lens moving method, only a lens in a camera module is moved in order to realign the center of an image sensor and an optical axis. On the other hand, the module tilting method is a method of moving the entire module including the lens and the image sensor.

Specifically, the module tilting method has an advantage that a correction range is wider than that of the lens moving method and a focal length between the lens and the image sensor is fixed, and thus image deformation may be minimized.

Meanwhile, in case of the lens moving method, a hall sensor is used to sense a position and movement of the lens. On the other hand, in the module tilting method, a photo reflector is used to sense movement of the module. However, both methods use a gyro sensor to sense movement of a user of the camera.

An OIS controller uses data recognized by the gyro sensor to predict a position in which the lens or the module should move in order to compensate for movement of a user.

Recently, an ultra-thin and ultra-small camera module is required in accordance with technological trends, but since the ultra-small camera module has a space limitation for OIS drive, there is a problem that it is difficult to implement the OIS function applied to a general large camera, and there is a problem that the ultra-thin and ultra-small camera module cannot be implemented when the OIS drive is applied.

In addition, in the conventional OIS technology, an OIS driver is disposed at a side surface of a solid-state lens assembly within a limited camera module size, and thus there is a problem that it is difficult to secure a sufficient amount of light because a size of a lens to be subjected to OIS is limited.

Specifically, in order to achieve the best optical characteristics in a camera module, an alignment between the lens groups at the time of OIS implementation should be well matched through movement of a lens or tilting of a module, but in the conventional OIS technology, when a decenter in which a spherical center between the lens groups deviates from an optical axis or a tilt which is a phenomenon of lens tilt occurs, there is a problem that adversely affects image quality or resolution.

In addition, the conventional OIS technology may implement AF or Zoom at the same time as OIS driving, but an OIS magnet and an AF or Zoom magnet are disposed close to each other due to space limitation of a camera module and a position of a driving part of the conventional OIS technology, and cause a magnetic field interference, and thus there is a problem that the OIS driving is not performed normally, and a decent or a tilt phenomenon is induced.

Further, in the conventional OIS technology, since a mechanical driving device is required for moving the lens or tilting the module, there is a problem that a structure is complicated and power consumption is increased.

Meanwhile, as described above, a camera module is applied to vehicles together with a radar, and may be used for an advanced driver assistance system (ADAS), which may greatly affect the safety and life of drivers and pedestrians as well as convenience for the driver.

For example, an advanced driver assistance system (ADAS) include an autonomous emergency braking system (AEB) that reduces speed or stops by itself even if a driver does not step on a brake in an event of a collision, a lane keep assist system (LKAS) that maintains a lane by controlling a traveling direction when leaving the lane, an advanced smart cruise control (ASCC) that maintains a distance from a vehicle ahead while running at a predetermined speed, an active blind spot detection system (ABSD) that detects the danger of blind spot collision and helps to change to a safe lane, and an around view monitor system (AVM) that visually displays a situation around a vehicle.

In such an advanced driver assistance system (ADAS), a camera module functions as a core component together with a radar and the like, and a portion in which the camera module is applied is gradually increasing.

For example, in case of an autonomous emergency braking system (AEB), a vehicle or a pedestrian in front of a vehicle is detected by a camera sensor and a radar sensor in front of the vehicle, so that emergency braking may be automatically performed when a driver does not control the vehicle.

Alternatively, in case of a lane keep assist system (LKAS), it detects through a camera sensor whether a driver leaves a lane without operating a turn signal, and automatically steers a steering wheel, so that it may control to maintain the lane.

In case of an around view monitor system (AVM), it may display visually a situation around a vehicle through a camera sensor disposed on four sides of the vehicle.

When a camera module is applied to an advanced driver assistance system (ADAS) of a vehicle, OIS technology is more important due to vibration of the vehicle, and a precision of OIS data may be directly related to the safety or life of a driver or pedestrian. In addition, when implementing AF or Zoom, a plurality of lens assemblies are driven by an electromagnetic force between a magnet and a coil, and there is a problem that a magnetic field interference occurs between magnets mounted in each lens assembly. There is a problem that AF or Zoom driving is not performed normally, and thrust is deteriorated due to such a magnetic field interference between magnets.

In addition, there is a problem that a decenter or tilt phenomenon due to a magnetic field interference between magnets is induced.

When an issue in a precision in camera control occurs or thrust is deteriorated due to such a magnetic field interference, or a decent or tilt phenomenon is induced, it may be directly related to the safety or life of a driver who is a user, or a pedestrian.

In addition, when detachment of each component of a camera module, for example, a magnet or the like, occurs in an environment in which vibration is severe such as a vehicle, it may cause not only mechanical reliability but also large problems such as thrust, precision, and control.

Meanwhile, contents described in items merely provide background information of the present disclosure and do not constitute the related art.

## DISCLOSURE

### Technical Problem

One of technical problems of embodiments is to provide a camera actuator capable of preventing generation of friction torque when moving a lens by zooming in a camera module, and a camera module including the same.

In addition, one of the technical problems of the embodiments is to provide a camera actuator capable of preventing a lens decentering, a lens tilt, or occurrence of a phenomenon that a center axis of an image sensor does not coincide with a center of a lens during a lens shift through zooming in a camera module, and the camera module including the same.

In addition, one of the technical problems of the embodiments is to provide an ultra-thin and ultra-small camera actuator and a camera module including the same.

In addition, one of the technical problems of the embodiments is to provide a camera actuator that may secure a sufficient amount of light by eliminating lens size limitation of an optical system lens assembly when OIS is implemented, and a camera module including the same.

In addition, one of the technical problems of the embodiments is to provide a camera actuator capable of achieving the best optical characteristics and a camera module including the same by minimizing occurrence of a decenter or tilt phenomenon when the OIS is implemented.

In addition, one of the technical problems of the embodiments is to provide a camera actuator capable of preventing a magnetic field interference with an AF or Zoom magnet when the OIS is implemented, and a camera module including the same.

In addition, one of the technical problems of the embodiments is, when implementing AF or Zoom, to provide a camera actuator capable of preventing a magnetic field interference between magnets mounted on each lens assembly when a plurality of lens assemblies are driven by an electromagnetic force between a magnet and a coil, and a camera module including the same.

In addition, the embodiment is to provide a camera actuator capable of preventing detachment of a magnet and a yoke, and a camera module including the same.

In addition, one of the technical problems of the embodiments is to provide a camera actuator capable of implementing the OIS with low power consumption, and a camera module including the same.

The technical problems of the embodiments are not limited to those described in this item, but include those that may be understood from the entire description of the invention.

Technical Solution

A camera module according to an embodiment may include a base **20**, a first lens assembly **110** and a second lens assembly **120** disposed on the base **20**, wherein the first lens assembly **110** may include a first driving part **116** and a third driving part **141**. The second lens assembly **120** may include a second driving part **126** and a fourth driving part **142**.

In the first lens assembly **110**, the first driving part **116** may include a first magnet **116*b*** and a first yoke **116*a***. The third driving part **141** may include a first coil part **141*b*** and a third yoke **141*a***.

In the second lens assembly **120**, the second driving part **126** may include a second magnet **126*b*** and a second yoke **126*a***, and the fourth driving part **142** may include a second coil part **142*b*** and a fourth yoke **142*a***. The first yoke **116*a*** may include a first support portion **116*a*1** and a first side protruding portion **116*a*2** extending from the first support portion **116*a*1** toward a first side surface of the first magnet **116*b***.

The first yoke **116*a*** may include a first fixed protruding portion **116*a*3** extending in a direction opposite to the first side protruding portion **116*a*2**.

A thickness of the first side protruding portion **116*a*2** may be thicker than that of the first support portion **116*a*1**. Accordingly, since a second thickness T**2** of the first side protruding portion **116*a*2** which is a region having a high magnetic flux density is thicker than a first thickness T**1** of the first support portion **116*a*1**, a shielding performance of leakage flux is improved and divergence efficiency of magnetic flux density is increased, so that a shielding function of magnetic flux may be improved and a concentration function of magnetic flux may be enhanced.

The first yoke **116*a*** may include a first extension protruding portion **116*a*22** extending more upward than an upper surface of the first magnet **116*b*** from the first side protruding portion **116*a*2**.

The total thickness PL of the first side protruding portion **116*a*2** and the first extension protruding portion **116*a*22** may be greater than a thickness ML of the first magnet **116*b***.

The first yoke **116*a*** may include a second side protruding portion **116*a*4** protruding to a second side surface of the first magnet **116*b***. In addition, a camera module according to an embodiment may include a base including a first side wall and a second side wall corresponding to the first side wall, a first guide part disposed adjacent to the first side wall of the base, a second guide part disposed adjacent to the second side wall of the base, a first lens assembly that moves along the first guide part, a second lens assembly that moves along the second guide part, a first ball disposed between the first guide part and the first lens assembly, and a second ball disposed between the second guide part and the second lens assembly.

The first lens assembly may include a first groove in which the first ball is disposed, and the second lens assembly may include a second groove in which the second ball is disposed.

The first guide part, the first ball, and the first groove may be disposed on a virtual straight line from the first side wall toward the second side wall.

In addition, a camera module according to an embodiment may include a base, a first guide part disposed on one side of the base, a second guide part disposed on the other side of the base, a first lens assembly corresponding to the first guide part, a second lens assembly corresponding to the second guide part, a first ball disposed between the first guide part and the first lens assembly; and a second ball disposed between the second guide part and the second lens assembly.

The first guide part may include a first-first rail of a first shape and a first-second rail of a second shape, the second guide part may include a second-first rail of the first shape and a second-second rail of the second shape.

The first shape of the first guide part and the second shape of the first guide part may be different shapes.

The first-first rail of the first shape and the second-first rail of the first shape may be positioned diagonally, and the first-second rail of the second shape and the second-second rail of the second shape may be positioned diagonally.

In addition, a camera module according to an embodiment may include a base, a first guide part disposed on one side of the base, a second guide part disposed on the other side of the base, a first lens assembly corresponding to the first guide part, a second lens assembly corresponding to the second guide part, a first ball disposed between the first guide part and the first lens assembly; and a second ball disposed between the second guide part and the second lens assembly.

The first guide part may include two first rails, and the second guide part may include two second rails.

The first lens assembly may include a first lens barrel and a first driving part, and the second lens assembly may include a first lens barrel and a second driving part.

The first driving part may correspond to the two first rails, and the second driving part may correspond to the two second rails.

The first guide part may be disposed between the first lens assembly and the first side wall of the base, and the second guide part may be disposed between the second lens assembly and the second side wall of the base.

The first guide part may include two first rails, and the second guide part may include two second rails.

The first ball may include two, one of the first balls may move along one of the two first rails, and the other one of the first balls may move along the other one of the two first rails.

The first shape of the first guide part and the second guide part may be an L-shape, and the second shape of the first guide part and the second guide part may be a V-shape.

The second guide part, the second ball, and the second groove may be disposed on a virtual straight line from the first side wall toward the second side wall.

The first lens assembly may include a first lens barrel on which a lens is disposed and a first driving part, the first groove of the first lens assembly may be in plural, and a distance between two first grooves of the plurality of first grooves with respect to an optical axis direction may be longer than a thickness of the first lens barrel.

A camera module according to an embodiment may further include a third lens assembly including a third housing, wherein the first guide part may include a first protrusion formed on a first surface of the first guide part and a second protrusion formed on a second surface thereof, the first protrusion of the first guide part may be coupled to a third side wall disposed between the first side wall and the second side wall of the base, and the second protrusion of the first guide part may be coupled to the third housing.

The first groove of the first lens assembly may be V-shaped, and the first rail of the first guide part may include an L-shaped first rail and a V-shaped first rail.

The second groove of the second lens assembly may be V-shaped, and the second rail of the second guide part may include an L-shaped second rail and a V-shaped second rail.

The V-shaped first rail and the V-shaped second rail may be disposed diagonally to each other, and the L-shaped first rail and the L-shaped second rail may be disposed diagonally to each other.

In addition, a camera module actuator or a camera module including the same according to an embodiment may include a lens unit **222***c*, a shaper unit **222** disposed on the lens unit **222***c*, a first driving part **72**M coupled to the shaper unit **222**, and a second driving part **72**C disposed to correspond to the first driving part **72**M.

A camera module according to an embodiment may further include a housing **210** in which the second driving part **72**C is disposed, wherein the housing **210** may include a housing body **212** in which the lens unit is disposed, a first housing side portion **214**P**1** disposed in a direction in which a first protruding region b**12** protrudes, and a second housing side portion **214**P**2** disposed in a direction in which a second protruding region b**34** protrudes.

The lens unit **222***c* may include a translucent support **222***c***2**, a tunable prism, a second translucent support (not shown), or a liquid lens.

The lens unit **222***c* may perform a lens function in addition to a prism function of changing a light path, but the embodiment is not limited thereto.

The first housing side portion **214P1** and the second housing side portion **214**P**2** may include a driving part hole **214**H in which the second driving part **72**C is disposed.

The housing may include first to fourth jig holes formed to be overlapped vertically with the first to fourth protrusions.

The housing may include an opening **212**H formed between the first to fourth jig holes.

In addition, a camera actuator according to an embodiment may include a housing **210**, an image shaking control unit **220** including a shaper unit **222** and a first driving part **72**M and disposed on the housing **210**, and a second driving part **72**C disposed on the housing **210**.

The shaper unit **222** may include a shaper body **222***a*, a protruding portion **222***b* extending from the shaper body **222***a* to a side surface thereof and coupled to the first driving part **72**M, and a lens unit **222***c* disposed on the shaper body **222***a*.

A camera actuator according to an embodiment may include a prism unit **230** provided on the image shaking control unit **220** and including a fixed prism **232**.

The lens unit **222***c* may include a translucent support **222***c***2**, a tunable prism **222***cp*, or a liquid lens.

The first driving part **72**M may include a magnet coupled to the protruding portion **222**, and the second driving part **72**C may include a coil coupled to the shaper body **222***a*.

A camera module according to an embodiment may include a lens assembly, an image sensor unit disposed on one side of the lens assembly, and any one of the camera actuators disposed on the other side of the lens assembly.

## Advantageous Effects

According to a camera actuator and a camera module including the same according to an embodiment, there is a technical effect that may solve a problem of generation of friction torque during zooming.

For example, according to the embodiment, a lens assembly is driven in a state in which the first guide part and the second guide part, which are precisely numerically controlled in the base, are coupled to each other, so that friction resistance is reduced by reducing friction torque, and thus there are technical effects such as improvement of driving force, reduction of power consumption, and improvement of control characteristics during zooming.

Accordingly, according to the embodiment, there is a complex technical effect that image quality or resolution may be improved remarkably by preventing occurrence of a phenomenon that a decenter of a lens, tilt of the lens, and a central axis of a lens group and an image sensor are not aligned while minimizing the friction torque during zooming.

In addition, a camera actuator according to the embodiment and a camera module including the same solve a problem of lens decenter or tilt generation during zooming, and align a plurality of lens groups well to prevent a change in an angle of view or occurrence of defocusing, and thus there is a technical effect that image quality or resolution is significantly improved.

For example, according to the embodiment, the first guide part includes the first-first rail and the first-second rail, and the first-first rail and the first-second rail guide the first lens assembly, and thus there is a technical effect that accuracy of alignment may be improved.

In addition, according to the embodiment, a center of a protrusion of the first guide part and a center of a groove of the third housing do not coincide, are spaced apart from each other, and are eccentrically disposed in order to increase the accuracy of lens alignment between a plurality of lens groups, and thus there is a technical effect that decenter and lens tilt may be minimized during zooming by increasing the accuracy of alignment between the lens groups.

Further, according to the embodiment, a center of a protrusion of the base and centers of grooves of the first and second guide parts do not coincide with each other, are spaced apart from each other, and are eccentrically disposed in order to increase the accuracy of lens alignment between a plurality of lens groups, and thus there is a technical effect that decenter and lens tilt may be minimized during zooming by increasing the accuracy of alignment between the lens groups.

In addition, two rails for each lens assembly are provided, and thus there is a technical effect that even though any one of the rails is distorted, the accuracy may be secured by the other one.

Further, according to the embodiment, the two rails for each lens assembly are provided, and thus there is a technical effect that despite an issue of the frictional force of the ball described later at any one of the rails, the driving force may be secured as the cloud driving proceeds smoothly in the other one.

Furthermore, according to the embodiment, since the two rails for each lens assembly are provided, it is possible to secure widely a distance between balls described later, and accordingly, there is a technical effect that a driving force may be improved, interference of a magnetic field may be prevented, and tilt may be prevented when the lens assembly is stopped or moved.

In the related art, when guide rails are disposed on the base itself, a gradient is generated along an injection direction, and thus there is difficulty in dimensional control, and there was a technical problem that friction torque increases and driving force decreases when injection is not performed normally.

On the other hand, according to the embodiment, the first guide part and the second guide part which are formed separately from the base are applied separately without disposing the guide rails on the base itself, and thus there is a special technical effect that generation of a gradient along the injection direction may be prevented.

In addition, according to the embodiment, there is a technical effect that it is possible to provide an ultra-thin and ultra-small camera actuator and a camera module including the same.

For example, according to the embodiment, the image shaking control unit **220** is disposed so as to utilize a space below the prism unit **230** and overlap each other, and thus there is a technical effect that it is possible to provide an ultra-thin and ultra-small camera actuator and a camera module including the same.

In addition, according to the embodiment, there is a technical effect that it is possible to provide a camera actuator capable of securing a sufficient amount of light and a camera module including the same by eliminating lens size limitation of an optical system lens assembly when the OIS is implemented.

For example, according to the embodiment, lens size limitation of an optical system lens assembly is eliminated by disposing the image shaking control unit **220** under the prism unit **230** when the OIS is implemented, and thus there is a technical effect that it is possible to provide a camera actuator capable of securing a sufficient amount of light and a camera module including the same.

In addition, according to the embodiment, there is a technical effect that it is possible to provide a camera actuator capable of achieving the best optical characteristics and a camera module including the same by minimizing occurrence of a decenter or tilt phenomenon when the OIS is implemented.

For example, according to the embodiment, the image shaking control unit **220** stably disposed on the housing **210** is provided, and a shaper unit **322** described later and a first driving part **72**M are included, and thus there is a technical effect that it is possible to provide a camera actuator capable of achieving the best optical characteristics and a camera module including the same by minimizing occurrence of a decenter or tilt phenomenon when the OIS is implemented through a lens unit **322***c* including a tunable prism **322***cp*.

In addition, according to the embodiment, there is a technical effect that it is possible to provide a camera actuator capable of preventing a magnetic field interference with an AF or Zoom magnet and a camera module including the same when the OIS is implemented.

For example, according to the embodiment, when the OIS is implemented, the first driving part **72**M, which is a magnet driving part, is disposed on the second camera actuator **200** separated from the first camera actuator or the first camera module **100**, and thus there is a technical effect that that it is possible to provide a camera actuator capable of preventing a magnetic field interference with an AF or Zoom magnet and a camera module including the same.

In addition, according to the embodiment, there is a technical effect that it is possible to provide a camera actuator capable of preventing a magnetic field interference between magnets mounted on each lens assembly when a plurality of lens assemblies are driven by an electromagnetic force between a magnet and a coil when AF or Zoom is implemented, and a camera module including the same.

For example, according to the embodiment, a yoke in a magnet driving part of a first lens assembly **110** or a second lens assembly **120** includes a side protruding portion extending to a side surface of the magnet, and thus there is a technical effect that it is possible to provide a camera actuator capable of preventing a magnetic field interference between magnets mounted on each lens assembly when a plurality of lens assemblies are driven by an electromagnetic force between a magnet and a coil when AF or Zoom is implemented, and a camera module including the same.

For example, according to the embodiment, a yoke in a magnet driving part of a first lens assembly **110** or a second lens assembly **120** includes a side protruding portion extending to a side surface of the magnet to prevent leakage flux generated in the magnet, and the side protruding portion is disposed in a region having a high magnetic flux density so that the magnetic flux is concentrated (FC), and thus there is a problem that thrust is significantly improved by increasing a density between a flux line and the coil to increase the Lorentz Force.

In addition, in the embodiment, there is a technical effect that may provide a camera actuator capable of preventing detachment of a magnet and a yoke, and a camera module including the same.

According to the embodiment, as the first yoke **116***a* includes the first side protruding portion **116***a***2** extending to the side surface of the first magnet **116***b*, there is an effect capable of preventing magnetic field interference between magnets mounted in each lens assembly, and there is a complex technical effect that thrust is improved by concentration of magnetic flux and the mechanical reliability is improved by firmly fixing the first magnet **116***b*.

In addition, according to the embodiment, there is a technical effect that it is possible to provide a camera actuator capable of implementing the OIS with low power consumption and a camera module including the same.

For example, according to the embodiment, unlike the conventional method of moving a plurality of solid lenses, the OIS is implemented by driving the shaper unit **222** through the lens unit **222***c* including the tunable prism, the first driving part **72**M which is a magnet driving part, and the second driving part **72**C which is a coil driving part, and thus there is a technical effect that it is possible to provide a camera actuator capable of implementing the OIS with low power consumption and a camera module including the same.

In addition, according to the embodiment, the prism unit **230** and the lens unit **222***c* including the tunable prism may be disposed very close to each other, and thus there is a special technical effect that even though the change in the optical path is made fine in the lens unit **222***c*, the change in the optical path may be widely secured in the actual image sensor unit.

The technical effects of the embodiments are not limited to those described in this item, but include those that may be understood from the entire description of the invention.

## DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view of a camera module according to an embodiment.

FIG. **2** is a perspective view in which a part of a configuration of the camera module according to the embodiment shown in FIG. **1** is omitted.

FIG. **3** is an exploded perspective view in which a part of a configuration of the camera module according to the embodiment shown in FIG. **1** is omitted.

FIG. **4** is a perspective view of a first guide part and a second guide part of the camera module according to the embodiment shown in FIG. **3**.

FIG. **5** is an additional perspective view of the first guide part and the second guide part of the embodiment shown in FIG. **4**.

FIG. 6A is a perspective view of the first guide part of the embodiment shown in FIG. 5.

FIG. 6B is a perspective view in a left direction of the first guide part of the embodiment shown in FIG. 6A.

FIG. 7A is a perspective view of a first lens assembly of the camera module according to the embodiment shown in FIG. 3.

FIG. 7B is a perspective view in which a part of a configuration of the first lens assembly 110 shown in FIG. 7A is removed.

FIG. 8A is a cross-sectional view taken along line B1-B2 in the camera module according to the embodiment shown in FIG. 2.

FIG. 8B is a driving example view of a camera module according to an embodiment.

FIG. 9 is a perspective view of a third lens assembly in the camera module according to the embodiment shown in FIG. 3 in a first direction.

FIG. 10 is a perspective view of the third lens assembly 130 shown in FIG. 9 in a second direction.

FIG. 11A is a perspective view of a base of the camera module according to the embodiment shown in FIG. 3.

FIG. 11B is a front view of the base shown in FIG. 11A.

FIG. 12 is an enlarged view of a first region of the base shown in FIG. 11B.

FIG. 13 is an illustrative view showing a combination of a third lens assembly and a first guide part in the camera module according to the embodiment shown in FIG. 3.

FIG. 14 is an enlarged view showing a coupling region of the third lens assembly shown in FIG. 13.

FIG. 15 is a cross-sectional example view showing a combination of the third lens assembly and the first guide part shown in FIG. 13.

FIG. 16A is an illustrative view showing a combination of a base and a first guide part of the camera module according to the embodiment shown in FIG. 3.

FIG. 16B is an enlarged view showing a coupling region of the first guide part shown in FIG. 16A.

FIG. 16C a cross-sectional example view showing a combination of the base and the first guide part shown in FIG. 16A.

FIG. 17A is a cross-sectional view taken along line C1-C2 in the camera module according to the embodiment shown in FIG. 1.

FIG. 17B is a driving example view of a camera module according to an embodiment.

FIG. 17C is a perspective view of a first driving part 116 of the camera module according to the embodiment shown in FIG. 17B.

FIG. 17D shows data of a magnetic flux density distribution in Comparative Example.

FIG. 17E shows data of a magnetic flux density distribution in Example.

FIG. 17F is a detailed perspective view of a first yoke 116*a* in the first driving part 116 in Example.

FIG. 17G is a bottom perspective view of the first yoke 116*a*.

FIG. 18A is a perspective view of a first driving part 116B of a camera module according to a first additional embodiment.

FIG. 18B is a perspective view of a first drive part 116C of a camera module according to a second additional embodiment.

FIG. 19 is a perspective view showing a camera module of an embodiment including a second camera actuator.

FIG. 20A is a perspective view of the second camera actuator in the camera module of the embodiment shown in FIG. 19 in a first direction.

FIG. 20B is a perspective view of the second camera actuator in the camera module of the embodiment shown in FIG. 19 in a second direction.

FIG. 21A is a perspective view of a first circuit board and a coil part of the second camera actuator of the embodiment shown in FIG. 20B.

FIG. 21B is a partially exploded perspective view of the second camera actuator of the embodiment shown in FIG. 20B.

FIG. 21C is a perspective view in which the first circuit board is removed from the second camera actuator of the embodiment shown in FIG. 20B.

FIG. 22A is an exploded perspective view of an image shaking control unit of the second camera actuator of the embodiment shown in FIG. 21B.

FIG. 22B is a combined perspective view of the image shaking control unit of the second camera actuator of the embodiment shown in FIG. 22A.

FIG. 22C is an exploded perspective view of a first driving part in the image shaking control unit shown in FIG. 22A.

FIG. 23 is a perspective view of a shaper unit of the second camera actuator of the embodiment shown in FIG. 22A.

FIG. 24 is a cross-sectional view of a lens unit taken along line A1-A1' of the shaper unit 322 shown in FIG. 23.

FIGS. 25A to 25B are illustrative views showing an operation of the second camera actuator of an embodiment.

FIG. 26 is a first operation example view of the second camera actuator of the embodiment.

FIG. 27 is a second operation example view of the second camera actuator of the embodiment.

FIG. 28 is a perspective view of a camera module according to another embodiment.

FIG. 29 is a perspective view of a mobile terminal to which a camera module according to an embodiment is applied.

FIG. 30 is a perspective view of a vehicle to which a camera module according to an embodiment is applied.

## MODE FOR INVENTION

Hereinafter, embodiments will be described in detail with reference to the accompanying drawings. While the invention may be modified in various ways and take on various alternative forms, specific embodiments thereof are shown in the drawings and described in detail below as examples. There is no intent to limit the invention to the particular forms disclosed. On the contrary, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the appended claims.

Although the terms "first," "second," etc. may be used to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. In addition, terms defined specially in consideration of a configuration and operation of the embodiment are only for describing the embodiment, and do not limit the scope of the embodiment.

In describing the embodiments, when elements are described with terms "above (up) or below (down)", "front (head) or back (rear)", the terms "above (up) or below (down)", "front (head) or back (rear)" may include both meanings that two elements are in direct contact with each other, or one or more other components are disposed between the two elements to form. Further, when expressed as "on (over)" or "under (below)", it may include not only the upper direction but also the lower direction based on one element.

In addition, relational terms such as "on/above" and "under/below" used below do not necessarily require or imply any physical or logical relationship or order between such entities or elements, and may be used to distinguish any entity or element from another entity or element.

## Embodiment

FIG. **1** is a perspective view of a camera module **100** according to an embodiment, FIG. **2** is a perspective view in which a part of the configuration of the camera module according to the embodiment shown in FIG. **1** is omitted, and FIG. **3** is an exploded perspective view in which a part of the configuration of the camera module according to the embodiment shown in FIG. **1** is omitted.

Referring to FIG. **1**, the camera module **100** according to the embodiment may include a base **20**, a circuit board **40** disposed outside the base **20**, a fourth driving part **142**, and a third lens assembly **130**.

FIG. **2** is a perspective view in which the base **20** and the circuit board **40** are omitted in FIG. **1**, and referring to FIG. **2**, a camera module **100** according to an embodiment includes a first guide part **210**, a second guide part **220**, a first lens assembly **110**, a second lens assembly **120**, a third driving part **141**, and a fourth driving part **142**.

The third driving part **141** and the fourth driving part **142** may include a coil or a magnet.

For example, when the third driving part **141** and the fourth driving part **142** include the coil, the third driving part **141** may include a first coil part **141***b* and a first yoke **141***a*, and the fourth driving part **142** may include a second coil part **142***b* and a second yoke **142***a*.

Or, conversely, the third driving part **141** and the fourth driving part **142** may include the magnet.

In an xyz-axis direction shown in FIG. **3**, a z-axis may refer to an optic axis direction or a direction parallel thereto, an xz plane represents the ground, and an x-axis may refer to a direction perpendicular to the z-axis on the ground (xz plane), and a y-axis may refer to a direction perpendicular to the ground.

Referring to FIG. **3**, a camera module **100** according to an embodiment may include a base **20**, a first guide part **210**, a second guide part **220**, a first lens assembly **110**, a second lens assembly **120**, and a third lens assembly **130**.

For example, the camera module **100** according to the embodiment may include the base **20**, the first guide part **210** disposed on one side of the base **20**, the second guide part **220** disposed on the other side of the base **20**, the first lens assembly **110** corresponding to the first guide part **210**, the second lens assembly **120** corresponding to the second guide part **220**, a first ball **117** (see FIG. 7A) disposed between the first lens assembly **110** and the first guide part **210**, and a second ball (not shown) disposed between the second guide part **220** and the second lens assembly **120**.

In addition, the embodiment may include the third lens assembly **130** disposed in front of the first lens assembly **110** in the optic axis direction.

Hereinafter, specific features of the camera device according to the embodiment will be described with reference to the drawings.

<Guide Part>

Referring to FIG. **2** and FIG. **3**, the embodiment may include a first guide part **210** disposed adjacent to the first side wall **21***a* (see FIG. **11**A) of the base **20**, and a second guide part **220** disposed adjacent to the second side wall **21***b* (referring to FIG. **11**A) of the base **20**.

The first guide part **210** may be disposed between the first lens assembly **110** and the first side wall **21***a* of the base **20**.

The second guide part **220** may be disposed between the second lens assembly **120** and the second side wall **21***b* of the base **20**. The first side wall **21***a* and the second side wall **21***b* of the base may be disposed to face each other.

According to the embodiment, a lens assembly is driven in a state in which the first guide part **210** and the second guide part **220**, which are precisely numerically controlled in the base, are coupled to each other, so that friction resistance is reduced by reducing friction torque, and thus there are technical effects such as improvement of driving force, reduction of power consumption, and improvement of control characteristics during zooming.

Accordingly, according to the embodiment, there is a complex technical effect that image quality or resolution may be improved remarkably by preventing occurrence of a phenomenon that a decenter of a lens, tilt of the lens, and a central axis of a lens group and an image sensor are not aligned while minimizing the friction torque during zooming,

In the related art, when guide rails are disposed on the base itself, a gradient is generated along an injection direction, and thus there is difficulty in dimensional control, and there was a technical problem that friction torque increases and driving force decreases when injection is not performed normally.

On the other hand, according to the embodiment, the first guide part **210** and the second guide part **220** which are formed separately from the base **20** are applied separately without disposing the guide rails on the base itself, and thus there is a special technical effect that generation of a gradient along the injection direction may be prevented.

The base **20** may be injected in a Z-axis direction. In the related art, when a rail is integrally formed with the base, there is a problem that a straight line of the rail is distorted due to a gradient generated while the rail is injected in the Z-axis direction.

According to the embodiment, since the first guide part **210** and the second guide part **220** are injected separately from the base **20**, it is possible to prevent generation of a gradient remarkably as compared with the related art, and thus there is a special technical effect that precise injection may be performed and generation of a gradient due to injection may be prevented.

In the embodiment, the first guide part **210** and the second guide part **220** may be injected on an X axis, and a length injected may be shorter than the base **20**. In this case, when rails **212** and **222** are disposed on the first guide part **210** and the second guide part **220**, generation of a gradient during injection may be minimized, and there is a technical effect that possibility that the straight line of the rail is distorted is low.

FIGS. **4** and **5** are enlarged perspective views of a first guide part **210** and a second guide part **220** of the camera module according to the embodiment.

Referring to FIG. **4**, in an embodiment, the first guide part **210** may include a single or a plurality of first rails **212**. In addition, the second guide part **220** may include a single or a plurality of second rails **222**.

For example, the first rail **212** of the first guide part **210** may include a first-first rail **212***a* and a first-second rail

212*b*. The first guide part **210** may include a first support portion **213** between the first-first rail **212***a* and the first-second rail **212***b*.

According to the embodiment, two rails for each lens assembly are provided, and thus there is a technical effect that even though any one of the rails is distorted, the accuracy may be secured by the other one.

In addition, according to the embodiment, the two rails for each lens assembly are provided, and thus there is a technical effect that despite an issue of the frictional force of the ball described later at any one of the rails, the driving force may be secured as the cloud driving proceeds smoothly in the other one.

The first rail **212** may be connected from one surface of the first guide part **210** to the other surface thereof.

A camera actuator according to the embodiment and a camera module including the same solve a problem of lens decenter or tilt generation during zooming, and align a plurality of lens groups well to prevent a change in an angle of view or occurrence of defocusing, and thus there is a technical effect that image quality or resolution is significantly improved.

For example, according to the embodiment, the first guide part **210** includes the first-first rail **212***a* and the first-second rail **212***b*, and the first-first rail **212***a* and the first-second rail **212***b* guide the first lens assembly **110**, and thus there is a technical effect that accuracy of alignment may be improved.

In addition, according to the embodiment, since the two rails for each lens assembly are provided, it is possible to secure widely a distance between balls described later, and accordingly, there is a technical effect that a driving force may be improved, interference of a magnetic field may be prevented, and tilt may be prevented when the lens assembly is stopped or moved.

In addition, the first guide part **210** may include a first guide protruding portion **215** that extends in a side surface direction perpendicular to a direction in which the first rail **212** extends.

A first protrusion **214***p* may be included on the first guide protruding portion **215**. For example, the first protrusion **214***p* may include a first-first protrusion **214***p***1** and a first-second protrusion **214***p***2**.

Referring to FIG. **4**, in the embodiment, the second guide part **220** may include a single or a plurality of second rails **222**.

For example, the second rail **222** of the second guide part **220** may include a second-first rail **222***a* and a second-second rail **222***b*. The second guide part **220** may include a second support portion **223** between the second-first rail **222***a* and the second-second rail **222***b*.

The second rail **222** may be connected from one surface of the second guide part **210** to the other surface thereof.

In addition, the second guide part **220** may include a second guide protruding portion **225** that extends in a side surface direction perpendicular to a direction in which the second rail **222** extends.

A second protrusion **224***p* including a second-first protrusion **224***p***1** and a second-second protrusion **224***p***2** may be included on the second guide protruding portion **225**.

The first-first protrusion **214***p***1** and first-second protrusion **214***p***2** of the first guide part **210** and the second-first protrusion **224***p***1** and second-second protrusion **224***p***2** of the second guide part **220** may be coupled to a third housing **21** of a third lens assembly **130** described later.

According to the embodiment, the first guide part **210** includes the first-first rail **212***a* and the first-second rail **212***b*, and the first-first rail **212***a* and the first-second rail **212***b* guide the first lens assembly **110**, and thus there is a technical effect that accuracy of alignment may be improved.

In addition, according to the embodiment, the second guide part **220** includes the second-first rail **222***a* and the second-second rail **222***b*, and the second-first rail **222***a* and the second-second rail **222***b* guide the second lens assembly **120**, and thus there is a technical effect that alignment accuracy may be increased.

Further, two rails for each lens assembly are provided, and thus there is a technical effect that even though any one of the rails is distorted, the accuracy may be secured by the other one.

In addition, according to the embodiment, since the two rails for each lens assembly are provided, it is possible to secure widely a distance between balls described later, and accordingly, there is a technical effect that a driving force may be improved, interference of a magnetic field may be prevented, and tilt may be prevented when the lens assembly is stopped or moved.

Further, according to the embodiment, the two rails for each lens assembly are provided, and thus there is a technical effect that despite an issue of the frictional force of the ball described later at any one of the rails, the driving force may be secured as the cloud driving proceeds smoothly in the other one.

Furthermore, according to the embodiment, the first guide part **210** and the second guide part **220** which are formed separately from the base **20** are applied separately without disposing the guide rails on the base itself, and thus there is a special technical effect that generation of a gradient along the injection direction may be prevented.

In the related art, when guide rails are disposed on the base itself, a gradient is generated along an injection direction, and thus there is difficulty in dimensional control, and there was a technical problem that friction torque increases and driving force decreases when injection is not performed normally.

Next, referring to FIG. **5**, the first rail **212** of the first guide part **210** may include a first-first rail **212***a* having a first shape R**1** and a first-second rail **212***b* having a second shape R**2**.

Further, the second rail **222** of the second guide part **220** may include a second-first rail **222***a* of the first shape R**1** and a second-second rail **222***b* of the second shape R**2**.

The first shape R**1** of the first guide part **210** and the second shape R**2** of the first guide part **210** may be different shapes.

For example, the first shape R**1** of the first guide part **210** and the second guide part **220** may be a V-shape. The second shape R**2** of the first guide part **210** and the second guide part **220** may be an L-shape, but the embodiment is not limited thereto.

The first-first rail **212***a* of the first shape R**1** and the second-first rail **222***a* of the first shape R**1** may be positioned diagonally.

The first-second rail **212***b* of the second shape R**2** and the second-second rail **222***b* of the second shape R**2** may be positioned diagonally.

Subsequently, referring to FIG. **5**, the first guide part **210** may include a single or a plurality of first guide part holes **210***h* in which a protrusion of a base is coupled in a first guide protrusion **215**. For example, the first guide part hole **210***h* may include a first regular hole **210***ha* and a first long hole **210***hb* in the first guide protrusion **215**. In the embodiment, the first regular hole **210***ha* is firmly coupled to the first guide protrusion **215**, and the first long hole **210***hb* is formed larger than the first guide protrusion **215**, and thus there is a special technical effect that generation of a minute tolerance of the first guide protrusion **215** generated in a Y-axis direction may be covered and rotation in an X-axis direction may be prevented. A regular hole and a long hole described below may also perform the same function.

In the embodiment, a first-second distance D**12** of the plurality of first guide part holes **210***h* to which a protrusion of the base **20** is coupled may be different from a first-first distance D**1***i* between first protrusions **214***p* of the plurality of first guide parts **210**, and accordingly, a coupling axis is formed in various ways, and a stable coupling force may be secured, thereby improving mechanical reliability.

For example, the first-second distance D**12** of the plurality of first guide part holes **210***h* to which the protrusion of the base **20** is coupled may be formed wider than the first-first distance D**11** between the first protrusions **214***p* of the plurality of first guide parts **210** coupled to a housing, and accordingly, a stable coupling force may be secured and mechanical reliability may be improved, but a length of the distance is not limited thereto.

The first regular hole **210***ha* may be a circular hole, and in the first long hole **210***hb*, a diameter in a first axis direction may be different from that in a second axis direction perpendicular the first axis direction. For example, in the first long hole **210***hb*, a diameter in the y-axis direction perpendicular to the x-axis may be larger than that in the x-axis direction horizontal to the ground.

In addition, the second guide part **220** may include a single or a plurality of second guide part holes **220***h* in a second guide protrusion **225**. For example, the second guide part hole **220***h* may include a second regular hole **220***ha* and a second long hole **220***hb* in the second guide protrusion **225**.

In addition, in the embodiment, a second-second distance D**22** of the plurality of second guide part holes **220***h* to which a protrusion of the base **20** is coupled may be different from a second-first distance D**21** between second protrusions **224***p* of the plurality of second guide parts **220**, and accordingly, a coupling axis is formed in various ways, and a stable coupling force may be secured, thereby improving mechanical reliability.

For example, the second-second distance D**22** of the plurality of second guide part holes **220***h* to which the protrusion of the base **20** is coupled may be formed wider than the second-first distance D**21** between the second protrusions **224***p* of the plurality of second guide parts **220** coupled to the housing, and accordingly, a stable coupling force may be secured and mechanical reliability may be improved, but a length of the distance is not limited thereto.

The second regular hole **220***ha* may be a circular hole, and in the second long hole **220***hb*, a diameter in a first axis direction may be different from that in the second axis direction perpendicular the first axis direction. For example, in the second long hole **220***hb*, a diameter in the y-axis direction perpendicular to the x-axis may be larger than that in the x-axis direction horizontal to the ground.

The first regular hole **210***ha* and the second regular hole **220***ha* may be positioned diagonally. In addition, the first long hole **210***hb* and the second long hole **220***hb* may be positioned diagonally. However, the embodiment is not limited thereto, the first regular hole **210***ha* and the second regular hole **220***ha* may be positioned at an upper portion, and the first long hole **210***hb* may be disposed below the first regular hole **210***ha*. In addition, the first long hole **210***hb* and the second long hole **220***hb* may be positioned at a parallel position, and the second long hole **220***hb* may be disposed below the second regular hole **220***ha*. The first long hole **210***hb* may be disposed above the first regular hole **210***ha*, and the second long hole **220***hb* may be disposed above the second regular hole **220***ha*.

Next, FIG. **6**A is a perspective view of the first guide part **210** of the embodiment shown in FIG. **5**, and FIG. **6**B is a perspective view in a left direction of the first guide part **210** of the embodiment shown in FIG. **6**A.

In the embodiment, a first-first recess **214***r***1** in a circular shape may be disposed around a first-first protrusion **214***p***1** of the first guide part **210**. Further, in the embodiment, a first-second recess **214***r***2** in a circular shape may be disposed around a first-second protrusion **214***p***2** of the first guide part **210**.

In addition, a second-first recess (not shown) in a circular shape may be disposed around a second-first protrusion **224***p***1** of the second guide part **220**. Further, a second-second recess (not shown) in a circular shape may be disposed around a second-second protrusion **224***p***2** of the second guide part **220**.

According to the embodiment, there is a technical effect that when the first-first protrusion **214***p***1** and the first-second protrusion **214***p***2** are formed, generation of burrs therearound may be prevented by the first-first recess **214***r***1** and the first-second recess **214***r***2** are disposed around the first-first protrusion **214***p***1** and the first-second protrusion **214***p***2** of the first guide part **210**, respectively.

Accordingly, there is a technical effect that the first-first protrusion **214***p***1** and the first-second protrusion **214***p***2** of the first guide part **210** may be firmly and tightly coupled to a third housing **21**.

Next, referring to FIG. **6**A, a single or a plurality of first ribs **217** may be disposed between a first support portion **213** and a first-second rail **212***b*.

In the related art, as an amount of an injected material increases or as a thickness of the injected material increases, shrinkage occurs, which makes it difficult to control dimensions, but on the other hand, when the amount of the injected material is reduced, a contradiction occurs in which strength is weakened.

According to the embodiment, the first rib **217** is disposed between the first support portion **213** and the first-second rail **212***b*, and thus there is a complex technology effect that accuracy of dimensional control may be improved by reducing the amount of injection material, and strength may be secured.

Next, referring to FIG. **6**B, a first rail **212** of the first guide part **210** may include a rail part recess **212***rb*. In addition, the first support portion **213** of the first guide part **210** may include a support portion recess **213***r*.

According to the embodiment, the rail part recess **212***rb* and the support portion recess **213***r* is provided in the first guide part **210**, and thus there is a complex technology effect that accuracy of dimensional control may be improved and strength may be secured by reducing the amount of injection material to prevent shrinkage.

In addition, referring to FIG. **6**B, the first guide part **210** may include a first-third protrusion **214***p***3** disposed in a region opposite to the first-first protrusion **214***p***1**, and the first-fourth protrusion **214***p***4** disposed in a region opposite to the first-second protrusion **214***p***2**.

The first-third protrusion **214***p***3** and the first-fourth protrusion **214***p***4** may be coupled to a base hole of a third side wall **21***c* of a base **20** described later.

<First and Second Lens Assemblies and Balls>

Next, FIG. **7**A is a perspective view of a first lens assembly **110** of the camera module according to the embodiment shown in FIG. **3**, and FIG. **7**B is a perspective view in which a part of a configuration of the first lens assembly **110** shown in FIG. **7**A is removed.

Referring briefly to FIG. **3**, the embodiment may include a first lens assembly **110** moving along the first guide part **210** and a second lens assembly **120** moving along the second guide part **220**.

Referring again to FIG. **7**A, the first lens assembly **110** may include a first lens barrel **112***a* on which a first lens **113** is disposed and a first driving part housing **112***b* on which a first driving part **116** is disposed. The first lens barrel **112***a* and the first driving part housing **112***b* may be a first housing, and the first housing may be in a barrel shape or a lens-barrel shape. The first driving part **116** may be a magnet driving part, but the embodiment is not limited thereto, and in some cases, a coil may be disposed therein.

In addition, the second lens assembly **120** may include a second lens barrel (not shown) on which a second lens (not shown) is disposed and a second driving part housing (not shown) on which a second driving part (not shown) is disposed. The second lens barrel (not shown) and the second driving part housing (not shown) may be a second housing, and the second housing may be in a barrel shape or a lens-barrel shape. The second driving part may be a magnet driving part, but the embodiment is not limited thereto, and in some cases, a coil may be disposed therein.

The first driving part **116** may correspond to the two first rails **212**, and the second driving part may correspond to the two second rails **222**.

In the embodiment, it is possible to drive using a single or a plurality of balls. For example, the embodiment may include a first ball **117** disposed between the first guide part **210** and the first lens assembly **110** and a second ball (not shown) disposed between the second guide part **220** and the second lens assembly **120**.

For example, in the embodiment, the first ball **117** may include a single or a plurality of first-first balls **117***a* disposed above the first driving part housing **112***b* and a single or a plurality of first-second balls **117***b* below the first driving part housing **112***b*.

In the embodiment, the first-first ball **117***a* of the first ball **117** may move along a first-first rail **212***a* which is one of the first rails **212**, and the first-second ball **117***b* of the first balls **117** may move along a first-second rail **212***b* which is another one of the first rails **212**.

A camera actuator according to the embodiment and a camera module including the same solve a problem of lens decenter or tilt generation during zooming, and align a plurality of lens groups well to prevent a change in an angle of view or occurrence of defocusing, and thus there is a technical effect that image quality or resolution is significantly improved.

For example, according to the embodiment, the first guide part includes the first-first rail and the first-second rail, and the first-first rail and the first-second rail guide the first lens assembly **110**, and thus there is a technical effect that accuracy of alignment between the second lens assembly **120** and an optic axis may be improved when the first lens assembly **110** moves.

Referring also to FIG. **7**B, in an embodiment, the first lens assembly **110** may include a first assembly groove **112***b***1** on which the first ball **117** is disposed. The second lens assembly **120** may include a second assembly groove (not shown) on which the second ball is disposed.

The first assembly groove **112***b***1** of the first lens assembly **110** may be in plural. In this case, a distance between two first assembly grooves **112***b***1** of the plurality of first assembly grooves **112***b***1** with respect to an optic axis direction may be longer than a thickness of the first lens barrel **112***a*.

In the embodiment, the first assembly groove **112***b***1** of the first lens assembly **110** may be in a V-shape. Further, the second assembly groove (not shown) of the second lens assembly **120** may be in a V-shape. The first assembly groove **112***b***1** of the first lens assembly **110** may be in a U-shape in addition to the V-shape, or a shape that contacts the first ball **117** at two or three points. In addition, the second assembly groove (not shown) of the second lens assembly **120** may be in a U-shape in addition to the V-shape, or a shape that contacts the first ball **117** at two or three points.

Referring to FIG. **2** and FIG. **7**A, in the embodiment, the first guide part **210**, the first ball **117**, and the first assembly groove **112***b***1** may be disposed on a virtual straight line from the first side wall **21***a* toward the second side wall **21***b*. The first guide part **210**, the first ball **117**, and the first assembly groove **112***b***1** may be disposed between the first side wall **21***a* and the second side wall **21***b*.

Referring to FIG. **8**, in the first lens assembly **110**, an assembly protrusion **112***b***2** may be disposed at a position opposite to the first assembly groove **112***b***1**. In the embodiment, strength according to disposition of the assembly groove **112***b***1** is maintained by the assembly protrusion **112***b***2**, and a recess region is provided at an upper end of the assembly protrusion **112***b***2** to reduce an amount of an injected material, thereby increasing accuracy of dimensional control by preventing shrinkage.

Next, FIG. **8**A is a cross-sectional view taken along line B**1**-B**2** in the camera module according to the embodiment shown in FIG. **2**.

According to the embodiment, the first guide part **210** and the second guide part **220** may be disposed and inserted into the base **20**, respectively, the first lens assembly **110** may be disposed to correspond to the first guide part **210**, and the second lens assembly **120** may be disposed to correspond to the second guide part **220**.

Meanwhile, according to the embodiment, there is a technical effect that it is possible to prevent the first lens assembly **110** and the second lens assembly **120** from being reversely inserted into the base **20**.

For example, referring to FIG. **8**A, a first upper portion and a first lower portion of the base **20** on which the first driving part housing **112***b* of the first lens assembly **110** is disposed may be spaced apart at a first distance A**20**.

In addition, a second upper portion and a second lower portion of the base **20** on which the first driving part housing **122***b* of the second lens assembly **120** is disposed may be spaced apart at a second distance A**20**.

In this case, a vertical width of the first driving part housing **112***b* may include a first width A**110**, and a vertical width of the second driving part housing **122***b* may include a second width B**120**.

In this case, unlike a distance and a width shown in FIG. **8**A, when a dimensional control is designed so that the second width B**120** which is the vertical width of the second driving part housing **122***b* is larger than the first distance A**20** between the first upper portion and the first lower portion of the base **20**, the second lens assembly **120** is not inserted into abase region in which the first lens assembly **110** is mounted, and thus there is a technical effect that reverse inserting is prevented.

In addition, unlike a distance and a width shown in FIG. **8**A, when a dimensional control is designed so that the first width A**110** which is the vertical width of the first driving part housing **112***b* is larger than the second distance B**20** between the second upper portion and the second lower portion of the base **20**, the first lens assembly **110** is not inserted into a base region in which the second lens assembly **120** is mounted, and thus there is a technical effect that reverse inserting is prevented.

Next, FIG. **8**B is a driving example view of the camera module according to the embodiment.

An interaction in which an electromagnetic force DEM is generated between a first magnet **116** and a first coil part **141***b* in the camera module according to the embodiment will be described with reference to FIG. **8**B.

As shown in FIG. **8**B, a magnetization method of the first magnet **116** of the camera module according to the embodiment may be a vertical magnetization method. For example, in the embodiment, all of an N-pole **116**N and an S-pole **116**S of the first magnet **116** may be magnetized so as to face the first coil part **141***b*. Accordingly, the N-pole **116**N and the S-pole **116**S of the first magnet **116** may be respectively disposed so as to correspond to a region in which current flows in a y-axis direction perpendicular to the ground at the first coil part **141***b*.

Referring to FIG. **8**B, in the embodiment, a magnetic force DM is applied in a direction opposite to an x-axis at the N-pole **116**N of the first magnet **116**, and when a current DE flows in a y-axis direction in a region of the first coil part **141***b* corresponding to the N-pole **116**N, the electromagnetic force DEM acts in a z-axis direction based on the Fleming's left-hand rule.

In addition, in the embodiment, the magnetic force DM is applied in the x-axis direction at the S-pole **116**S of the first magnet **116**, and when the current DE flows in a direction opposite to the y-axis perpendicular to the ground at the first coil part **141***b* corresponding to the S pole **116**S, the electromagnetic force DEM acts in a z-axis direction based on the Fleming's left-hand rule.

At this time, since a third driving part **141** including the first coil part **141***b* is in a fixed state, the first lens assembly **110**, which is a mover on which the first magnet **116** is disposed, may be moved back and forth along a rail of the first guide part **210** in a direction parallel to the z-axis direction by the electromagnetic force DEM according to a current direction. The electromagnetic force DEM may be controlled in proportion to the current DE applied to the first coil part **141***b*.

Likewise, an electromagnetic force DEM is generated between a second magnet (not shown) and the second coil part **142***b* of the camera module according to the embodiment, and thus the second lens assembly **120** may be moved along a rail of the second guide part **220** horizontally with respect to the optic axis.

<Third Lens Assembly>

Next, FIG. **9** is a perspective view of a third lens assembly **130** in the camera module according to the embodiment shown in FIG. **3** in a first direction, and FIG. **10** is a perspective view of the third lens assembly **130** shown in FIG. **9** in a second direction, and is a perspective view in which a third lens **133** is removed.

Referring to FIG. **9**, in an embodiment, the third lens assembly **130** may include a third housing **21**, a third barrel **131**, and a third lens **133**.

In the embodiment, the third lens assembly **130** includes a barrel recess **21***r* at an upper end of the third barrel **131**, and thus there is a complex technology effect that a thickness of the third barrel **131** of the third lens assembly **130** may be adjusted to be constant, and accuracy of dimensional control may be improved by reducing an amount of injection material.

In addition, according to the embodiment, the third lens assembly **130** may include a housing rib **21***a* and a housing recess **21***b* in the third housing **21**.

In the embodiment, the third lens assembly **130** includes the housing recess **21***b* in the third housing **21**, and thus there is a complex technology effect that accuracy of dimensional control may be improved by reducing the amount of injection material, and strength may be secured by including the housing rib **21***a* in the third housing **21**.

Next, referring to FIG. **10**, the third lens assembly **130** may include a single or a plurality of housing holes in a third housing **21**. For example, the housing hole may include a third regular hole **22***ha* and a third long hole **22***hb* around a third barrel **131** of the third housing **21**.

The housing hole may be coupled to a first protrusion **214***p* of a first guide part **210** and a second protrusion **224***p* of a second guide part **220**.

The third regular hole **22***ha* may be a circular hole, and in the third long hole **22***hb*, a diameter in a first axis direction may be different from that in a second axis direction perpendicular the first axis direction. For example, in the third long hole **22***hb*, a diameter in the y-axis direction perpendicular to the x-axis may be larger than that in the x-axis direction horizontal to the ground.

The housing hole of the third lens assembly may include two third regular hole **22***ha* and two third long hole **22***hb*.

The third regular hole **22***ha* may be disposed below the third housing **21**, and the third long hole **22***hb* may be disposed above the third housing **21**, but the embodiment is not limited thereto. The third long hole **22***hb* may be positioned diagonally to each other, and the third regular hole **22***ha* may be positioned diagonally to each other.

In an embodiment, the third housing **21** of the third lens assembly **130** may include a single or a plurality of housing protrusions **21***p*. In the embodiment, the housing protrusion **21***p* is provided inside the third housing **21**, and thus it is possible to prevent reverse insertion, and to prevent the third housing **21** from being coupled to the base **20** by turning left and right.

The number of the housing protrusions **21***p* may be plural, for example, four, but the embodiment is not limited thereto. Referring also to FIG. **11**B, the housing protrusion **21***p* may be coupled to a side recess **23***a* disposed on a base-side protruding portion **23***a*.

<Base>

Next, FIG. **11**A is a perspective view of the base **20** of the camera module according to the embodiment shown in FIG. **3**, FIG. **11**B is a front view of the base **20** shown in FIG. **11**A, and FIG. **12** is an enlarged view of a first region **21***c*A of the base **20** shown in FIG. **11**B.

Referring to FIG. **3**, the first guide part **210**, the second guide part **220**, the first lens assembly **110**, the second lens assembly **120**, etc. may be disposed in the base **20** according to the embodiment. The third lens assembly **130** may be disposed at one side surface of the base.

Referring again to FIG. **11**A, the base **20** may have a rectangular parallelepiped shape having a space therein.

For example, the base **20** may include a first side wall **21***a*, a second side wall **21***b*, a third side wall **21***c*, and a fourth side wall **21***d*, and the base **20** may include a plurality of side walls and a base upper surface **21***e*, and a base lower surface **21***f*.

For example, the base **20** may include the first side wall **21***a* and the second side wall **21***b* corresponding to the first side wall **21***a*. For example, the second side wall **21***b* may be disposed in a direction facing the first side wall **21***a*.

The first side wall **21***a* and the second side wall **21***b* may include a first opening **21***b*O and a second opening (not shown), respectively.

In addition, the base **20** may further include the third side wall **21***c* disposed between the first side wall **21***a* and the second side wall **21***b* and connecting the first side wall **21***a* and the second side wall **21***b*. The third side wall **21***c* may be disposed in a direction perpendicular to the first side wall **21***a* and the second side wall **21***b*.

The first, second, and third side walls **21***a*, **21***b*, and **21***c* may be formed in an injection shape integrally with each other, or may be in a form in which each of configurations is coupled.

Referring to FIG. **11**B, a base protrusion may be disposed on the fourth side wall **21***d* of the base **20**.

The base protrusion may include a first base protrusion **22***p***1**, a second base protrusion **22***p***2**, a third base protrusion **22***p***3**, and a fourth base protrusion **22***p***4** disposed on the fourth side wall **21***d*.

The first to fourth base protrusions **22***p***1**, **22***p***2**, **22***p***3**, and **22***p***4** may be coupled to a first guide part hole **210***h* and a second guide part hole **220***h*.

The fourth side wall **21***d* may be in an opened form, and may include a fourth opening **21***d*O.

The first guide part **210**, the second guide part **220**, the first lens assembly **110**, and the second lens assembly **120** may be detachably coupled to the inside of the base **20** through the fourth opening **21***d*O.

Next, referring to FIGS. **11**A and **11**B, the base **20** may include a base protruding portion **23***b* protruding in a z-axis direction from the fourth side wall **21***d*. In the embodiment, the base protruding portion **23***b* is provided on the fourth side wall **21***d*, so that when the first guide part **210** and the second guide part **220** are assembled to the base **20**, epoxy or adhesive is applied for bonding between the base **20** and the third housing **21** of the third lens assembly, thereby improving a strong bonding force.

In addition, the embodiment may include a side protruding portion **23***a* extending in an x-axis direction of the fourth side wall **21***d* of the base **20**. The side protruding portion **23***a* of the base **20** may serve a guiding function when a main FPCB (sensor FPCB) is coupled to the base **20**.

Subsequently, referring to FIG. **11**A, the base **20** may include the base upper surface **21***e* and the base lower surface **21***f*.

The base upper surface **21***e* may include a base upper groove **21***er*.

In the embodiment, the base upper groove **21***er* is provided on the base upper surface **21***e*, and thus a thickness of a cross section thickened for assembling the first and second guide parts **210** and **220** is constant, thereby preventing shrinkage during injection.

The base upper surface **21***e* may include a base upper rib **21***ea*.

In the embodiment, the base upper rib **21***ea* is disposed on the base upper surface **21***e*, and thus it is possible to serve as a guide at the time of placing a FPCB, and serve a function of adjusting a thickness of a placing portion and a non-placing portion of the FPCB.

In addition, in the embodiment, the base lower surface **21***f* may include a base step **21***s*.

In the embodiment, the base step **21***s* is provided at the base lower surface **21***f*, thereby improving robust reliability of the first and second driving parts mounted therein.

Next, FIG. **12** is an enlarged view of the first region **21***c*A of the third side wall **21***c* of the base shown in FIG. **11**B.

In an embodiment, the third side wall **21***c* of the base may include a base hole.

For example, the base hole may include a single or a plurality of regular holes and a single or a plurality of long holes on the third side wall **21***c*.

For example, the third side wall **21***c* may include a fourth-first regular hole **21***ha***1**, a fourth-second regular hole **21***ha***2**, a fourth-first long hole **21***hb***1**, and a fourth-second long hole **21***hb***2**.

The base hole may be coupled to a first-third protrusion **214***p***3** and a first-fourth protrusion **214***p***3** of the first guide part **210** and a second-fourth protrusion (not shown) of the second guide part **220**.

The fourth-first regular hole **21***ha***1** and the fourth-second regular hole **21***ha***2** may be circular holes, and the fourth-first long hole **21***hb***1** and the fourth-second long hole **21***hb***2** may have different diameters in a first axis direction and a second axis direction perpendicular thereto. The fourth-first regular hole **21***ha***1** and the fourth-second regular hole **21***ha***2** may be disposed diagonally. In this case, the fourth-first long hole **21***hb***1** and the fourth-second long hole **21***hb***2** may be disposed diagonally. However, the embodiment is not limited thereto, the fourth-first regular hole **21***ha***1** and the fourth-second regular hole **21***ha***2** may be disposed above the first region **21***c*A, and the fourth-first long hole **21***hb***1** and the fourth-second long hole **21***hb***2** may be disposed below the first region **21***c*A.

<Eccentric Features>

Next, FIG. **13** is an illustrative view showing a combination of the third lens assembly **130** and the first guide part **210** in the camera module according to the embodiment shown in FIG. **3**, FIG. **14** is an enlarged view showing a correspondence between a plane and a cross section of a third regular hole **22***hb*, which is a coupling region of the third lens assembly **130** shown in FIG. **13**, and FIG. **15** a cross-sectional example view showing a combination of the third lens assembly **130** and the first guide part **210** shown in FIG. **13**.

Specifically, in FIG. **13**, a region in which the first-second protrusion **214***p***2** of the first guide part **210** and the third regular hole **22***ha* of the third housing are coupled is indicated by a first region **214**PH, and FIG. **15** is a cross-sectional view of a state in which they are coupled.

FIG. **14**B is a cross-sectional view taken along line A**1**-A**2** in FIG. **14**A.

Referring to FIG. **14**, the third regular hole **22***ha* of the third housing **21** may include a third groove **22***hr* and a third hole **22***ht* disposed in the third groove **22***hr*.

In the embodiment, a center **22***hrc* of the third groove and a center **22***htc* of the third hole do not coincide with each other and may be eccentric.

According to the embodiment, the center **22***hrc* of the third groove and the center **22***htc* of the third hole do not coincide, are spaced apart from each other, and are eccentrically disposed in the third regular hole **22***ha* of the third housing **21** in order to increase the accuracy of lens alignment between a plurality of lens groups, and thus there is a technical effect that decenter and lens tilt may be minimized during zooming by increasing the accuracy of alignment between the lens groups.

Next, referring to FIG. **15**, there is a cross-sectional view taken along line A**1**-A**2** of the first region **214**PH in which the first-second protrusion **214***p***2** of the first guide part **210** and the third regular hole **22***ha* of a third housing are coupled.

In the embodiment, the first-second protrusion **214***p***2** may protrude from the first guide part **210**, and a first-second recess **214***r***2** in a circular shape may be disposed around the first-second protrusion **214***p***2**.

According to the embodiment, a center **214***p***2***c* of the first-second protrusion may not coincide with a center of the first-second recess or the center **22***hrc* of the third groove.

According to the embodiment, a center of a protrusion of the first guide part **210** and a center of a groove of the third housing do not coincide, are spaced apart from each other, and are eccentrically disposed in order to increase the accuracy of lens alignment between a plurality of lens groups, and thus there is a technical effect that decenter and lens tilt may be minimized during zooming by increasing the accuracy of alignment between the lens groups.

Next, FIG. **16**A is an illustrative view showing a combination of a base **20** and a first guide part **210** of the camera module according to the embodiment shown in FIG. **3**, and FIG. **16**B is a cross-sectional example view showing a combination of a first regular hole **210***ha* and a first base protrusion **22***p***1** of the first guide part **210** shown in FIG. **16**A.

FIG. **16**C is a cross-sectional view showing a combination of the base **20** and the first guide part **210** shown in FIG. **16**A.

Specifically, in FIG. **16**A, a region in which the first base protrusion **22***p***1** of the base **20** and the first regular hole **210***ha* the first guide part are coupled is indicated by a second region **22**PH, and FIG. **16**C is a cross-sectional view of a state in which they are coupled.

(b) of FIG. **16**B is a cross-sectional view taken along line A**1**-A**2** in (a) of FIG. **16**B.

Referring to FIG. **16**B, the first regular hole **210***ha* of the first guide part **210** may include a first groove **210***hr* and a first hole **210***ht* disposed in the first groove **210***hr*.

In the embodiment, a center **210***hr*c of the first groove and a center **210***htc* of the first hole do not coincide with each other and may be eccentric.

According to the embodiment, a center of the first groove **210***hr* and centers of grooves of the first and second guide parts do not coincide, are spaced apart from each other, and are eccentrically disposed in the first regular hole **210***ha* of the first guide part **210** in order to increase the accuracy of lens alignment between a plurality of lens groups, and thus there is a technical effect that decenter and lens tilt may be minimized during zooming by increasing the accuracy of alignment between the lens group.

Next, referring to FIG. **16**C, there is a cross-sectional view along line A**3**-A**4** of the second region **22**PH in which the first base protrusion **22***p***1** of the base **20** and the first regular hole **210***ha* of the first guide part are coupled.

In the embodiment, the first base protrusion **22***p***1** may protrude from the base **20**, and a first base recess **20***r* in a circular shape may be disposed around the first base protrusion **22***p***1**.

According to the embodiment, a center **22***p***1***c* of the first base protrusion may not coincide with a center of the first base recess or the center **210***htc* of the first groove.

According to the embodiment, a center of a protrusion of the base and centers of grooves of the first and second guide parts do not coincide with each other, are spaced apart from each other, and are eccentrically disposed in order to increase the accuracy of lens alignment between a plurality of lens groups, and thus there is a technical effect that decenter and lens tilt may be minimized during zooming by increasing the accuracy of alignment between the lens groups.

Referring again to FIG. **12**, as described above, a third side wall **21***c* of the base may include the fourth-first regular hole **21***ha***1**, the fourth-second regular hole **21***ha*, the fourth-first long hole **21***hb***1**, and the fourth-second long hole **21***hb***2**. The base hole may be coupled to the first-third protrusion **214***p***3** and the first-fourth protrusion **214***p***4** of the first guide part **210**, and the second-fourth protrusion (not shown) of the second guide part **220**.

At this time, in the embodiment, the fourth-first regular hole **21***ha***1**, the fourth-second regular hole **21***ha* may include a fourth-first groove (not shown) or a fourth-second groove (not shown), respectively.

At this time, in the embodiment, a center of the fourth-first groove and a center of the fourth-second groove do not coincide with a center of the fourth-first regular hole and a center of fourth-second regular hole, respectively, and may be eccentric.

According to the embodiment, the center of the fourth-first groove and the center of the fourth-second groove do not coincide with the center of the fourth-first regular hole and the center of fourth-second regular hole, respectively, are spaced apart from each other, and are eccentrically disposed in order to increase the accuracy of lens alignment between a plurality of lens groups, and thus there is a technical effect that decenter and lens tilt may be minimized during zooming by increasing the accuracy of alignment between the lens groups. In addition, according to the embodiment, a center of the first-third protrusion **214***p***3** of the first guide part **210** and a center of the second-fourth protrusion (not shown) of the second guide part **220** do not coincide with the center of the fourth-first groove and the center of the fourth-second groove, respectively.

According to the embodiment, the center of the first-third protrusion **214***p***3** of the first guide part **210** and the center of the second-fourth protrusion (not shown) of the second guide part **220** do not coincide with the center of the fourth-first groove and the center of the fourth-second groove, respectively, are spaced apart from each other, and are eccentrically disposed in order to increase the accuracy of lens alignment between a plurality of lens groups, and thus there is a technical effect that decenter and lens tilt may be minimized during zooming by increasing the accuracy of alignment between the lens groups.

<Magnetic Field Interference Prevention Structure>

One of technical problems of embodiments is, when implementing AF or Zoom, to provide a camera actuator capable of preventing a magnetic field interference between magnets mounted on each lens assembly when a plurality of lens assemblies are driven by an electromagnetic force between a magnet and a coil, and a camera module including the same.

In addition, one of the technical problems of the embodiments is to provide a camera actuator capable of preventing detachment of a magnet and a yoke, and a camera module including the same.

FIG. **17**A is a cross-sectional view taken along line C**1**-C**2** in the camera module according to the embodiment shown in FIG. **1**.

Referring to FIG. **17**, the camera module **100** according to the embodiment may include a base **20** and a lens assembly disposed on the base **20**. For example, a third lens assembly **130**, a first lens assembly **110**, and a second lens assembly **120** may be sequentially disposed on the base **20** based on a light incident direction, and an image sensor **180** may be disposed on a rear side of the second lens assembly **120**.

As described above, the camera module **100** according to the embodiment may be driven by an electromagnetic force of a predetermined magnet and coil part.

For example, referring to FIG. **17**A, in the camera module according to the embodiment, the first lens assembly **110** may include a first driving part **116** and a third driving part **141**, and the second lens assembly **120** may include a second driving part **126** and a fourth driving part **142**.

The first driving part **116** and the third driving part **141** may be magnet driving parts, and the second driving part **126** and the fourth driving part **142** may be coil driving parts, but the embodiment is not limited thereto.

Hereinafter, it will be described as a case in which the first driving part **116** and the third driving part **141** are magnet driving parts, respectively, and the second driving part **126** and the fourth driving part **142** are coil driving parts, respectively.

In the camera module according to the embodiment, in the first lens assembly **110**, the first driving part **116** may include a first magnet **116***b* and a first yoke **116***a*, and the third driving part **141** may include a first coil part **141***b* and a third yoke **141***a*. The third driving part **141** may include a first circuit board **41** between the first coil part **141***b* and the third yoke **141***a*.

In addition, in the camera module according to the embodiment, in the second lens assembly **120**, the second driving part **126** may include a second magnet **126***b* and a second yoke **126***a*, and the fourth driving part **142** may include a second coil part **142***b* and a fourth yoke **142***a*. The fourth driving part **142** may include a second circuit board **42** between the second coil part **142***b* and the fourth yoke **142***a*.

Next, FIG. **17**B is a driving example view of a camera module according to an embodiment.

Referring to FIG. **17**B, as described with reference to FIG. **8**B, the first lens assembly **110** may be driven in an optical axis direction by an electromagnetic force (DEM) between the first magnet **116***b* of the first driving part **116** and the first coil part **141***b* of the third driving part **141**.

Next, FIG. **17**C is a perspective view of the first driving part **116** of the camera module according to the embodiment shown in FIG. **17**B.

Referring to FIG. **17**C, in the embodiment, the first driving part **116** may include a first magnet **116***b* and a first yoke **116***a*, and the first yoke **116***a* may include a first support portion **116***a***1** and a first side protruding portion **116***a***2** extending from the first support portion **116***a***1** toward a side surface of the first magnet **116***b*.

The first side protruding portion **116***a***2** may be disposed on both side surfaces of the first magnet **116***b*.

In addition, the first yoke **116***a* may include a first fixed protruding portion **116***a***3** extending in a different direction, for example, in a direction opposite to the first side protruding portion **116***a***2**.

The first fixed protruding portion **116***a***3** may be disposed at a position about a middle of the first support portion **116***a***1**, but the embodiment is not limited thereto.

Similarly, in the embodiment, the second driving part **126** may include a second magnet **126***b* and a second yoke **126***a*, and the second yoke **126***a* may include a second support portion (not shown) and a second side protruding portion extending from the second support portion toward a side surface of the second magnet **126***b* (hereinbefore, see a structure of the second yoke **126***a* in FIG. **17**A).

The second side protruding portion may be disposed on both side surfaces of the second magnet **126***b*. In addition, the second yoke **126***a* may include a second fixed protruding portion (not shown) extending in a different direction, for example, in a direction opposite to the second side protruding portion. The second fixed protruding portion may be disposed at a position about a middle of the second support portion, but the embodiment is not limited thereto.

In the related art, in addition, when implementing AF or Zoom, a plurality of lens assemblies are driven by an electromagnetic force between a magnet and a coil, and there is a problem that a magnetic field interference occurs between magnets mounted in each lens assembly. There is a problem that AF or Zoom driving is not performed normally, and thrust is deteriorated due to such a magnetic field interference between magnets.

In addition, there is a problem that a decent or tilt phenomenon due to a magnetic field interference between magnets is induced.

When an issue in a precision in camera control occurs or thrust is deteriorated due to such a magnetic field interference, or a decent or tilt phenomenon is induced, it may be directly related to the safety or life of a driver who is a user or pedestrian.

For example, FIG. **17**D shows data of a magnetic flux density distribution in Comparative Example.

Comparative Example of FIG. **17**D is a non-disclosed internal technology of an applicant, and has a structure applied so as to perform a shielding function of magnetic flux by disposing a back yoke for a magnet. A shielding performance of the magnetic flux is improved by applying back yoke technology for the magnet, but there are technical problems as follows.

For example, referring to FIG. **17**D, it is magnetic flux density data between respective magnets mounted in the first lens assembly and the second lens assembly, and thus there is a problem that magnetic field interference (IF) occurs between the respective magnets, and loss of thrust occurs due to leakage (LE) of the magnetic flux generated in each magnet.

In particular, in case of a high-magnification Zoom Actuator applied recently, there is a problem that not only magnetic field interference occurs between permanent magnets of the first lens assembly and the second lens assembly, which are moving lenses, but also the magnetic field interference (IF) with a magnet of the OIS actuator occurs.

Movement of each group is disturbed due to the magnetic field interference (IF), and as a result, there is a problem that an input current is also increased.

According to the embodiment, a yoke in a magnet driving part of the first lens assembly **110** or the second lens assembly **120** includes a side protruding portion extending to a side surface of the magnet, and thus there is a special technical effect that it is possible to provide a camera actuator capable of preventing a magnetic field interference between magnets mounted on each lens assembly when a plurality of lens assemblies are driven by an electromagnetic force between a magnet and a coil when AF or Zoom is implemented, and a camera module including the same.

For example, FIG. **17**E shows data of a magnetic flux density distribution in Example.

Referring to FIG. **17**E, it is magnetic flux density data between respective magnets mounted in the first lens assembly and the second lens assembly, and a yoke in a magnet driving part of the first lens assembly **110** and the second lens assembly **120** includes a side protruding portion extending to a side surface of the magnet, and thus the precision of camera control is improved significantly.

In addition, according to the embodiment, the yoke in the magnet driving part of the first lens assembly **110** or the second lens assembly **120** includes the side protruding portion extending to the side surface of the magnet to prevent leakage flux generated in the magnet, and the side protruding portion is disposed in a region having a high magnetic flux density so that the magnetic flux is concentrated (FC), and thus there is a technical effect that thrust is significantly improved by increasing a density between a flux line and the coil to increase the Lorentz Force.

Next, FIG. **17**F is a detailed perspective view of a first yoke **116***a* in the first driving part **116** in Example, and FIG. **17**G is a bottom perspective view of the first yoke **116***a*.

The first yoke **116***a* may include a first support portion **116***a***1** and a first side protruding portion **116***a***2** extending from the first support portion **116***a***1** toward a side surface of the first magnet **116***b*. The first side protruding portion **116***a***2** may be disposed on both side surfaces of the first magnet **116***b*.

The first yoke **116***a* may be formed of a ferromagnetic material, but the embodiment is not limited thereto.

The first yoke **116***a* may include a first fixed protruding portion **116***a***3** extending in a different direction, for example, in a direction opposite to the first side protruding portion **116***a***2**. In addition, the first yoke **116***a* may include a support portion recess **116***ar* between the first side protruding portion **116***a***2** and the first fixed protruding portion **116***a***3**. Structures of the first side protrusion **116***a***2** and the first fixed protrusion **116***a***3** may be more firmly formed by the support portion recess **116***ar*.

According to the embodiment, as the first yoke **116***a* includes the first side protruding portion **116***a***2** extending to the side surface of the first magnet **116***b*, and the first side protruding portion **116***a***2** is disposed on both sides of the first support portion **116***a***1**, it is possible to serve a function of firmly fixing the first magnet **116***b*, thereby significantly improving mechanical reliability.

Accordingly, as the first yoke **116***a* includes the first side protruding portion **116***a***2** extending to the side surface of the first magnet **116***b*, there is an effect capable of preventing magnetic field interference between magnets mounted in each lens assembly, and there is a complex technical effect that thrust is improved by concentration of magnetic flux and the mechanical reliability is improved by firmly fixing the first magnet **116***b*.

In addition, the first yoke **116***a* includes the first fixed protruding portion **116***a***3** extending in a different direction, for example, in a direction opposite to the first side protruding portion **116***a***2**, and thus there is an effect that a mechanical coupling force is improved.

For example, according to the embodiment, the first yoke **116***a* includes the first fixed protruding portion **116***a***3** extending in a direction opposite to the first side protruding portion **116***a***2**, and the first fixed protruding portion **116***a***3** is fixed to the first lens assembly, thereby improving the mechanical reliability.

Meanwhile, according to an additional embodiment, a second thickness T**2** of the first side protruding portion **116***a***2** may be formed thicker than a first thickness T**1** of the first support portion **116***a***1** (see FIG. **17**F). Accordingly, since the second thickness T**2** of the first side protruding portion **116***a***2** which is a region having a high magnetic flux density is thicker than the first thickness T**1** of the first support portion **116***a***1**, a shielding performance of leakage flux is improved and divergence efficiency of magnetic flux density is increased, so that a shielding function of magnetic flux may be improved and a concentration function of magnetic flux may be enhanced.

Next, FIG. **18**A is a perspective view of a first driving part **116**B of a camera module according to a first additional embodiment.

Referring to FIG. **18**A, the third yoke **116**A**3** may include a first support portion **116***a***1**, a first side protruding portion **116***a***2** extending from the first support portion **116***a***1** toward a side surface of the first magnet **116***b*, and a first extension protruding portion **116***a***22** extending more upward than an upper surface of the first magnet **116***b* from the first side protruding portion **116***a***2**.

Accordingly, the total thickness PL of the first side protruding portion **116***a***2** and the first extension protruding portion **116***a***22** may be greater than a thickness ML of the first magnet **116***b*.

According to the first additional embodiment, a yoke in a magnet driving part of a first lens assembly **110** and a second lens assembly **120** includes an extension protruding portion extending more upward than an upper surface of a magnet, and thus there is a special technical effect that leakage flux may be more effectively prevented, and thrust may be significantly improved by maximizing concentration of magnetic flux in a region having a high magnetic flux density.

Next, FIG. **18**B is a perspective view of a first driving part **116**C of a camera module according to a second additional embodiment.

In the second additional embodiment, the fourth yoke **142***a* may include a first support portion **116***a***1**, a first side protruding portion **116***a***2** extending from the first support portion **116***a***1** toward a first side surface of the first magnet **116***b*, and a second side protruding portion **116***a***4** protruding to a second side surface of the first magnet **116***b*.

The first side surface of the first magnet **116***b* and the second side surface of the first magnet **116***b* may not be facing each other.

According to the second additional embodiment, a yoke in a magnet driving part of a first lens assembly **110** and a second lens assembly **120** includes a side protruding portion having a structure surrounding four side surfaces of a magnet, and thus there is a technical effect that leakage flux may be more effectively prevented, and a magnetic flux density in which the leakage flux is prevented may be used to improve thrust.

<Camera Module Coupled to OIS Actuator>

Next, FIG. **19** is a perspective view showing a camera module **1000**A to which an OIS actuator **300** is coupled.

The camera module **1000**A according to an embodiment may include a single or a plurality of camera actuators. For example, the camera module **1000**A according to the embodiment may include a first camera actuator **100** and a second camera actuator **300**.

The first camera actuator **100** supports one or a plurality of lenses, and may perform an autofocus function or a zoom function by moving a lens vertically according to a control signal of a predetermined control unit. In addition, the second camera actuator **300** may be an optical image stabilizer (OIS) actuator, but the embodiment is not limited thereto.

Hereinafter, the OIS actuator which is the second camera actuator **300** will be mainly described.

Next, FIG. **20**A is a perspective view of the second camera actuator **300** in the camera module **1000**A of the embodiment shown in FIG. **19** in a first direction, and FIG. **20**B is a perspective view of the second camera actuator **300** in the camera module **1000**A of the embodiment shown in FIG. **19** in a second direction.

Referring to FIGS. **20**A and **20**B, the second camera actuator **300** of the embodiment may include a housing **310**, an image shaking control unit **320** disposed on the housing **310**, a prism unit **330** disposed on the image shaking control unit **320**, and a second driving part **72**C (see FIG. **21**A) electrically connected to a second circuit board **350**.

Accordingly, according to the embodiment, the image shaking control unit **320** is provided, which is disposed on the housing **310**, and thus there is a technical effect that it is possible to provide an ultra-thin and ultra-small camera actuator and a camera module including the same.

In addition, according to the embodiment, the image shaking control unit **320** is disposed below the prism unit **330**, and thus there is a technical effect that when the OIS is implemented, lens size limitation of an optical system lens assembly may be eliminated, and a sufficient amount of light may be secured.

In addition, according to the embodiment, the image shaking control unit **320** stably disposed on the housing **310** is provided, and a shaper unit **322** and a first driving part **72**M of FIG. **22**A described later are included, and thus there is a technical effect that when the OIS is implemented through a lens unit **322***c* including a tunable prism **322***cp*, occurrence of a decenter or tilt phenomenon may be minimized to achieve the best optical characteristics.

Further, according to the embodiment, when the OIS is implemented, the first driving part **72**M, which is a magnet driving part, is disposed on the second camera actuator **300** separated from the first camera actuator **100**, and thus there is a technical effect that a magnetic field interference with an AF or Zoom magnet of the first camera actuator **100** may be prevented.

Furthermore, according to the embodiment, unlike the conventional method of moving a plurality of solid lenses, the OIS is implemented by including the lens unit **322***c* including the tunable prism **322***cp*, the shaper unit **322**, and the first driving part **72**M, and thus there is a technical effect that the OIS may be implemented with low power consumption.

Hereinafter, the second camera actuator **300** of the embodiment will be described in more detail with reference to the drawings.

FIG. **21**A is a perspective view of the second circuit board **350** and the second driving part **72**C of the second camera actuator **300** of the embodiment shown in FIG. **20**B, and FIG. **21**B is a partially exploded perspective view of the second camera actuator **300** of the embodiment shown in FIG. **20**B, and FIG. **21**C is a perspective view in which the second circuit board **350** is removed from the second camera actuator **300** of the embodiment shown in FIG. **20**B.

First, referring to FIG. **21**A, the second circuit board **350** may be connected to a predetermined power supply (not shown) to apply power to the second driving part **72**C. The second circuit board **350** may include a circuit board having a wiring pattern that may be electrically connected, such as a rigid printed circuit board (Rigid PCB), a flexible printed circuit board (Flexible PCB), and a rigid flexible printed circuit board (Rigid Flexible PCB).

The second driving part **72**C may include a single or a plurality of unit driving parts, and may include a plurality of coils. For example, the second driving part **72**C may include a fifth unit driving part **72**C**1**, a sixth unit driving part **72**C**2**, a seventh unit driving part **72**C**3**, and an eighth unit driving part (not shown).

In addition, the second driving part **72**C may further include a hall sensor (not shown) to recognize a position of a first driving part **72**M (see FIG. **21**B) described later. For example, the fifth unit driving part **72**C**1** may further include a first hall sensor (not shown), and the seventh unit driving part **72**C**3** may further include a second hall sensor (not shown).

According to the embodiment, the image shaking control unit **320** stably disposed on the housing **310** is provided, and the OIS is implemented through the second driving part **72**C which is a coil driving part, the first driving part **72**M which is a magnet driving part, and the lens unit **322***c* including a tunable prism, and thus occurrence of a decenter or tilt phenomenon may be minimized to achieve the best optical characteristics.

In addition, according to the embodiment, unlike the conventional method of moving a plurality of solid lenses, the OIS is implemented by driving the shaper unit **322** through the lens unit **322***c* including the tunable prism, the first driving part **72**M which is a magnet driving part, and the second driving part **72**C which is a coil driving part, and thus there is a technical effect that the OIS may be implemented with low power consumption.

Next, referring to FIG. **21**B and FIG. **21**C, the second camera actuator **300** of the embodiment may include the housing **310**, the image shaking control unit **320** including the shaper unit **322** and the first driving part **72**M and disposed on the housing **310**, the second driving part **72**C disposed on the housing **310**, and a prism unit **330** disposed on the image shaking control unit **320** and including a fixed prism **332**.

Referring to FIG. **21**B, the housing **310** may include a predetermined opening **312**H through which light may pass at a housing body **312**, and may include a housing side portion **314**P extending above the housing body **312** and including a driving part hole **314**H in which the second driving part **72**C is disposed.

For example, the housing **310** may include a first housing side portion **314**P**1** extending above the housing body **312** and including a first driving part hole **314**H**1** in which the second driving part **72**C is disposed, and a second housing side portion **314**P**2** including a second driving part hole **314**H**2** in which the second driving part **72**C is disposed.

According to the embodiment, the second driving part **72**C is disposed on the housing side portion **314**P, and the OIS is implemented by driving the shaper unit **322** and the lens unit **322***c* including the tunable prism through the first driving part **72**M, which is a magnet driving part, and an electromagnetic force, and thus the OIS may be implemented with low power consumption.

In addition, according to the embodiment, the OIS is implemented by controlling the lens unit **322***c* including a tunable prism through the second driving part **72**C stably fixed on the housing side portion **314**P and the first driving part **72**M which is a magnet driving part, and thus occurrence of a decenter or tilt phenomenon may be minimized to achieve the best optical characteristics.

Next, the fixed prism **332** may be a right-angle prism, and may be disposed inside the first driving part **72**M of the image shaking control unit **320**. In addition, in the embodiment, a predetermined prism cover **334** is disposed above the fixed prism **332** so that the fixed prism **332** may be tightly coupled to the housing **310**, and thus there is a technical effect that prism tilt and occurrence of decenter at the second camera actuator **300** may be prevented.

In addition, according to the embodiment, the image shaking control unit **320** is disposed so as to utilize a space below the prism unit **330** and overlap each other, and thus there is a technical effect that it is possible to provide an ultra-thin and ultra-small camera actuator and a camera module including the same.

Specifically, according to the embodiment, the prism unit **330** and the lens unit **322***c* including the tunable prism may be disposed very close to each other, and thus there is a special technical effect that even though a change in an optical path is made fine in the lens unit **322***c*, the change in the optical path may be widely secured in the actual image sensor unit.

For example, referring briefly to FIG. **25**B, a second moving path L**1***a* of light beam changed by the fixed prism **332** may be changed by the tunable prism **322***cp* to be changed to a third moving path L**1***b*.

At this time, according to the embodiment, the fixed prism **332** and the lens unit **322***c* including the tunable prism may be disposed very close to each other, and a distance between the lens unit **322***c* and an image plane **190**P of the first lens assembly (not shown) may be secured to be relatively long.

Accordingly, a first distance D**16** reflected on the image plane **190**P may be secured widely according to a change in an inclination of a predetermined angle Θ in the tunable prism **322***cp*, and thus there is a special technical effect that even though the change in the optical path is made fine in the lens unit **322***c*, the change in the optical path may be widely secured in the actual image sensor unit.

Next, FIG. 22A is an exploded perspective view of the image shaking control unit **320** of the second camera actuator **300** of the embodiment shown in FIG. **21**B, and FIG. **22**B is a combined perspective view of the image shaking control unit **320** of the second camera actuator of the embodiment shown in FIG. **22**A, and FIG. **22**C is an exploded perspective view of the first driving part **72**M of the image shaking control unit **320** shown in FIG. **22**A.

Referring to FIGS. **22**A and **22**B, in the embodiment, the image shaking control unit **320** may include the shaper unit **322** and the first driving part **72**M.

The shaper unit **322** may include a shaper body **322***a* including a hole through which light may pass, and a protruding portion **322***b* extending from the shaper body **322***a* to a side surface thereof and coupled to the first driving part **72**M in a first vertical direction.

In addition, the shaper unit **322** may include a lens unit **322***c* disposed on the shaper body **322***a* in a second vertical direction opposite to the first vertical direction and including a tunable prism.

Accordingly, according to the embodiment, OIS is implemented through the image shaking control unit **320** including the shaper unit **322** and the first driving part **72**M, and the lens unit **322***c* including the tunable prism, and thus there is a technical effect that occurrence of a decenter or tilt phenomenon may be minimized to achieve the best optical characteristics.

Specifically, referring to FIGS. **22**A and **22**B, the first driving part **72**M may include a single or a plurality of magnet frames **72**MH**1** and **72**MH**2** coupled to the protruding portion **322***b*, and a unit driving part disposed on the magnet frames **72**MH**1** and **72**MH**2**.

For example, the first driving part **72**M may include a first magnet frame **72**MH**1** and a second magnet frame **72**MH**2**, and a first unit driving part **72**M**1** and a second unit driving part **72**M**2** may be disposed on the first magnet frame **72**MH, and a third unit driving part **72**M**3** and a fourth unit driving part **72**M**4** may be disposed on the second magnet frame **72**MH**2**.

Each of the first to fourth unit driving parts **72**M**1**, **72**M**2**, **72**M**3**, and **72**M**4** may include first to fourth magnets.

FIG. **22**C is an exploded perspective view of the first driving part **72**M of the image shaking control unit **320** shown in FIG. **22**A.

In the embodiment, the first driving part **72**M may block the interference of the magnetic field by further including yokes **72**MY disposed on the first and second magnet frames **72**MH**1** and **72**MH**2**.

For example, the first magnet frame **72**MH**1** of the first driving part **72**M may include a frame groove **72**MR, and the yoke **72**MY may be disposed on the frame groove **72**MR. Thereafter, the first unit driving part **72**M**1** and the second unit driving part **72**M**2** may be disposed on the yoke **72**MY, respectively.

At this time, the yoke **72**MY may include a yoke protruding portion **72**MYP to be firmly coupled to the protruding portion **322***b* of the shaper unit **322**.

Next, FIG. **23** is a perspective view of the shaper unit **322** of the second camera actuator of the embodiment shown in FIG. **22**A.

Referring to FIG. **23**, the shaper unit **322** may include a shaper body **322***a* including an opening through which light may pass, a protruding portion **322***b* extending from the shaper body **322***a* to a side surface thereof and coupled to the first driving part **72**M in a first vertical direction, and a lens unit **322***c* disposed on the shaper body **322***a* in a second vertical direction opposite to the first vertical direction and including a tunable prism **322***cp*.

Specifically, in the embodiment, the shaper unit **322** may include a plurality of magnet support portions extending from the shaper body **322***a* to both sides thereof, respectively. For example, the shaper unit **322** may include a first protruding portion **322***b***1** and a second protruding portion **322***b***2** that are branched and extend from the shaper body **322***a* to a first side thereof, and a third protruding portion **322***b***3** and a fourth protruding portion **322***b***4** that are branched and extend to a second side thereof.

The first driving part **72**M may include first to fourth unit driving parts **72**M**1**, **72**M**2**, **72**M**3**, and **72**M**4** coupled to the first to fourth protruding portions **322***b***1**, **322***b***2**, **322***b***3**, and **322***b***4**, respectively.

Referring to FIG. **23**, in the embodiment, the shaper unit **322** may include a coupling groove **322***bh* in the magnet support portion to be coupled to a magnet frame. Accordingly, the image shaking control unit **320** as shown in FIG. **22**B may be coupled to the shaper unit **322**.

According to the embodiment, in a state in which the first driving part **72**M is firmly coupled to the shaper unit **322**, OIS is implemented through an optical path control of the lens unit **322***c* including a tunable prism, and thus there is a special technical effect that occurrence of a decenter or tilt phenomenon may be minimized to achieve the best optical characteristics.

Next, FIG. **24** is a cross-sectional view of the lens unit **322***c* taken along line A**1**-A**1**' of the shaper unit **322** shown in FIG. **23**.

Referring to FIG. **24**, in the embodiment, the lens unit **322***c* may include a translucent support **322***c***2**, a bracket **322***cb* disposed on the translucent support **322***c***2** with a predetermined accommodation space, a tunable prism **322***cp* or a liquid lens (not shown) disposed in the accommodation space of the bracket **322***cb*, a flexible plate **322***cm* disposed on the tunable prism **322***cp* or the liquid lens, and a second translucent support (not shown) disposed on the flexible plate **322***cm*. The flexible plate **322***cm* may be formed of a translucent material.

The translucent support **322*c*2** and the second translucent support (not shown) may be formed of a translucent material. For example, the translucent support **322*c*2** and the second translucent support may be formed of glass, but the embodiment is not limited thereto.

The translucent support **322*c*2** and the second translucent support may have a hollow circular ring shape or a square ring shape.

A size of the second translucent support (not shown) may be formed smaller than that of the accommodation space of the bracket **322*cb***.

The tunable prism **322*cp*** may include an optical liquid disposed in a space created by the translucent support **322*c*2**, the support bracket **322*cb***, and the flexible plate **322*cm***. Alternatively, the tunable prism **322*cp*** may include a wedge prism.

In an embodiment, the tunable prism **322*cp*** may be a lens made of a fluid, and the fluid lens may have a shape in which a liquid is surrounded by a fluid film, but the embodiment is not limited thereto.

In the embodiment, an optical liquid used by the tunable prism **322*cp*** may be a transparent, low-fluorescent, non-toxic material. For example, the optical liquid of the embodiment may use a chlorofluorocarbon (CFC) component or the like, but the embodiment is not limited thereto.

The bracket **322*cb*** may be formed of a stretchable material or a non-stretchable material. For example, the bracket **322*cb*** may be formed of an elastic film material or a metal material, but the embodiment is not limited thereto.

When the flexible plate **322*cm*** receives a predetermined force by the shaper body **322*a*** according to movement of the first driving part **72M**, as shown in FIG. **25**B, a part of the flexible plate **322*cm*** moves upward or downward due to characteristics of a flexible elastic material, and the form of the tunable prism **322*cp*** may be variable.

For example, the flexible plate **322*cm*** may be a reverse osmosis (RO) membrane, a nano filtration (NF) membrane, an ultra-filtration (UF) membrane, a micro filtration (MF) membrane, and the like, but the embodiment is not limited thereto. Here, the RO membrane may be a membrane having a pore size of about 1 to 15 angstroms, the NF membrane may be a membrane having a pore size of about 10 angstroms, the UF membrane may be a membrane having a pore size of about 15 to 200 angstroms, and the MF membrane may be a membrane having a pore size of about 200 to 1000 angstroms.

According to the embodiment, the image shaking control unit **320** stably disposed on the housing **310** is provided, and the shaper unit **322** and the first driving part **72M** are included, and thus there is a technical effect that when the OIS is implemented through the lens unit **322*c*** including the tunable prism **322*cp***, occurrence of a decenter or tilt phenomenon may be minimized to achieve the best optical characteristics.

Next, FIGS. **25**A to **25**B are illustrative views showing an operation of the second camera actuator **300** of the embodiment.

For example, FIG. **25**A is an illustrative view before an operation of the OIS actuator of the embodiment, and FIG. **25**B is an illustrative view after the operation of the OIS actuator of the embodiment.

In a broad sense, the prism in an embodiment may include a fixed prism **332** that changes a path of a predetermined light beam, and a tunable prism **322*cp*** that is disposed below the fixed prism **332** and changes a path of a light beam emitted from the fixed prism **332**.

Referring to FIGS. **25**A and **25**B, the second camera actuator **300** of the embodiment may change a form of the tunable prism **322*cp*** through the first driving part **72M** and the second driving part **72C** to control the path of the light beam.

For example, in the embodiment, the second camera actuator **300** may control the path of the light beam by changing an apex angle Θ of the tunable prism **322*cp*** through the first driving part **72M** which is a magnet driving part.

For example, referring to FIG. **25**A, an incident light L**1** is changed to the second moving path L**1*a*** by the fixed prism **332**, but the light path is not changed by the tunable prism **322*cp***.

On the other hand, referring to FIG. **25**B, the second moving path L**1*a*** of the light beam changed by the fixed prism **332** may be changed in the tunable prism **322*cp*** to be changed to the third moving path L**1*b***.

For example, when the flexible plate **322*cm*** receives a predetermined force by the shaper body **322*a*** according to movement of the first driving part **72M**, the second translucent support (not shown) receives the force, and the force is transmitted to the flexible plate **322*cm***, and a part of the flexible plate **322*cm*** moves upward or downward due to characteristics of a flexible elastic material, and the form of the tunable prism **322*cp*** may be variable.

For example, as a left upper end of the shaper body **322*a*** receives a force F**2** in a second direction by the first unit driving part **72M1**, and a right upper end of the shaper body **322*a*** receives a force F**1** in a first direction by the second unit driving part **72M2**, it may be varied. The second translucent support (not shown) receives a force according to movement of the shaper body **322*a***, and the flexible plate **322*cm*** may be changed in an inclination of a predetermined angle Θ of by the force.

Hereinafter, with reference to FIG. **25**B, in the embodiment, an image stabilizing device for controlling the path of the light beam will be described in further detail by deforming the shape of the tunable prism **322*cp*** through the first driving part **72M**.

First, according to the embodiment, due to occurrence of camera shake, an image needs to move to a side surface by a first distance D**16** on an image plane (not shown) of a lens assembly provided in the first camera actuator **100**.

At this time, D**1** is a distance from the tunable prism **322*cp*** to the image plane of the lens assembly, δ is a chromatic aberration of the tunable prism **322*cp***, and Θ is an apex angle of the tunable prism **322*cp***.

That is, according to the embodiment, after calculating a changed apex angle Θ of the tunable prism **322*cp***, the path of the light beam may be controlled to the third moving path L**1*b*** by changing the apex angle Θ of the tunable prism **322*cp*** through the first driving part **72M**.

At this time, a relationship of δΘ may be established between the chromatic aberration δ of the tunable prism **322*cp*** and the apex angle Θ of the tunable prism **322*cp*** (where n is a refractive index of the tunable prism **322*cp*** with respect to a center wavelength of a band of interest).

According to the embodiment, the prism unit **330** and the lens unit **322*c*** including the tunable prism may be disposed very close to each other, and thus there is a special technical effect that even though a change in an optical path is made fine in the lens unit **322*c***, the change in the optical path may be widely secured in the actual image sensor unit.

For example, according to the embodiment, the fixed prism **332** and the lens unit **322*c*** including the tunable prism may be disposed very close to each other, and a distance between the lens unit **322***c* and an image plane **190**P of the first lens assembly (not shown) may be secured to be relatively long. Accordingly, a first distance D**16** reflected on the image plane **190**P may be secured widely according to a change in an inclination of a predetermined angle Θ in the tunable prism **322***cp*, and thus there is a special technical effect that even though the change in the optical path is made fine in the lens unit **322***c*, the change in the optical path may be widely secured in the actual image sensor unit.

Next, FIG. **26** is a first operation illustrative view of the second camera actuator of the embodiment.

For example, FIG. **26** is the first operation example view viewed from a z-axis direction of the second camera actuator **300** according to the embodiment shown in FIG. **20**B.

Referring to FIG. **26**, power is applied to the second driving part **72**C through the second circuit board **350**, and a current flows through each coil, and accordingly, an electromagnetic force may be generated between the second driving part **72**C and the first driving part **72**M in a first direction F**1** or a second direction F**2**, and the flexible plate **322***cm* may be tilted at a predetermined angle by the first driving part **72**M that is moved, thereby controlling the apex angle Θ of the tunable prism **322***cp*.

For example, referring to FIG. **26**, the first unit driving part **72M1** and the second unit driving part **72M2** may be disposed so that a direction of the magnetic force may be generated in a direction of the fifth unit driving part **72C1** and the sixth unit driving part **72C2**, and the third unit driving part **72M3** and the fourth unit driving part **72M4** may be disposed so that the direction of the magnetic force may be generated in a direction of the seventh unit driving part **72C3** and the eighth unit driving part **72C4**.

At this time, when a current C**1** in the first direction flows in the fifth unit driving part **72C1** and the sixth unit driving part **72C2**, the force F**2** may be applied in the second direction. On the other hand, when the current C**1** in the first direction flows in the seventh unit driving part **72C3** and the eighth unit driving part **72C4**, the force F**1** may be applied in the first direction opposite to the second direction.

Accordingly, in the first unit driving part **72M1** and the second unit driving part **72M2**, the force F**2** may be applied to the flexible plate **322***cm* in the second direction, and in the third unit driving part **72M3** and the fourth unit driving part **72M4**, the force F**1** may be applied to the flexible plate **322***cm* in the first direction, and accordingly, the apex angle Θ of the tunable prism **322***cp* may be deformed at a first angle Θ**1** to change and control the light path.

Next, FIG. **27** is a second operation example view of the second camera actuator **300** of the embodiment.

For example, FIG. **27** is the second operation example view viewed from a z-axis direction of the second camera actuator **300** according to the embodiment shown in FIG. **20**B.

For example, power is applied to the second driving part **72**C, and a current flows through each coil, and accordingly, an electromagnetic force may be generated between the second driving part **72**C and the first driving part **72**M in a first direction F**1** or a second direction F**2**, and the flexible plate **322***cm* may be tilted at a predetermined angle.

For example, referring to FIG. **27**, the first unit driving part **72M1** and the second unit driving part **72M2** may be disposed so that a direction of the magnetic force may be generated in a direction of the fifth unit driving part **72C1** and the sixth unit driving part **72C2**, and the third unit driving part **72M3** and the fourth unit driving part **72M4** may be disposed so that the direction of the magnetic force may be generated in a direction of the seventh unit driving part **72C3** and the eighth unit driving part **72C4**.

At this time, a current C**1** in the first direction may flow in the fifth unit driving part **72C1** and the seventh unit driving part **72C3**, and a current C**2** in the second direction may flow in the sixth unit driving part **72C2** and the eighth unit driving part **72C4**.

Accordingly, the force F**2** may be applied in the second direction in the first unit driving part **72M1** and the fourth unit driving part **72M4**, and the force F**1** may be applied in the first direction in the second unit driving part **72M2** and the third unit driving part **72M3**.

Accordingly, in the first unit driving part **72M1** and the fourth unit driving part **72M4**, the force F**2** may be applied to the flexible plate **322***cm* of the variable prism **322***cp* in the second direction, and in the second unit driving part **72M2** and the third unit driving part **72M3**, the force F**1** may be applied to the flexible plate **322***cm* of the variable prism **322***cp* in the first direction, and accordingly, the apex angle Θ of the tunable prism **322***cp* may be deformed at a second angle Θ**2** to change and control the light path.

According to the embodiment, the image shaking control unit **320** is disposed so as to utilize a space below the prism unit **330** and overlap each other, and thus there is a technical effect that it is possible to provide an ultra-thin and ultra-small camera actuator and a camera module including the same.

In addition, according to the embodiment, the image shaking control unit **320** is disposed below the prism unit **330**, and thus there is a technical effect that when the OIS is implemented, lens size limitation of an optical system lens assembly may be eliminated, and a sufficient amount of light may be secured.

In addition, according to the embodiment, the image shaking control unit **320** stably disposed on the housing **310** is provided, and a shaper unit **322** and a first driving part **72**M are included, and thus there is a technical effect that when the OIS is implemented through a lens unit **322***c* including a tunable prism **322***cp*, occurrence of a decenter or tilt phenomenon may be minimized to achieve the best optical characteristics.

Further, according to the embodiment, when the OIS is implemented, the first driving part **72**M, which is a magnet driving part, is disposed on the second camera actuator **300** separated from the first camera actuator **100**, and thus there is a technical effect that a magnetic field interference with an AF or Zoom magnet of the first camera actuator **100** may be prevented.

Next, FIG. **28** is another perspective view of a camera module **1000** according to another embodiment.

The camera module **1000** according to another embodiment may further include a second camera module **1000**B in addition to the camera module **1000**A described above. The second camera module **1000**B may be a camera module of a fixed focal length lens. The fixed focal length lens may be referred to as a "single focal length lens" or a "single lens". The second camera module **1000**B may be electrically connected to a third group of circuit boards **430**. The second camera actuator **300** included in the camera module **1000**A may be electrically connected to a second group of circuit boards **420**.

## INDUSTRIAL APPLICABILITY

Next, FIG. **29** shows a mobile terminal **1500** to which a camera module according to an embodiment is applied.

As shown in FIG. **29**, the mobile terminal **1500** according to the embodiment may include a camera module **1000**, a flash module **1530**, and an autofocus device **1510** provided on a back surface.

The camera module **1000** may include an image capturing function and an autofocus function. For example, the camera module **1000** may include an autofocus function using an image.

The camera module **1000** processes a still image or a moving image frame obtained by an image sensor in a photographing mode or a video call mode. The processed image frame may be displayed on a predetermined display unit, and may be stored in a memory. A camera (not shown) may be disposed on a front surface of the body of the mobile terminal.

For example, the camera module **1000** may include a first camera module **1000**A and a second camera module **1000**B, and OIS may be implemented together with an AF or zoom function by the first camera module **1000**A.

The flash module **1530** may include a light-emitting device that emits light therein. The flash module **1530** may be operated by a camera operation of a mobile terminal or by user control.

The autofocus device **1510** may include one of packages of a surface emitting laser element as a light-emitting unit.

The autofocus device **1510** may include an autofocus function using a laser. The autofocus device **1510** may be mainly used in a condition in which an autofocus function using an image of the camera module **1000** is deteriorated, for example, in a close environment of 10 m or less or a dark environment. The autofocus device **1510** may include a light-emitting unit including a vertical cavity surface emitting laser (VCSEL) semiconductor device, and a light receiving unit that converts light energy into electric energy such as a photodiode.

Next, FIG. **30** is a perspective view of a vehicle **700** to which a camera module according to an embodiment is applied,

For example, FIG. **30** is an appearance view of a vehicle having a vehicle driving assistance device to which a camera module **1000** according to the embodiment is applied.

Referring to FIG. **30**, the vehicle **700** according to the embodiment may include wheels **13**FL and **13**FR that rotate by a power source, and a predetermined sensor. The sensor may be a camera sensor **2000**, but the embodiment is not limited thereto.

The camera sensor **2000** may be a camera sensor to which the camera module **1000** according to the embodiment is applied.

The vehicle **700** according to the embodiment may acquire image information through the camera sensor **2000** that photographs a front image or a surrounding image, and may determine an unidentified situation of a lane by using the image information and generate a virtual lane at the time of unidentification.

For example, the camera sensor **2000** may acquire the front image by photographing a front of the vehicle **700**, and a processor (not shown) may acquire the image information by analyzing an object included in the front image.

For example, when an object such as a lane, a neighboring vehicle, a traveling obstacle, and a median strip, a curb, and a street tree corresponding to an indirect road marking is photographed in an image photographed by the camera sensor **2000**, the processor detects such an object to include in the image information.

In this case, the processor may acquire distance information with the object detected through the camera sensor **2000** to further complement the image information. The image information may be information about an object captured in the image.

Such a camera sensor **2000** may include an image sensor and an image processing module. The camera sensor **2000** may process a still image or moving image obtained by the image sensor (e.g., CMOS or CCD). The image processing module may process the still image or moving image acquired through the image sensor to extract necessary information, and may transmit the extracted information to the processor.

At this time, the camera sensor **2000** may include a stereo camera so as to improve the measurement accuracy of the object and to secure more information such as a distance between the vehicle **700** and the object, but the embodiment is not limited thereto.

The characteristics, structures and effects described in the embodiments above are included in at least one embodiment but are not limited to one embodiment. Furthermore, the characteristics, structures, effects, and the like illustrated in each of the embodiments may be combined or modified even with respect to other embodiments by those of ordinary skill in the art to which the embodiments pertain. Thus, it would be construed that contents related to such a combination and such a modification are included in the scope of the embodiments.

Embodiments are mostly described above, but they are only examples and do not limit the embodiments. A person skilled in the art to which the embodiments pertain may appreciate that several variations and applications not presented above may be made without departing from the essential characteristic of the embodiments. For example, each component particularly represented in the embodiments may be varied. In addition, it should be construed that differences related to such a variation and such an application are included in the scope of the embodiment defined in the following claims.

The invention claimed is:

**1**. A camera module comprising:
a base;
a first lens assembly and a second lens assembly disposed in the base and configured to move in an optical axis direction;
a first yoke disposed on the first lens assembly;
a second yoke disposed on the second lens assembly;
a first magnet disposed on the first yoke;
a second magnet disposed on the second yoke;
a first coil disposed in the base and opposite to the first magnet; and
a second coil disposed in the base and opposite to the second magnet,
wherein the first lens assembly includes a first lens barrel and a first driving part housing extended from the first lens barrel in the optical axis direction,
wherein the first yoke is disposed on the first driving part housing and extended along the optical axis direction, and
wherein at least one first portion of the first yoke is overlapped by the first magnet in the optical axis direction.

**2**. The camera module according to claim **1**, wherein the at least one first portion of the first yoke is disposed on both side surfaces of the first magnet.

**3**. The camera module according to claim **1**, wherein the first magnet is extended along the optical axis, and is disposed on the first driving part housing.

**4**. The camera module according to claim **1**, wherein the first yoke includes a second portion extended from the at least one first portion along the optical axis direction.

**5**. The camera module according to claim **4**, wherein the at least one first portion is extended from the second portion along a first direction vertical to the optical axis direction.

**6**. The camera module according to claim **4**, wherein the first magnet is disposed on the second portion of the first yoke.

**7**. The camera module according to claim **1**, wherein the second lens assembly includes a second lens barrel and a second driving part housing extended from the second lens barrel in the optical axis direction, and

wherein the second yoke is disposed on the second driving part housing and extended along the optical axis direction.

**8**. The camera module according to claim **7**, wherein at least one third portion of the second yoke is overlapped by the second magnet in the optical axis direction.

**9**. The camera module according to claim **8**, wherein the at least one third portion of the first yoke is disposed on both side surfaces of the second magnet.

**10**. The camera module according to claim **8**, wherein the second yoke includes a fourth portion extended from the third portion along the optical axis direction.

**11**. A camera module comprising:

a base;

a first lens assembly and a second lens assembly disposed in the base and configured to move in an optical axis direction;

a first yoke disposed on the first lens assembly; and

a first magnet disposed on the first yoke,

wherein the first yoke extends along the optical axis direction, and

wherein at least one first portion of the first yoke is overlapped by the first magnet in the optical axis direction.

**12**. The camera module according to claim **11**, wherein the first lens assembly includes a first lens barrel and a first driving part housing extended from the first lens barrel in the optical axis direction, and

wherein the first yoke is disposed on the first driving part housing.

**13**. The camera module according to claim **12**, wherein the first magnet is extended along the optical axis, and is disposed on the first driving part housing.

**14**. The camera module according to claim **11**, wherein the at least one first portion of the first yoke is disposed on both side surfaces of the first magnet.

**15**. The camera module according to claim **11**, wherein the first yoke includes a second portion extended from the at least one first portion along the optical axis direction.

**16**. The camera module according to claim **15**, wherein the at least one first portion is extended from the second portion along a first direction vertical to the optical axis direction.

**17**. The camera module according to claim **15**, wherein the first magnet is disposed on the second portion of the first yoke.

**18**. The camera module according to claim **11**, wherein the second lens assembly includes a second lens barrel and a second driving part housing extended from the second lens barrel in the optical axis direction, and

further comprising a second yoke disposed on the second driving part housing and extended along the optical axis direction.

**19**. The camera module according to claim **18**, further comprising:

a second magnet disposed on the second yoke;

a first coil disposed in the base and opposite to the first magnet; and

a second coil disposed in the base and opposite to the second magnet.

**20**. The camera module according to claim **19**, wherein at least one third portion of the second yoke is overlapped by the second magnet in the optical axis direction.

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