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OPTICAL SIGHTING DEVICE

Abstract

An optical sighting device **10** used by being installed to a firearm includes: an objective system part **12,** forming an inverted image of a target object on a first focal plane; and an erect system part **14,** forming an erect image obtained by reversing the inverted image on a second focal plane. The erect system **14** has: lenses **112** to **116** arranged between the first focal plane and the second focal plane; and a movable cylinder **134** as an erect system cylinder holding the lenses **112** to **116.** The adjustment mechanism **20** is a mechanism for adjusting tilting of an axial direction of the movable cylinder, and has: an advancing-retracting shaft **204** as an advancing-retracting member advancing and retracting on an end side of the movable cylinder **134;** and a spring **206** as a double torsion spring biasing the movable cylinder **134** toward the advancing-retracting shaft **204.**

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of Japan application serial no. 2024-022192, filed on Feb. 16, 2024. The entirety of the above-mentioned patent application is hereby incorporated by reference herein and made a part of this specification.

BACKGROUND

Technical Field

[0002] The invention relates to an optical collimator.

Description of Related Art

[0003] Conventionally, optical sighting devices equipped on hunting firearms and sports firearms have been widely used (see, for example, Patent Document 1). In addition, as an optical sighting device, for example, a configuration including an adjustment mechanism for adjusting an impact position is widely used.

[0004] [Patent Document 1] Japanese Laid-open No. 2022-109448

[0005] In the optical sighting device, for example, by forming an inverted image on a first focal plane by using an objective system (objective optical system) and forming an image, on a second focal plane, by reversing the inverted image into an erect image by an erect system (erect optical system), an image of the target object is visually recognized by the user. In addition, in such configuration, for example, there may be instances where the adjustment is made in relation to the erect orthogonal system to tilt a cylindrical body holding at least a portion of the lens. Then, in such case, generally, the wider the range within which the cylindrical body is able to tilt, the broader the adjustable range (adjustment width of the optical sighting device) becomes. Therefore, conventionally, a configuration able to further widen the range within which the cylindrical body is able to tilt is desired. Therefore, an objective of the invention is to provide an optical sighting device capable of addressing such issue.

[0006] In the optical sighting device using the cylindrical body, in the case of adjusting the tilting of the cylindrical body, for example, it can be as considered to tilt the cylindrical body by using an advancing-retracting member that advances and retracts on an end side of the cylindrical body. In such case, at the time when the advancing-retracting member retracts, for example, it can be considered as using a spring that biases the cylindrical body toward the advancing-retracting member, thereby moving an end of the cylindrical body by matching the movement of the advancing-retracting member. Through extensive research, the inventors of the application have discovered that in such a configuration the adjustment range of the optical sighting device can be appropriately expanded by using a double torsion spring. Through even further extensive research, the inventors of the application further discovered the features necessary to obtain such effects, leading to the invention.

SUMMARY

[0007] The invention provides an optical lighting device. The optical sighting device is installed to a firearm to be used and includes: an objective system part, forming an inverted image of a target object serving as a target of sighting on a first focal plane; an erect system part, forming an erect image obtained by reversing the inverted image on a second focal plane; and an adjustment mechanism, performing adjustment with respect to the erect system part. The erect system part has: a lens, arranged between the first focal plane and the second focal plane; and an erect system cylinder, as a cylindrical body holding the lens. The adjustment mechanism is a mechanism that performs adjustment to tilting an axial direction of the erect system cylinder, and has: an

advancing-retracting member that advances and retracts on an end side of the erect system cylinder; and a double torsion spring, biasing the erect system cylinder toward the advancing-retracting member.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIGS. **1**A and **1**B are views illustrating an optical sighting device **10** according to an embodiment of the invention. FIG. **1**A is a cross-sectional view illustrating an example of a configuration of main components of an optical sighting device **10**. FIG. **1**B is an enlarged view in a vicinity of a position indicated by using a dot-chain line in FIG. **1**A.

[0009] FIGS. **2**A and **2**B are views illustrating an adjustment mechanism **20** in greater detail. FIG. **2**A is a view illustrating an example of a way of biasing a movable cylinder **134** by using a spring **206**. FIG. **2**B is an A-A cross-sectional view in which the cross-section at the position indicated by using the dot-chain line in FIG. **1**A is simplified and shown.

[0010] FIGS. **3**A and **3**B are views illustrating an example of how the spring **206** is installed. FIG. **3**A is an exploded perspective view illustrating an example of a configuration of a spring fixing part **208** of the embodiment together with a lens holder **132** and the spring **206**. FIG. **3**B is an exploded perspective view illustrating the configuration shown in FIG. **3**A from a perspective different from the perspective of FIG. **3**A.

[0011] FIGS. **4**A and **4**B are views illustrating an example of how the spring **206** is installed. FIG. **4**A is a perspective view illustrating an example of a configuration of the lens holder **132**. FIG. **4**B is a perspective view illustrating a state in which the spring **206** is installed to the lens holder **132** from multiple perspectives.

[0012] FIGS. **5**A and **5**B are views illustrating a modified example of the configuration and a way of fixing the spring **206**. FIG. **5**A is an exploded perspective view illustrating an example of a configuration of the spring **206** of the modified example together with the lens holder **132** and the spring fixing part **208**. FIG. **5**B is a perspective view illustrating an example of a way of fixing the spring **206** in the modified example.

DESCRIPTION OF THE EMBODIMENTS

[0013] The invention provides an optical lighting device. The optical sighting device is installed to a firearm to be used and includes: an objective system part, forming an inverted image of a target object serving as a target of sighting on a first focal plane; an erect system part, forming an erect image obtained by reversing the inverted image on a second focal plane; and an adjustment mechanism, performing adjustment with respect to the erect system part. The erect system part has: a lens, arranged between the first focal plane and the second focal plane; and an erect system cylinder, as a cylindrical body holding the lens. The adjustment mechanism is a mechanism that performs adjustment to tilting an axial direction of the erect system cylinder, and has: an advancing-retracting member that advances and retracts on an end side of the erect system cylinder; and a double torsion spring, biasing the erect system cylinder toward the advancing-retracting member.

[0014] In such configuration, for example, through an operation of moving the advancing-retracting member toward the erect system cylinder, the axial direction of the erect system cylinder can be tilted by pressing an end side of the erect system cylinder by using the advancing-retracting member. In such case, even at the time when the advancing-retracting member retracts, by biasing the erect system cylinder toward the advancing-retracting member by using the double torsion spring, the axial direction of the erect system cylinder can be changed by matching the movement of the advancing-retracting member, for example. Therefore, according to such configuration, for example, the tilting of the axial direction of the erect system cylinder can be adjusted appropriately.

Also, in the configuration, regarding the adjustment with respect to the erect system part in relation to the adjustment mechanism, for example, it can be considered as making the adjustment to the optical sighting device by tilting the axial direction of the erect system cylinder, for example. In such case, by using the double torsion spring as a spring biasing the erect system cylinder, for example, a spring with high resilience can be used, as compared with the case where the plate spring, etc., is used. Accordingly, for example, the range in which the erect system cylinder is tilted can be increased, and, regarding the adjustment to the optical sighting device, it is possible to have a large adjustment width. Therefore, according to the configuration, the optical sighting device can be adjusted appropriately, for example.

[0015] In such configuration, for example, the adjustment mechanism further has a spring fixing part, fixing an end and an other end of the double torsion spring. In such case, for example, the spring fixing part fixes an end and an other end of the double torsion spring to the erect system cylinder and a different cylindrical body. According to the configuration, for example, the double torsion spring can be fixed appropriately to a position where biasing can be performed with respect to the erect system cylinder. As the cylindrical body different from the erect system cylinder, for example, a cylindrical body disposed at a position adjacent to the erect system cylinder, for example, can be used appropriately. More specifically, as the different cylindrical body, for example, a lens holder, etc., holding at least a portion of a lens in the objective system part, for example, can be appropriately used. According to such configuration, for example, the number of components forming the optical sighting device can be prevented from excessively increasing, and the double torsion spring can be appropriately fixed. In addition, regarding the different cylindrical body, it can be considered as a spring fixing cylindrical body, etc., used for fixing the double torsion spring, for example. As the spring fixing cylindrical body, for example, a cylindrical body other than the lens holder may be used.

[0016] In the case of using the spring fixing part, the spring fixing part has, for example, a spring end fixing plate for each of the end and the other end of the double torsion spring. In such case, the spring end fixing plate is, for example, a plate-shaped body fixed to an outer surface of the spring fixing cylindrical body. The spring end fixing plate is, for example, fixed to an outer surface of the spring fixing cylindrical body by sandwiching the end of the double torsion spring with an outer surface of a spring fixing cylindrical body that is the different cylindrical body, for example. In such case, the spring end fixing plate, for example, a plate-shaped part and a protrusion part. The plate-shaped part is a plate-shaped portion fixed along the outer surface of the spring fixing cylindrical body. The protrusion part is a portion protruding from the plate-shaped part. In a state in which the protrusion part is inserted into a coil part, which is a portion on which a wiring material is wound, in the double torsion spring, and the spring end fixing plate is fixed to the outer surface of the spring fixing cylindrical body. According to the configuration, for example, the double torsion spring can be fixed appropriately with respect to the spring fixing cylindrical body.

[0017] In such configuration, for example, the spring fixing part, for example, further has a screw fixing the plate-shaped part of the spring end fixing plate onto the outer surface of the spring fixing cylindrical body. The plate-shaped part, for example, has: a cylindrical body side surface, which is a surface facing a side of the spring fixing cylindrical body at a time of being fixed to the spring fixing cylindrical body; and an outer side surface, which is a surface on a back side of the cylindrical body side surface. Moreover, in the plate-shaped part, for example, a screw hole penetrating through from the outer side surface toward the cylindrical body side surface is formed as a hole through which the screw passes. The screw is inserted into the screw hole from a side of the outer side surface in the plate-shaped part. According to the configuration, for example, the spring end fixing plate can be fixed appropriately with respect to the spring fixing cylindrical body. Accordingly, the double torsion spring can be fixed appropriately with respect to the spring fixing cylindrical body, for example. In addition, in this case, the orientation of the force received by the screw at the biasing time when the erect system cylinder is biased by the double torsion spring can

be considered as a direction different from the insertion direction of the screw. More specifically, the orientation of the force received by the screw at the time of biasing, for example can be considered as a direction orthogonal to the insertion direction of the screw. Therefore, in such case, even if force is applied to the screw at the time of biasing, the screw is unlikely to fall off. Therefore, for example, the spring end fixing plate can be appropriately prevented from falling off, etc., due to the influence of the force at the time of biasing.

[0018] In addition, in such configuration, a concave part accommodating the plate-shaped part is formed on the outer surface of the spring fixing cylindrical body. In such case, at a biasing time of biasing the erect system cylinder by using the double torsion spring, the end of the double torsion spring is pressed against a wall surface of the concave part, for example. According to the configuration, for example, the position of the end of the double torsion spring can be fixed appropriately at the time of biasing. Accordingly, for example, by using the double torsion spring, the erect system cylinder can be appropriately biased. Regarding the position where the spring end is fixed, the spring end fixing plate used for fixing the end of the double torsion spring and the spring end fixing plate used for fixing the other end of the double torsion spring are, for example, fixed at positions facing each other by sandwiching a center of a circle of a cross-section orthogonal to an axial direction of the spring fixing cylindrical body on the outer surface of the spring fixing cylindrical body. According to the configuration, for example, the function of the double torsion spring can be more appropriately exerted. In addition, in such case, by using the double torsion spring, for example, the distance between the fulcrum of the spring and the acting point can be appropriately increased without blocking the optical path in the optical sighting device **10**. In this way, for example, the range in which the erect system cylinder is able to tilt can be more appropriately increased.

[0019] In addition, in the configuration, as the adjustment mechanism, for example, a mechanism for adjusting the impact position by tilting the axial direction of the erect system cylinder can be used appropriately. In such case, the adjustment mechanism, for example, further has: an upper-lower adjustment operation part, receiving, from a user, an operation that performs adjustment to the impact position in an upper-lower direction; and a left-right adjustment operation part, receiving, from the user, an operation that performs adjustment to the impact position in a left-right direction. In such case, the adjustment mechanism has, as an advancing-retracting member, for example: an upper-lower advancing-retracting shaft, which is the advancing-retracting member that is shaft-like and advances and retracts in the upper-lower direction in accordance with the operation of the user with respect to the upper-lower adjustment operation part, and a left-right advancing-retracting shaft, which is the advancing-retracting member that is shaft-like and advances and retracts in the left-right direction in accordance with the operation of the user with respect to the left-right adjustment operation part. In addition, the double torsion spring, for example, biases the erect system cylinder with respect to both the upper-lower advancing-retracting shaft and the left-right advancing-retracting shaft. In such case, regarding that the double torsion spring biases the erect system cylinder with respect to the upper-lower advancing-retracting shaft, for example, it can be considered as that the double torsion spring biases the erect system cylinder, so that the tilting of the erect system cylinder changes by matching the movement of the upper-lower advancing-retracting shaft when the upper-lower advancing-retracting shaft retracts, for example. Regarding that the double torsion spring biases the erect system cylinder with respect to the left-right advancing-retracting shaft, for example, it can be considered as that the double torsion spring biases the erect system cylinder toward the left-right advancing-retracting shaft, so that the tilting of the erect system cylinder changes by matching the movement of the left-right advancing-retracting shaft when the left-right advancing-retracting shaft retracts, for example. According to such configuration, for example, at the time of adjusting the impact position in both of the upper-lower direction and the left-right direction, the erect system cylinder **134** can be biased appropriately by using one double torsion spring. In this case, by using the double torsion spring,

the spring is brought into contact with a wide range of the erect system cylinder, for example, thereby biasing the erect system cylinder. Accordingly, for example, biasing in multiple directions can be performed appropriately with respect to the erect system cylinder. In addition, as a configuration of the invention, it can be considered to adopt a method for adjusting an optical sighting device with the same features. In such case, for example, the same effects can also be obtained.

[0020] According to the invention, for example, the optical sighting device can be adjusted appropriately.

[0021] In the following, the embodiments of the invention are described with reference to the drawings. FIGS. **1**A and **1**B are views illustrating an optical sighting device **10** according to an embodiment of the invention. FIG. **1**A is a cross-sectional view illustrating an example of a configuration of main components of an optical sighting device **10**. FIG. **1**B is an enlarged view in a vicinity of a position indicated by using a dot-chain line in FIG. **1**A. The optical sighting device **10** is an optical machine allowing the user to visually recognize a target object, and is installed to a firearm, such as a hunting firearm or a sports firearm, to be used. More specifically, in the embodiment, the optical sighting device **10** is installed to a firearm for long-distance shooting (e.g., a rifle gun, etc.), and enlarges a remote shooting target object, such as a prey, target, etc., for hunting, thereby being visually recognized by the user. In such case, a sighting telescope having a telescopic function, for example, can also be considered as the optical sighting device **10**. A scope (e.g., a rifle scope) installed to a firearm, for example, can also be considered as the optical lighting device **10**. In addition, in the embodiment, the optical sighting device **10** includes an objective system part **12**, an erect system part **14**, an eyepiece system part **16**, a housing **18**, and an adjustment mechanism **20**. Except for the points described in the following, the optical sighting device **10** has the same or similar properties as those of the conventional optical sighting device **10**. For example, except for the point to be described in the following, as the configuration of each part of the optical sighting device **1**, a configuration having the same function as the conventional configuration can be used appropriately.

[0022] The objective system part **12**, the erect system part **14**, and the eyepiece system part **16** are configurations corresponding to the optical system in the optical sighting device **10**. With the objective system part **12**, which serves as an objective lens side, facing the front side of the firearm and the eyepiece system part **16**, which serves as an eyepiece system side, facing the rear side of the firearm, the shooting target is visually recognized by the user as a shooter of the firearm. More specifically, among these, the objective system part **12** is a configuration corresponding to the objective optical system (objective system), and is disposed on a side (objective side) closer to the target object than the erect system part **14** with respect to the target object that is the object as a sighting target, and forms an inverted image of the target object on a first focal plane (first focal plane). Regarding the first focal plane, for example, it can be considered as a focal plane set at a predetermined first position in the optical axis direction in the optical sighting device **10**. In addition, in the embodiment, the objective system part **12** has multiple lenses **102**, **104**, **106**, and a lens holder **132**. In such case, regarding the lenses **102**, **104**, **106** in the objective system part **12**, for example, it can be considered as objective lenses, etc., in the optical sighting device **10**. In addition, the lens holder **132** is a cylindrical body (cylindrical member) holding at least a portion of the lenses in the objective system part **12**. Regarding the lens holder **132**, for example, it can be considered as a cylindrical body, etc., in which the axial direction and the optical axis direction of the optical sighting device **10** are parallel to each other and which is disposed in the housing **18**. In the embodiment, the lens holder **132** is an example of a cylindrical body different from a movable cylinder **134** in the erect system part **14**, disposed at a position adjacent to the erect system part **14**, and holds the lens **106** disposed at a position closest to the erect system part **14**. In this case, other lenses in the objective system part **12** are held by the housing **18**. In addition, the objective system part **12** may be further provided with a lens holder for other lenses.

[0023] The erect system part **14** is a configuration corresponding to the erect optical system (erect system), disposed between the objective system part **12** and the eyepiece system part **16**, and forms, on a second focal plane, an erect image obtained by reversing the inverted image formed on the first focal plane. Regarding the second focal plane, for example, it can be considered as a focal plane, etc., set at a predetermined second position in the optical axis direction in the optical sighting device **10**. In addition, in the embodiment, the erect system part **14** has multiple lenses **112**, **114**, **116**, and a movable cylinder **134**. In this case, the multiple lenses **112**, **114**, **116** are arranged between the first focal plane and the second focal plane, and form an erect image on the second focal plane, the erect image being formed by reversing the inverted image formed on the first focal plane. The movable cylinder **134** is a cylindrical body holding the lenses **112**, **114**, **116**. Also, in the embodiment, the movable cylinder **134** is an example of the erect system cylinder, and, in the housing **18**, is arranged so that the axial direction changes in accordance with the operation of the user with respect to the adjustment mechanism **20**. More specifically, in the movable cylinder **134**, the tilting of the axial direction is changed by moving the end part on the side of the objective system part **12** in the upper-lower direction and the left-right direction by using the predetermined position on the side of the eyepiece system part **16** as a fulcrum. In such case, regarding the movable cylinder **134**, it can be considered as forming a structure that tilts inside the body of the optical sighting device **10** by using the end part on the side of the eyepiece system part **16** as a fulcrum. Regarding the upper-lower direction and the left-right direction, it can be considered as the upper-lower direction and the left-right direction, etc., when the optical sighting device **10** installed to the firearm is in use, for example. In addition, in FIG. **1**A, the upper-lower direction in the drawing corresponds to the upper-lower direction of the optical sighting device **10**. In addition, a direction orthogonal to the paper surface of the drawing and the upper-lower direction corresponds to the left-right direction of the optical sighting device **10**. In addition, in the embodiment, the erect system part **14**, for example, changes the magnification of the optical sighting device **10** by moving at least a portion of the lenses **112**, **114**, **116** in the axial direction of the movable cylinder **134**. In such case, the erect system part **14**, for example, changes the magnification in accordance with the operation of the user with respect to the operation part for magnification adjustment in the optical sighting device **10**, for example. Also, in such case, regarding the lenses in the erect system part **14**, for example, it can be considered as a lens group, etc., that reverses the inverted image formed on the first focal plane into an erect image and adjusts the magnification. In addition, regarding the movable cylinder **134**, it can be considered as a cylinder into which the lens group is entered, for example. In addition, the eyepiece system part **16** is a configuration corresponding to the eyepiece optical system (eyepiece system), arranged on a side (eyepiece side) close to the user than the erect system part **14**, and allows the user to visually recognize the erect image formed on the second focal plane. In the embodiment, the eyepiece system part **16** has multiple lenses **122**, **124**. Regarding the lenses **122**, **124** in the eyepiece system part **16**, for example, it can be considered as an eyepiece lens, etc., in the optical sighting device **10**.

[0024] In addition, the housing **18** is a housing accommodating the objective system part **12**, the erect system part **14**, and the eyepiece system part **16**, etc. In the embodiment, the housing **18** is fixed and installed to a predetermined position in the firearm by using a mount not shown in the drawings, for example. The adjustment mechanism **20** is a mechanism for making adjustment relating to the function of the optical sighting device **10** in accordance with the operation of the user. Regarding the adjustment relating to the function of the optical sighting device **10**, for example, it can be considered as an adjustment regarding the optical properties, sighting, etc., of the optical sighting device **10**. In addition, more specifically, in the embodiment, the adjustment mechanism **20** shown in the drawings is a mechanism that adjusts the impact position, and makes adjustment with respect to the optical sighting device **10** by making adjustment to tilting the axial direction of the movable cylinder **134** in the erect system part **14** in accordance with the operation of the user. In such case, regarding the adjustment mechanism **20**, for example, it can be considered

as a mechanism for making adjustment to the erect system part **14**. In addition, regarding the adjustment to the impact position, for example, it can be considered as the adjustment to the relationship between the impact point (impact position) of the bullet from the firearm to which the optical sighting device **10** is installed and the optical axis direction of the optical sighting device **10**, etc. Regarding the adjustment to the impact position, for example, it can be considered as an adjustment for matching the aim point and the impact point of the firearm, etc. For example, in the embodiment, the adjustment mechanism **20** changes the center of the image visually recognized by the user by tilting the axial direction of the movable cylinder **134**, thereby adjusting the impact point. In addition, in FIG. **1**, for the case of illustration, regarding the adjustment mechanism **20**, only the configuration for adjusting the impact position in the upper-lower direction is mainly illustrated. In addition to the configuration as shown, the adjustment mechanism **20** may further have a configuration for adjusting the impact position in the left-right direction. More specifically, in the embodiment, the adjustment mechanism **20** has the operation part **202**, an advancing-retracting shaft **204**, and a spring **206**, etc., as shown in FIG. **1**B, for example. In addition, while the symbol in FIGS. **1**A and **1**B is omitted, the adjustment mechanism **20** is further provided with a spring fixing part fixing the spring **206** with respect to the lens holder **132** in the objective system part **12**. In addition, in these configurations, the operation part **202** receives the operation of the user. In the embodiment, the operation part **202** is a dial that rotates in accordance with the operation of the user. In addition, the advancing-retracting shaft **204** is a member (advancing-retracting member) that advances and retracts in accordance with the operation of the user with respect to the operation part **202** on an end side of the movable cylinder **134** in the erect system part **14**. In the embodiment, the advancing-retracting part **204** advances and retracts in accordance with the rotation of the operation part **202** at the end part on the side of the objective system part **12** in the movable cylinder **134**. Accordingly, the advancing-retracting shaft **204** changes the position of the end part of the movable cylinder **134**.

[0025] In FIGS. **1**A and **1**B, the operation part **202** and the advancing-retracting shaft **204** in the figure are the operation part **202** and the advancing-retracting shaft **204** for adjusting the impact position in the upper-lower direction. In addition, in the embodiment, the adjustment mechanism **20** further includes an operation part **202** and an advancing-retracting shaft **204** for adjusting the impact position in the left-right direction, in addition to the operation part **202** and the advancing-retracting shaft **204** shown in the drawing. In such case, regarding the adjustment mechanism **20**, for example, it can be considered as a mechanism having multiple operation parts **202** and advancing-retracting shafts **204**. In addition, in such case, regarding the operation part **202** for making adjustment in the upper-lower direction, for example, it can be considered as an elevation dial, etc., for adjusting the impact point in the upper-lower direction. Regarding the operation part **202** for making adjustment in the left-right direction, for example, it can be considered as an elevation dial, etc., for adjusting the impact point in the upper-lower direction. In addition, the operation part **202** for making adjustment in the upper-lower direction in the embodiment is an example of an upper-lower adjustment operation part for receiving from the user an operation for adjusting the impact position in the upper-lower direction. The advancing-retracting shaft **204** for making adjustment in the upper-lower direction is an example of an upper-lower advancing-retracting shaft that is a shaft-like advancing-retracting member advancing and retracting in the upper-lower direction in accordance with the operation of the user with respect to the upper-lower adjustment operation part. In addition, the operation part **202** for making adjustment in the left-right direction is an example of a left-right adjustment operation part for receiving from the user an operation for adjusting the impact position in the left-right direction. The advancing-retracting shaft **204** for making adjustment in the left-right direction is an example of a left-right advancing-retracting shaft that is a shaft-like advancing-retracting member that advances and retracts in the left-right direction in accordance with the operation of the user with respect to the left-right adjustment operation part.

[0026] In addition, in the adjustment mechanism **20**, the spring **206** biases the movable cylinder **134** toward the advancing-retracting shaft **204**. Accordingly, the spring **206** presses the movable cylinder **134** toward the advancing/retracting shaft **204**. In such configuration, for example, through an operation of moving the advancing-retracting shaft **204** toward the movable cylinder **134**, the end side of the movable cylinder **134** can be pressed by the advancing-retracting shaft **204** to appropriately tilt the axial direction of the movable cylinder **134**. In such case, when the advancing-retracting shaft **204** retracts, by biasing the movable cylinder **134** toward the advancing-retracting shaft **204** by using the spring **206**, for example, the axial direction of the movable cylinder **134** can be changed by matching the movement of the advancing-retracting shaft **204**. Therefore, according to such configuration, for example, the tilting of the axial direction of the movable cylinder **134** can be adjusted appropriately. In addition, in the embodiment, as the spring **206**, a double torsion spring. In such case, as the spring **206**, for example, a spring same as or similar to the conventional double torsion spring can be used appropriately. Regarding the double torsion spring, for example, it can be considered as a spring with a configuration in which multiple torsion coil springs are combined in series. In addition, regarding the double torsion spring, for example, it can be considered as a spring having multiple coil parts that are portions around which wires of coil springs are wound. Regarding the double torsion spring, for example, it can be considered as a spring which has multiple coil parts and in which portions between the coil parts are bent. In addition, in the embodiment, the spring **206** is a spring having two coil parts and the portion between the coil parts is bent. In the case where the double torsion spring of such configuration is used, for example, through acting of a torsional moment to two coil parts simultaneously, for the torque generated at the same torsion angle, the coil part can be considered as becoming twice as one torsion coil spring. In addition, the double torsion spring, for example, may also be referred to as a double kick spring.

[0027] In addition, in the embodiment, the spring **206** is commonly used for adjustment to the impact position in the upper-lower direction and the left-right direction. In such case, regarding the spring **206**, for example, the movable cylinder **134** can be considered as being biased with respect to both of the advancing-retracting shaft **204** for the adjustment in the upper-lower direction and the advancing-retracting shaft **204** for the adjustment in the left-right direction. Regarding the spring **206** biasing the movable cylinder **134** with respect to the advancing-retracting shaft **204** for the adjustment in the upper-lower direction, for example, it can be considered as biasing, by using the spring **206**, the movable cylinder **134** so that the tilting of the movable cylinder **134** changes by matching the movement of the advancing-retracting shaft **204** when the advancing-retracting shaft **204** retracts, for example. Regarding the spring **206** biasing the movable cylinder **134** with respect to the advancing-retracting shaft **204** for the adjustment in the left-right direction, for example, it can be considered as biasing, by using the spring **206**, the movable cylinder **134** so that the tilting of the movable cylinder **134** changes by matching the movement of the advancing-retracting shaft **204** when the advancing-retracting shaft **204** retracts, for example, can be considered. According to such configuration, for example, at the time of adjusting the impact position in both of the upper-lower direction and the left-right direction, the movable cylinder **134** can be biased appropriately. In addition, in such case, by using a double torsion spring as the spring **206**, for example, a spring with high resilience can be used appropriately. In addition, in such case, for example, by bringing the spring **206** into contact with the movable cylinder **134** in a wide range, the biasing with respect to the movable cylinder **134** can be carried out. Therefore, according to the embodiment, for example, the biasing in multiple directions can be carried out appropriately with respect to the movable cylinder **134**.

[0028] Then, the function of the spring **206**, etc., in the adjustment mechanism **20** can be described in greater detail. FIGS. **2**A and **2**B are views illustrating the adjustment mechanism **20** in greater detail. FIG. **2**A is a view illustrating an example of a way of biasing a movable cylinder **134** by using a spring **206**. FIG. **2**B is an A-A cross-sectional view in which the cross-section at the

position indicated by using the dot-chain line in FIG. **1**A is simplified and shown. As described above, in the embodiment, the tilting of the movable cylinder **134** changes in accordance with the advancing and retracting of the advancing-retracting shaft **204** in the adjustment mechanism **20**. By biasing the movable cylinder **134** toward the advancing-retracting shaft **204** by using the spring **206** when the advancing-retracting shaft **20** retracts, for example, the axial direction of the movable cylinder **134** is changed by matching the movement of the advancing-retracting shaft **204**, for example. In such case, regarding the spring **206**, for example, it can be considered as keeping the tilting of the movable cylinder **134** in accordance with the position of the advancing-retracting shaft **204** by biasing the movable cylinder **134**, for example,.

[0029] In addition, in the embodiment, the spring **206** is fixed to the lens holder **132** in the objective system part **12** (see FIGS. **1**A, **1**B) by using the spring fixing part **208**, so that the portion between the two coil parts contacts an end of the movable cylinder **134**, as shown in FIG. **2**A. In this case, regarding the lens holder **132**, for example, it can be considered as a cylindrical body, etc., arranged at a position adjacent to the movable cylinder **134**. In addition, for the case of illustration, in FIGS. **1**A, **1**B, and **2**A, regarding the spring **206**, it is shown that the movable cylinder **134** is pressed (pressurized) from the lower part to the upper part in the upper-lower direction. However, as described above, in the embodiment, the spring **206** is commonly used for the adjustment in both the upper-lower direction and the left-right direction. Therefore, in the actual configuration, the spring **206** obliquely presses the movable cylinder **134**, so that the movable cylinder **134** is biased toward the advancing-retracting shaft **204** in both the upper-lower direction and the left-right direction as shown as the pressurizing direction in FIG. **2**B, for example. More specifically, in FIG. **2**B, an example of the position relationship between the movable cylinder **134** and the advancing-retracting shaft **204** when viewed from the eyepiece side and the pressurizing direction in which the spring **206** presses the movable cylinder **134** is shown. In such case, regarding the pressurizing direction, for example, it can be considered as pressurizing from 45 degrees diagonally downward to the left to 45 degrees diagonally upward to the right in the drawing. According to such configuration, for example, the movable cylinder **134** can be biased appropriately by the spring **206**.

[0030] Here, at the time of adjusting the impact position, the greater the amount (range) in which the movable cylinder **134** can be tilted, the greater the adjustment width, which is the range in which the impact point can be adjusted. In addition, in this case, when the adjustment width becomes wider, it is possible to shoot in a wider range by using the optical sighting device **10**. Therefore, the adjustment width of the impact point may normally be greater. Meanwhile, in order to increase the adjustment width of the impact point, it is necessary to greatly tilt the movable cylinder **134** inside (in the inner space of the body) of the housing of the optical sighting device **10**. In addition, in such case, the load with respect to the spring **206** holding the tilting of the movable cylinder **134** also increases.

[0031] Regarding this point, as the spring holding the tilting of the movable cylinder **134**, a plate spring, etc., can be considered in addition to a double torsion spring, for example. However, in such case, the resilience (repulsive force, reaction force) of the spring weakens, and an issue such as the inability of appropriately holding the movable cylinder **134** may easily occur. Comparatively, in the embodiment, in the case where the double torsion spring is used as the spring **206**, the resilience of the spring **206** can appropriately exceed the case where a plate spring, etc., is used. Accordingly, for example, the movable cylinder **134** can be held more appropriately. In this case, by using the spring **206** having resilience higher than a plate spring, etc., for example, it is possible to widen the range in which the movable cylinder **134** is able to tilt. Accordingly, for example, regarding the adjustment for the optical sighting device **10**, it is possible to have a large adjustment width. Therefore, according to the embodiment, the optical sighting device **10** can be adjusted appropriately, for example. In addition, regarding the way of installing the spring **206** with respect to the optical sighting device **10**, for example, an installation method able to more appropriately

exert the properties of the double torsion spring may be adopted. More specifically, as described above, in the embodiment, the spring **206** is fixed to the lens holder **132** in the objective system part **12** by using the spring fixing part **208**. In addition, in this case, as shown in FIGS. **3**A, **3**B, **4**A, and **4**B, the spring **206** is fixed to the lens holder **132**.

[0032] FIGS. **3**A, **3**B, **4**A and **4**B are views illustrating an example of how the spring **206** is installed. FIG. **3**A is an exploded perspective view illustrating an example of a configuration of a spring fixing part **208** of the embodiment together with a lens holder **132** and the spring **206**. FIG. **3**B is an exploded perspective view illustrating the configuration shown in FIG. **3**A from a perspective different from the perspective of FIG. **3**A. FIG. **4**A is a perspective view illustrating an example of a configuration of the lens holder **132**. FIG. **4**B is a perspective view illustrating a state in which the spring **206** is installed to the lens holder **132** from multiple perspectives.

[0033] In the embodiment, the spring fixing part **208** has multiple fulcrum plates **302** and multiple screws **304**. In this case, the spring fixing part **208** has the fulcrum plate **302** for an end and the other end of the spring **206**. In addition, the spring fixing part **208** has the screw **304** corresponding to each of the fulcrum plates **302**. The fulcrum plate **302** is a plate-shaped body as an example of a spring end fixing plate, and is fixed to the outer surface of the lens holder **132**. Regarding the outer surface of the lens holder **132**, for example, it can be considered as a surface, etc., corresponding to the side surface of the cylindrical body, for example. The lens holder **132** is an example of a spring fixing cylindrical body. More specifically, on each of an end side and the other side of the spring **206**, the fulcrum plate **302** is fixed to the outer surface of the lens holder **132** by sandwiching the end of the spring **206** with the outer surface of the lens holder **132**. In addition, in the embodiment, the fulcrum plate **302** has a plate-shaped part **312** and a protrusion part **314**. The plate-shaped part **312** is a plate-shaped portion fixed along the outer surface of the lens holder **132**. In this case, for example, the plate-shaped part **312** can be considered as having a cylindrical body side surface as a surface facing toward the side of the lens holder **132** when the plate-shaped part **312** is fixed to the lens holder **132** and an outer side surface as a surface on the back side of the cylindrical body side surface. In addition, in the embodiment, a screw hole is formed on the plate-shaped part **312**. The screw hole penetrating through from the outer side surface toward the cylindrical body side surface. The screw hole, for example, can be considered as a hole, etc., for the screw **304** to pass through. In addition, the protrusion part **314** is a portion protruding from the plate-shaped part **312**. In the embodiment, the protrusion part **314** protrudes in a direction toward the inner side of the lens holder **132** with respect to the plate-shaped part **312**. In addition, in this case, the fulcrum plate **302** is fixed to the outer surface of the lens holder **132** in a state in which the protrusion part **314** is inserted into the coil part **222** of the spring **206**, as shown in FIG. **4**B. According to the configuration, for example, by using the fulcrum plate **302**, the coil part **222** serving as the fulcrum (rotational fulcrum) of the spring **206** can be fixed appropriately. In addition, in this case, the protrusion part **314**, for example, can be considered as serving as a guide rod with respect to the spring **206**. The multiple screws **304** are fixing members for fixing the multiple fulcrum plates **302** on the outer surface of the lens holder **132**. In the embodiment, the screw **304** is inserted from the side of the outer side surface of the plate-shaped part **312** with respect to the screw hole in the plate-shaped part **312** of the fulcrum plate **302**. According to such configuration, for example, the fulcrum plate **302** can be fixed to the lens holder **132** appropriately. Accordingly, for example, the spring **206** can be fixed appropriately with respect to the lens holder **132**.

[0034] Regarding the way of fixing the spring **206** with respect to the lens holder **132**, more specifically, in the embodiment, a concave part **402** and a hole **404** are formed on the outer surface of the lens holder **132**, as shown in FIG. **4**A, for example. In this case, at the time of fixing the fulcrum plate **302** to the lens holder **132**, the concave part **402** accommodates the plate-shaped part **312** of the fulcrum plate **302**. According to such configuration, for example, the fulcrum plate **302** can be fixed to the lens holder **132** appropriately without protrusion of the fulcrum plate **302** from the outer surface of the lens holder **132**. In addition, by forming the concave part **402** on the outer

surface of the lens holder **132**, for example, the fulcrum plate **302** can be easily and appropriately installed to the correct position. In addition, the hole **404** is a hole into which the screw **304** is inserted when the fulcrum plate **302** is fixed. In the embodiment, the hole **404** is formed, on the bottom surface of the concave part **402**, at a position corresponding the screw hole in the plate-shaped part **312** of the fulcrum plate **302**. According to such configuration, for example, the fulcrum plate **302** can be fixed to the lens holder **132** appropriately. The hole **404** may also be a hole in which a female screw corresponding to the screw **304** is formed.

[0035] In addition, as shown in FIG. **4**A, in the embodiment, a groove part **412** is further formed on the bottom surface of the concave part **402**. In such case, regarding the configuration of the concave part **402**, for example, it can be considered that a second concave part corresponding to the groove part **412** is formed in a first concave part corresponding to the concave part **412** itself. In addition, in the embodiment, the groove part **412** is a concave part for accommodating the end part of the spring **206**. In such case, at the time of fixing the spring **206** by using the spring fixing part **208**, an end part of the spring **206** is inserted into the groove part **412**. In addition, in a state in which the end part of the spring **206** is inserted into the groove part **412**, the fulcrum plate **302** is installed to the concave part **402** so as to cover the groove part **412** by using the plate-shaped part **312**. According to such configuration, for example, by using the fulcrum plate **302**, the end part of the spring **206** can be reliably fixed with respect to the lens holder **132**. In addition, in the embodiment, the groove part **412** is formed at a position at an end of the concave part **402**, so that a wall surface of the groove part **412** is connected with the wall surface of the concave part **402**. More specifically, in such case, for example, regarding the wall surface on a side against which the end part of the spring **206** is pressed at the biasing time when the movable cylinder **134** (see FIGS. **1**A and **1**B) is biased by the spring **206**, the wall surface of the concave part **402** and the wall surface of the groove part **412** are connected. In such case, for example, it can be considered that a wall surface of the groove **412** is included and becomes the wall surface of the concave part **402**. In such case, at the time of biasing by using the spring **206**, the end of the spring **206** is pressed against the wall surface of the concave part **402**, for example. Therefore, according to the configuration, for example, at the time of biasing by using the spring **206**, the position of the end of the spring **206** can be appropriately fixed at a predetermined position by using the wall surface of the concave part **402**. Accordingly, for example, the movable cylinder **134** can be more appropriately biased by using the spring **206**.

[0036] Regarding the positions where the fulcrum plates **302** are fixed, in the embodiment, the fulcrum plates **302** are fixed to an end side and the other side of the diameter of a circle of the cross-section of the lens holder **132**, as shown in the figure. In this case, the circle of the cross-section of the lens holder **132**, for example, can be considered as a circle, etc., of a cross-section orthogonal to the axial direction of the lens holder **132**. In addition, regarding the circle of the cross-section can be considered as a circle, etc., similar to the cross-sectional shape of the lens holder **132**, for example. In addition, regarding the circle, for example, it can be considered as a circle, etc., with the position of the optical axis of the lens held by the lens holder **132** as the center on a cross-section orthogonal to the optical axis. In such case, regarding the fulcrum plates **302** fixed to an end side and the other end side of the diameter of the circle, for example, it can be considered that the fulcrum plates **302** are fixed so that a line passing through the center of the circle on the cross-section intersects with the fulcrum plates **302**, etc. In such case, the fulcrum plate **302** used for fixing at an end of the spring **206** and the fulcrum plate **302** used for fixing at the other end of the spring **206**, for example, can be considered as being fixed at positions facing each other by sandwiching the center of the circle of the cross-section. According to the configuration, for example, the function of the double torsion spring used as the spring **206** can be more appropriately exerted. In addition, by using the double torsion spring as the spring **206**, for example, the distance between the fulcrum of the spring **206** and the acting point can be appropriately increased without blocking the optical path in the optical sighting device **10** (see

FIGS. **1**A and **1**B), for example. In this way, for example, the range in which the movable cylinder **134** is able to tilt can be more appropriately increased. Therefore, according to the embodiment, for example, the spring **206** can be more appropriately fixed with respect to the lens holder **132**. In such case, for example, it can be considered that the double torsion spring is used as the spring **206**, and the fulcrum plates **302** on the end side and the other end side of the diameter of the circle of the cross-section of the lens holder **132** are fixed, thereby being able to more appropriately using a spring with high resilience force. In such case, for example, by fixing the end and the other end of the spring **206** at multiple positions separated by a distance, distortion, etc., can be prevented from occurring in the lens holder **132**.

[0037] As can be understood from the configuration of the spring **206**, etc., as shown in FIG. **3**A, in the embodiment, the spring **206** contacts the movable cylinder **134** at a contact part **224** that is a portion between the two coil parts **222**. In addition, in this case, with the fulcrum plates **302** being fixed to the end side and the other end side of the diameter of the circle of the cross-section of the lens holder **132**, for example, the range serving as the contact part **224** can be sufficiently ensured. Accordingly, for example, one spring **206** can be more appropriately used for the adjustment in both the upper-lower direction and the left-right direction. Moreover, as described above, in the embodiment, an end of the spring **206** is fixed to the position of the wall surface of the concave part **402** of the lens holder **132**. In addition, the wall surface of the concave part **402** is a wall surface on the side against which the end of the spring **206** is pressed at the time of biasing by using the spring **206**. In addition, in such case, at the time of biasing, it can be considered as a configuration, etc., in which the end of the spring **206** and the contact part **224** are located on opposite sides with respect to the diameter of the cross-section where the fulcrum plates **302** are located at two ends. In such case, regarding the end of the spring **206** and the contact part **224** being on opposite sides with respect to the diameter, such as the corresponding relationship of semi-circles in the case where the circle is split into two by the diameter, it can be considered as that the position of the end of the spring **206** is at a position corresponding to a semi-circle, and the position corresponding to the contact part **224** is at a position corresponding to the other semicircle, etc. Regarding the diameter of the cross-section on which multiple fulcrum plates **302** are located at the two ends, for example, it can be considered as a diameter, etc., in which the diameter or its extension line passes through a predetermined reference position in the fulcrum plates **302**. The reference position of the fulcrum plates **302**, for example, can be considered as a predetermined position for a common fulcrum plate **302** with respect to the two fulcrum plates **302**. Regarding the end of the spring **206** and the contact part **224** being on opposite sides with respect to the diameter at the time of biasing, for example, it can be considered that the end of the spring **206** and the contact part **224** are on opposite sides, etc., with respect to a plane including the diameter and being parallel to the optical axis of the optical sighting device **10**. In addition, with the required resilience in the spring **206** or the configuration of the optical sighting device **10**, etc., the position where the end of the spring **206** is fixed can also be considered as a position on the same side with the contact part **224** at the time of biasing, being located on the diameter, etc., for example. In such case as well, by using a double torsion spring as the spring **206**, the distance between the fulcrum of the spring **206** and the acting point can be appropriately increased.

[0038] Here, regarding the spring that biases the movable cylinder **134**, for example, in the case where solely the biasing of the movable cylinder **134** is considered, a plate spring, etc., can be considered, instead of using a double torsion spring. However, in the case where the plate spring is used, the position of fixing the spring to the cylindrical body, such as the lens holder **132**, is generally located on the outer side of the position where the plate spring contacts the movable cylinder **134** in the direction of the force with which the plate spring biases the movable cylinder **134**. In addition, in such case, the spring may easily fall off due to the force applied by the spring (plate spring) at the time of biasing. Comparatively, in the configuration of the embodiment, regarding the orientation of the force received by the screw **304** used for fixing the fulcrum plate

302 of the spring fixing part **208**, it can be considered as a direction different from the insertion direction of the screw **304**, for example. More specifically, regarding the orientation of the force received by the screw **304** at the time of biasing, for example, it can be considered as a direction orthogonal to the insertion direction of the screw **304**, for example. In addition, in such case, even if force is applied to the screw **304** at the time of biasing, the screw **304** is unlikely to fall off. Therefore, according to the embodiment, for example, the fulcrum plate **302** can be appropriately prevented from falling off, etc., under the influence of the force at the time of biasing. In the case where a plate spring, etc., is used, in order to prevent the spring from falling off, it suffices as long as a sufficiently long screw is used to fix the plate spring, etc. However, in the case where a screw is fixed to a cylindrical body, such as the lens holder **132**, in association with the optical path of the optical sighting device **10**, if a long screw, etc., is used, an influence on the optical path, etc., may occur due to the projection of the tip of the screw into the cylindrical body. Comparatively, according to the embodiment, for example, even if the short screw **304** is used, the spring **206** can be appropriately fixed to the lens holder **132**, etc.

[0039] In addition, the specific configuration of the optical sighting device **10** is not limited to the configuration described above, and various changes are possible. In this case, for example, regarding the specific configuration of the spring **206**, the way of fixing the spring **206**, etc., a configuration different from the configuration described above and shown in FIGS. **5**A and **5**B can be considered. FIGS. **5**A and **5**B are views illustrating a modified example of the configuration and a way of fixing the spring **206**. FIG. **5**A is an exploded perspective view illustrating an example of a configuration of the spring **206** of the modified example together with the lens holder **132** and the spring fixing part **208**. FIG. **5**B is a perspective view illustrating an example of a way of fixing the spring **206** in the modified example. Except for the points described below, components in FIGS. **5**A and **5**B that are given the same reference numerals as in FIGS. **1**A to **4**B may have the same or similar features as the components in FIGS. **1**A to **4**B. In addition, in the modified example with further changes to the configuration of the spring **206** or how the spring **206** is fixed, only some of the properties described below may be different from the configuration described using FIGS. **1**A to **4**B.

[0040] In the modified example, as shown in FIG. **5**A, for example, the spring **206** has a bent part **232** in a portion between the coil **222** and the contact part **224**. The bent part **232** is a portion bent in a predetermined direction in the spring **206**. For example, as shown in FIG. **5**B, the bent part **232** is bent in a direction from the spring **206** toward the movable cylinder **134** at the time of biasing with respect to the movable cylinder **134** (see FIGS. **1**A and **1**B). By using the spring **206** having the bent part **232**, for example, the resilience of the spring **206** can be appropriately increased. In addition, at the time when the advancing-retracting shaft **204** (see FIGS. **1**A and **1**B) in the adjustment mechanism **20** retracts, the biasing with respect to the movable cylinder **134** due to the spring **206** can be carried out more appropriately even in the case where the advancing-retracting shaft **204** further retracts. Therefore, according to such configuration, for example, the range (movable region) in which the movable cylinder **134** is tilted at the time of adjustment can be more appropriately increased. In addition, in the spring **206** of the modified example, as shown in FIG. **5**A, the contact part **224** is further curved by being fit with the shape of the movable cylinder **134**. In such case, for example, the contact part **224** can also be considered as being curved into a shape close to the outer diameter of the movable cylinder **134**. In the case of such configuration, for example, the range (grounded area) in which the spring **206** makes contact with respect to the movable cylinder **134** can be more appropriately increased. Accordingly, for example, at the time of making adjustment in the upper-lower direction and the left-right direction, an appropriate force (pressurizing force) can be applied from the spring **206** to the movable cylinder **134**.

[0041] In addition, in the modified example, as shown in FIG. **5**B, for example, the way of fixing the spring **206** with respect to the lens holder **132** is also different from the case described above by using FIGS. **4**A and **4**B, etc. More specifically, in the modified example as well, the concave part

402 and the hole **404** are formed on the outer surface of the lens holder **132**. The concave part **402** accommodates the fulcrum plate **302** in the spring fixing part **208**, and the hole **404** is provided for the screw **304**. However, in the modified example, the groove part **412** (see FIGS. **4**A and **4**B) on the bottom surface of the concave part **402** is not formed. According to such configuration, for example, the processing with respect to the lens holder **132** can be carried out more easily and appropriately. By doing so, for example, the cost required for processing the lens holder **132**, etc., can be reduced.

[0042] Moreover, in the modified example, the concave part **402** of the lens holder **132** is formed to be wider than the fulcrum plate **302** as shown in FIG. **5**B, for example. In addition, in this way, the concave part **402** accommodates the fulcrum plate **302**, so that a gap **414** can be provided between at least one wall surface of the concave part **402** and the fulcrum plate **302** in the circumferential direction of the lens holder **132**. In such case, in the state in which the coil part **222** of the spring **206** is inserted into the protrusion part of the fulcrum plate **302** and the end part of the spring **206** is accommodated in the gap **404**, the spring **206** is fixed to the lens holder **132**. In this case, as can be understood from the configuration as shown, etc., the gap **414** in which the end part of the spring **206** is accommodated is located on the wall surface of the concave part **402** on the side against which the end of the spring **206** is pressed at the time when the movable cylinder **134** is biased by the spring **206**. Therefore, in the modified example as well, for example, at the time of biasing by using the spring **206**, the position of the end of the spring **206** can be appropriately fixed at a predetermined position by using the wall surface in the concave part **402**. Accordingly, for example, the movable cylinder **134** can be more appropriately biased by using the spring **206**. In addition, in the case as well, the wall surface of the concave part **402** can be considered as a portion of the outer surface of the lens holder **132**. Therefore, in the case as well, the fulcrum plate **302** can be considered as being fixed to the outer surface of the lens holder **132** by sandwiching the end of the spring **206** with the outer surface of the lens holder **132**, for example.

[0043] In the following, the supplementary description relating to the configuration described above and additional modified examples are described. For case of description, hereinafter, the present example may be used to include the modified examples described above or below. As described above, in the adjustment mechanism **20**, for example, by using the screw fixing part **208**, the end and the other end of the spring **206** are fixed with respect to the lens holder **132** as a cylindrical body different from the movable cylinder **134**. According to the configuration, for example, the double torsion spring used as the spring **206** can be appropriately fixed to a position able to bias the movable cylinder **134**. In addition, in such case, by fixing the spring **206** to the lens holder **132**, for example, the number of components forming the optical sighting device **10** can be prevented from excessively increasing, and the spring **206** can be appropriately fixed. Comparatively, in the modified example of the configuration of the optical sighting device **10**, the end and the other end of the spring **206** may also be fixed to a cylindrical body other than the lens holder **132**. In such case, the cylindrical body, for example, can be considered as an example of a spring fixing cylindrical body. In addition, in such case, as the cylindrical body fixing the end and the other end of the spring **206**, for example, it can be considered as a cylindrical body arranged on the objective side with respect to the first focal plane in the optical sighting device **10**. Accordingly to the configuration, the position of fixing the spring **206** can be determined more flexibly. In this way, for example, the degree of freedom for designing the optical sighting device **10** can be increased.

[0044] In addition, as described above, the double torsion spring, for example, can be considered as a spring with multiple coil parts. In such case, in the modified example in which the double torsion spring is used as the spring **206** that biases the movable cylinder **134**, for example, it can be considered as a double torsion spring formed by combining multiple torsion springs (single torsion springs) with one coil portion. More specifically, in such case, for example, a configuration in which two single torsion springs are connected directly or via a component can be considered as a

double torsion spring. In the case of being configured in this way, for example, regarding the double torsion spring, by using the same or similar configuration as described above, the same or similar effects can be obtained appropriately.

[0045] In addition, the properties of the embodiments described above can be considered, for example, as the properties of the installation mechanism of the double torsion spring in the optical sighting device **10** of a riflescope or the like. In addition, the properties can be considered as corresponding to the properties of the adjustment method of the optical sighting device **10**. In such case, regarding the method for adjusting the optical sighting device **10**, it can be considered as a method for making adjustment while biasing the movable cylinder **134** by using a double torsion spring, etc. Regarding the adjustment performed for the optical sighting device **10**, the adjustment to the impact position is described mainly. Regarding this, in the optical sighting device **10**, adjustments other than the adjustment to the impact position may also be further performed. In such case, for example, the optical sighting device **10** further includes an adjustment mechanism relating to adjustments other than the adjustment to the impact position. In addition, as such adjustment mechanism, the optical sighting device **10**, for example, may further include an adjustment mechanism for adjusting the magnification ratio, an adjustment mechanism for adjusting the focus, an adjustment mechanism for adjusting illumination, etc.

INDUSTRIAL UTILITY

[0046] The invention can be appropriately used in an optical sighting device, etc., for example.

Claims

1. An optical sighting device, installed to a firearm to be used, the optical sighting device comprising: an objective system part, forming an inverted image of a target object serving as a target of sighting on a first focal plane; an erect system part, forming an erect image obtained by reversing the inverted image on a second focal plane; and an adjustment mechanism, performing adjustment with respect to the erect system part, wherein the erect system part has: a lens, arranged between the first focal plane and the second focal plane; and an erect system cylinder, as a cylindrical body holding the lens, wherein the adjustment mechanism is a mechanism that performs adjustment to tilting an axial direction of the erect system cylinder, and has: an advancing-retracting member that advances and retracts on an end side of the erect system cylinder; and a double torsion spring, biasing the erect system cylinder toward the advancing-retracting member.

2. The optical sighting device as claimed in claim 1, wherein the adjustment mechanism further has a spring fixing part, fixing an end and an other end of the double torsion spring to a cylindrical body different from the erect system cylinder.

3. The optical sighting device as claimed in claim 2, wherein the different cylindrical body is a lens holder holding at least a portion of a lens in the objective system part.

4. The optical sighting device as claimed in claim 2, wherein the spring fixing part has a spring end fixing plate for each of the end and the other end of the double torsion spring, the spring end fixing plate is a plate-shaped body fixed to an outer surface of a spring fixing cylindrical body that is the different cylindrical body by sandwiching the end of the double torsion spring with an outer surface of the spring fixing cylindrical body, the spring end fixing plate has: a plate-shaped part is a plate-shaped portion fixed along the outer surface of the spring fixing cylindrical body; and a protrusion part, protruding from the plate-shaped part, and in a state in which the protrusion part is inserted into a coil part, which is a portion on which a wiring material is wound, in the double torsion spring, the spring end fixing plate is fixed to the outer surface of the spring fixing cylindrical body.

5. The optical sighting device as claimed in claim 4, wherein the spring fixing part further has a screw fixing the plate-shaped part of the spring end fixing plate onto the outer surface of the spring fixing cylindrical body, the plate-shaped part has: a cylindrical body side surface, which is a surface facing a side of the spring fixing cylindrical body at a time of being fixed to the spring

fixing cylindrical body; and an outer side surface, which is a surface on a back side of the cylindrical body side surface, and a screw hole penetrating through from the outer side surface toward the cylindrical body side surface is formed as a hole through which the screw passes, and the screw is inserted into the screw hole from a side of the outer side surface in the plate-shaped part.

6. The optical sighting device as claimed in claim 4, wherein a concave part accommodating the plate-shaped part is formed on the outer surface of the spring fixing cylindrical body, and at a biasing time of biasing the erect system cylinder by using the double torsion spring, the end of the double torsion spring is pressed against a wall surface of the concave part.

7. The optical sighting device as claimed in claim 4, wherein the spring end fixing plate used for fixing the end of the double torsion spring and the spring end fixing plate used for fixing the other end of the double torsion spring are fixed at positions facing each other by sandwiching a center of a circle of a cross-section orthogonal to an axial direction of the spring fixing cylindrical body on the outer surface of the spring fixing cylindrical body.

8. The optical sighting device as claimed in claim 1, wherein the adjustment mechanism is a mechanism that performs adjustment to an impact position by tilting an axial direction of the erect system cylinder, and the adjustment mechanism further has: an upper-lower adjustment operation part, receiving, from a user, an operation that performs adjustment to the impact position in an upper-lower direction; and a left-right adjustment operation part, receiving, from the user, an operation that performs adjustment to the impact position in a left-right direction, as the advancing-retracting member, an upper-lower advancing-retracting shaft, which is the advancing-retracting member that is shaft-like and advances and retracts in the upper-lower direction in accordance with the operation of the user with respect to the upper-lower adjustment operation part, and a left-right advancing-retracting shaft, which is the advancing-retracting member that is shaft-like and advances and retracts in the left-right direction in accordance with the operation of the user with respect to the left-right adjustment operation part are provided, and the double torsion spring biases the erect system cylinder with respect to both the upper-lower advancing-retracting shaft and the left-right advancing-retracting shaft.