

DESCRIPTION

TITLE OF INVENTION: SHOCK-ABSORBING DEVICE

TECHNICAL FIELD

5 [0001]

The present disclosure relates to a shock-absorbing device.

Priority is claimed on Japanese Patent Application No. 2023-183381, filed October 25, 2023, the content of which is incorporated herein by reference.

BACKGROUND ART

10 [0002]

Disclosed in Patent Document 1 is an operation device for a gear-type transmission having a shock-absorbing function. The operation device includes a fork shaft, a locking member, a shift fork, and spring means. The fork shaft reciprocates in a direction along an axis. Two locking members are provided on an outer periphery of the fork shaft with a gap provided therebetween in the direction along the axis. A proximal portion of the shift fork is supported by the fork shaft to be movable between the two locking members in the direction along the axis, and a distal end portion of the shift fork moves a sleeve in the direction along the axis, the sleeve switching between transmission gears. A pair of spring means is interposed between both axial sides of the proximal portion of the shift fork and the locking members. That is, the fork shaft is sandwiched by the pair of spring means in the direction along the axis. The pair of spring means elastically positions and holds the shift fork with respect to the fork shaft. Accordingly, transmission of an impact load between a shaft and the shift fork is suppressed.

25 Citation List

Patent Document

[0003]

Patent Document 1: Japanese Unexamined Patent Application, First Publication
No. 2012-47230

5 SUMMARY OF INVENTION

Technical Problem

[0004]

However, in the case of the device disclosed in Patent Document 1, the fork shaft comes into contact in a hole of the shift fork and the fork shaft becomes unable to
10 relatively move in the direction along the axis due to strong friction in a case where the fork shaft and the shift fork are relatively inclined. Accordingly, there is a problem in that a shock-absorbing function of the spring means is lost.

[0005]

The present disclosure has been provided to solve the above-described problem,
15 and an object of the present disclosure is to provide a shock-absorbing device that can favorably exhibit a shock-absorbing function.

Solution to Problem

[0006]

In order to solve the above-described problem, a shock-absorbing device
20 according to the present disclosure includes a base portion, a guide bar that is connected to the base portion and that extends in a direction along an axis, a supporting target body that is disposed along the guide bar and that is configured to move relative to the base portion in the direction along the axis, a slider that is fixed to the supporting target body and that is configured to slide with respect to the guide bar in the direction along the axis,
25 and a spring member that is configured to urge the slider against movement of the slider,

and the slider includes a bush that is configured to automatically align a relative angle with respect to the axis, with respect to the guide bar.

Advantageous Effects of Invention

[0007]

5 According to a shock-absorbing device of the present disclosure, it is possible to favorably exhibit a shock-absorbing function.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

 [FIG. 1] A schematic configuration diagram of a shock-absorbing device
10 according to a first embodiment of the present disclosure.

 [FIG. 2] A cross-sectional view along line II-II of FIG. 1.

 [FIG. 3] A cross-sectional view of a slider along line III-III of FIG. 2.

 [FIG. 4] A cross-sectional view along line IV-IV of FIG. 1.

 [FIG. 5] A cross-sectional view of a centering mechanism according to a second
15 embodiment of the present disclosure as seen in a circumferential direction with respect to a center axis of a supporting target body.

 [FIG. 6] A cross-sectional view of the centering mechanism according to the second embodiment of the present disclosure as seen in a direction along the center axis of the supporting target body.

20 [FIG. 7] A cross-sectional view of a centering mechanism according to a third embodiment of the present disclosure as seen in the circumferential direction with respect to the center axis of the supporting target body.

 [FIG. 8] A cross-sectional view of the centering mechanism according to the third embodiment of the present disclosure as seen in the direction along the center axis
25 of the supporting target body.

[FIG. 9] A cross-sectional view of a centering mechanism according to a modification example of the third embodiment of the present disclosure as seen in the circumferential direction with respect to the center axis of the supporting target body.

[FIG. 10] A cross-sectional view of the centering mechanism according to the
5 modification example of the third embodiment of the present disclosure as seen in the direction along the center axis of the supporting target body.

[FIG. 11] A cross-sectional view of a centering mechanism according to a fourth embodiment of the present disclosure as seen in a circumferential direction with respect to a center axis of a supporting target body.

10 [FIG. 12] A cross-sectional view of the centering mechanism according to the fourth embodiment of the present disclosure as seen in a direction along the center axis of the supporting target body.

DESCRIPTION OF EMBODIMENTS

[0009]

15 <First Embodiment>

Hereinafter, a shock-absorbing device 100 according to a first embodiment of the present disclosure will be described with reference to FIGS. 1 to 4.

The shock-absorbing device 100 is used for buffering a device on which an impact load acts during operation. In the present embodiment, the shock-absorbing
20 device 100 is installed in a furnace 1 for coal, petroleum, waste, or the like. A container 2 of the furnace 1 is formed in, for example, a rectangular parallelepiped-like shape. In the container 2, deposits are likely to be generated due to accumulation of particles of soot, ash, minerals, or other combustion products and by-products of combustion. Adhesion of such particles may reduce the processing performance of the furnace 1 and
25 may cause damage. Therefore, the container 2 of the present embodiment is provided

with a combustion tube (a supporting target body 20 which will be described later). The combustion tube emits a pressure wave into the container 2 to remove the deposits in the container 2 and to clean the inside of the container 2. When the combustion tube generates a pressure wave, a large impact acts on the combustion tube as a reaction.

- 5 The shock-absorbing device 100 of the present embodiment is installed to absorb the impact acting on the combustion tube.

[0010]

(Configuration of Shock-Absorbing Device)

- As shown in FIG. 1, the shock-absorbing device 100 includes a base portion 3,
10 an attachment wall portion 4, guide bars 10, the supporting target body 20, a supporting mechanism 30, retaining members 5, a flange 6, sliders 40, spring members 7, and centering mechanisms 60.

[0011]

(Base Portion)

- 15 The base portion 3 of the present embodiment is a wall portion of the container 2 of the furnace 1 described above and extends in a vertical direction. The base portion 3 is provided with an opening portion 3a that penetrates the base portion 3 in a horizontal direction. The opening portion 3a is formed in a circular shape.

[0012]

- 20 (Attachment Wall Portion)

- The attachment wall portion 4 is disposed outside the container 2 and is attached to the base portion 3. The attachment wall portion 4 extends in the vertical direction and is formed in an annular shape with an opening portion 4a that penetrates the attachment wall portion 4 in the horizontal direction. The opening portion 4a is formed
25 in a circular shape. The center of the opening portion 4a of the attachment wall portion

4 coincides with the center of the opening portion 3a of the base portion 3 when viewed in a direction along axes O which will be described later. In addition, the diameter of the opening portion 4a of the attachment wall portion 4 is smaller than the diameter of the opening portion 3a of the base portion 3.

5 [0013]

(Guide Bars)

The guide bars 10 are indirectly connected to the base portion 3 via the attachment wall portion 4. In addition, as shown in FIG. 2, a plurality of (four in an example shown in the drawing) guide bars 10 are provided to surround the opening
10 portion 4a from an outer peripheral side (a radially outer side with respect to a center axis O1 which will be described later). The plurality of guide bars 10 are disposed at equal intervals on the same circle C1. That is, the plurality of guide bars 10 are disposed at equal intervals in a circumferential direction with respect to the center axis O1.

[0014]

15 The guide bars 10 extend in the direction along the axes O of the guide bars 10. The axes O of the guide bars 10 extend in the same direction as a direction in which the center axis of the opening portion 3a of the base portion 3 extends. Hereinafter, the axes O of the guide bars 10 may be simply referred to as the "axes O". In addition, unless otherwise specified, a radial direction with respect to the axes O of the guide bars
20 10 will be simply referred to as a "radial direction", and a circumferential direction with respect to the axes O of the guide bars 10 will be simply referred to as a "circumferential direction".

[0015]

Each of the guide bars 10 of the present embodiment is formed in a shaft-like shape extending in the direction along the axes O. Each guide bar 10 includes a guide bar main body 11 and locking members 12.

The guide bar main body 11 is formed in a columnar shape extending in the direction along the axes O. An end portion of the guide bar main body 11 that is on the base portion 3 side in the direction along the axes O is provided with a fixed end 13. A screw portion is formed on an outer peripheral surface of the fixed end 13. The fixed end 13 is screwed into the attachment wall portion 4 and the base portion 3 in the direction along the axes O. In this manner, the guide bar 10 is fixed to the base portion 3.

[0016]

Each of both sides of the guide bar 10 in the direction along the axes O is provided with one locking member 12. That is, two locking members 12 are provided at an interval in the direction along the axes O. The locking member 12 on the base portion 3 side in the direction along the axes O abuts against the attachment wall portion 4 in the direction along the axes O.

[0017]

(Supporting Target Body)

The supporting target body 20 is disposed along the guide bars 10. The supporting target body 20 is provided to be relatively movable with respect to the base portion 3 in the direction along the axes O.

[0018]

The supporting target body 20 of the present embodiment is a combustion tube for pressure wave cleaning of the furnace 1 described above. The supporting target body 20 includes a tubular portion 21 and an outer ring 22. The tubular portion 21 is

formed in a cylindrical shape extending in the direction along the axes O. The supporting target body 20 is installed horizontally such that the center axis O1 of the tubular portion 21 extends in the direction along the axes O. In addition, the length of the tubular portion 21 in the direction along the axes O is larger than the lengths of the guide bars 10 in the direction along the axes O. An end portion of the tubular portion 21 that is on the base portion 3 side in the direction along the axes O is inserted into the opening portion 4a of the attachment wall portion 4 and the opening portion 3a of the base portion 3, and is positioned inside the container 2. The outer ring 22 is provided to surround an outer peripheral surface of the tubular portion 21 from an outer peripheral side. The outer ring 22 is provided at a position that is more separated from the base portion 3 in the direction along the axes O than two locking members 12 are.

[0019]

(Supporting Mechanism)

The supporting mechanism 30 includes fixation tools 31 and wires 32. The fixation tools 31 are fixed to an upper surface of the tubular portion 21. A plurality of (two in the example shown in the drawing) fixation tools 31 are provided at intervals in the direction along the axes O. The number of the fixation tools 31 can be changed as appropriate. It is not necessary that a plurality of fixation tools 31 is provided. Two fixation tools 31 are disposed at positions at which the outer ring 22 of the tubular portion 21 is interposed between the fixation tools 31 in the direction along the axes O. The wire 32 extends upward from each fixation tool 31. The supporting mechanism 30 supports the supporting target body 20 with the supporting target body 20 hung by means of the wires 32.

[0020]

(Retaining Members)

Each of the retaining members 5 is provided at an end portion of a main body of the guide bar 10 that is on a side opposite to the base portion 3 in the direction along the axes O while being provided at a position at which the retaining member 5 overlaps with the outer ring 22 of the supporting target body 20 in the radial direction. The retaining member 5 is a so-called shaft retainer and is provided to retain the supporting target body 20 from an outer peripheral side. The retaining member 5 is disposed with a slight gap provided between the retaining member 5 and the outer ring 22 and is provided to be relatively slidable with respect to the supporting target body 20.

[0021]

10 (Flange)

The flange 6 is formed in an annular shape that projects from the outer peripheral surface of the tubular portion 21. The flange 6 is disposed at a position at which the flange 6 is interposed between two locking members 12 in the direction along the axes O, the two locking members 12 being separated from each other in the direction along the axes O. Specifically, the flange 6 is provided between the fixation tool 31 on the base portion 3 side in the direction along the axes O and the tubular portion 21 of the supporting target body 20. A plurality of (four in the example shown in the drawing) fitting grooves 6a are provided at the flange 6 at intervals in the circumferential direction with respect to the center axis O1 of the tubular portion 21. Each fitting groove 6a is open outward in the radial direction with respect to the center axis O1 of the tubular portion 21.

[0022]

(Slider)

The sliders 40 are fixed to the supporting target body 20. Furthermore, the sliders 40 are provided to be slidable with respect to the guide bars 10 in the direction along the axes O.

[0023]

5 In the present embodiment, one slider 40 is provided for each guide bar 10. That is, four sliders 40 are provided in total. Each slider 40 is fitted into the fitting groove 6a of the flange 6. As shown in FIG. 3, the slider 40 includes a bush 41 and an outer tubular portion 42.

[0024]

10 (Bush)

The bush 41 is a member having a function of enabling automatic alignment (automatic adjustment) of a relative angle θ with respect to the axis O of the guide bar 10, with respect to the guide bar 10. The bush 41 of the present embodiment is a so-called spherical bush. The bush 41 includes an inner member 43 and an outer member
15 44.

The inner member 43 is an annular member and is inserted onto the guide bar 10. The inner member 43 covers the guide bar 10 from an outer peripheral side. In addition, the inner member 43 is attached to an outer peripheral surface of the guide bar 10 to be slidable in the direction along the axes O. Specifically, an inner surface 43a of
20 the inner member 43 that is on a radially inner side is in contact with the outer peripheral surface of the guide bar 10 to be slidable. In addition, the inner member 43 includes a spherical surface 43b formed to project radially outward on the outer peripheral side.

[0025]

The outer member 44 is an annular member and covers the inner member 43
25 from the outer peripheral side. Furthermore, the outer member 44 is attached to the

inner member 43 to be slidable along the spherical surface 43b. Specifically, an inner surface 44a of the outer member 44 that is on the radially inner side is in contact with the spherical surface 43b of the inner member 43 to be slidable. The relative angle θ with respect to the axis O can be automatically aligned with the outer member 44 sliding with respect to the inner member 43.

In addition, the outer member 44 is fixed to the supporting target body 20 via the flange 6 and the outer tubular portion 42 which will be described later.

[0026]

A center axis O2 of the outer member 44 extends along the axis O of the guide bar 10. In addition, the center axis O2 of the outer member 44 extends in the same direction as a direction in which the center axis O1 of the supporting target body 20 extends. The outer member 44 is fixed to the supporting target body 20. Therefore, when the supporting target body 20 is inclined with respect to the axis O, the outer member 44 is inclined with respect to the axis O at the same relative angle θ as the supporting target body 20. That is, the relative angle θ between the center axis O2 of the outer member 44 and the axis O of the guide bar 10 coincides with a relative angle between the axis O of the guide bar 10 and the center axis O1 of the supporting target body 20. In the present embodiment, the relative angle θ with respect to the axis O that can be automatically adjusted by the slider 40 means an angle between the center axis O2 of the outer member 44 of the bush 41 and the axis O of the guide bar 10.

[0027]

(Outer Tubular Portion)

The outer tubular portion 42 is a cylindrical member and covers the outer member 44 of the bush 41 from the radially outer side.

An inner peripheral groove 42a is formed over the entire circumference on an inner peripheral surface of the outer tubular portion 42. The outer member 44 of the bush 41 is fitted into the inner peripheral groove 42a from the radially inner side. A bottom surface of the inner peripheral groove 42a is in contact with an outer surface 44b of the outer member 44 without a gap.

[0028]

An outer peripheral groove 42b is formed over the entire circumference on an outer peripheral surface of the outer tubular portion 42. The outer peripheral groove 42b is fitted into the fitting groove 6a of the flange 6, so that the slider 40 is fixed to the flange 6.

An end surface groove 42c is formed on each of end surfaces of the outer tubular portion 42 that are on both sides in the direction along the axes O. The end surface groove 42c is formed in a circular shape as seen in the direction along the axes O.

[0029]

In addition, from another point of view, the outer tubular portion 42 includes a main body portion 45 and an attached piece 46.

The main body portion 45 includes a first member 45a, a second member 45b, and a third member 45c.

The first member 45a is formed in an annular shape. Each of both end portions of the first member 45a in the direction along the axes O is positioned outward of the flange 6 in the direction along the axes O, with respect to the flange 6. The outer peripheral groove 42b is formed on an outer peripheral surface of the first member 45a.

[0030]

The second member 45b is formed in an annular shape to project radially inward from an inner peripheral surface of the first member 45a.

The third member 45c is provided on an inner peripheral surface of the second member 45b while being provided at an end portion on a side opposite to the base portion 3 in the direction along the axes O. The third member 45c is formed in an annular shape to project radially inward from the inner peripheral surface of the second member 45b. One end surface groove 42c is formed by end surfaces of the second member 45b and the third member 45c that are on the side opposite to the base portion 3 in the direction along the axes O and the inner peripheral surface of the first member 45a.

The first member 45a, the second member 45b, and the third member 45c are integrally formed with each other to form the main body portion 45.

10 [0031]

The attached piece 46 is attached to an end portion of the main body portion 45 that is on the base portion 3 side in the direction along the axes O. The attached piece 46 includes a ring portion 46a and a flange portion 46b.

The ring portion 46a is an annular member that abuts against the second member 45b of the main body portion 45 from the radially inner side. The ring portion 46a protrudes to be closer to the base portion 3 side in the direction along the axes O than the second member 45b is.

The flange portion 46b is provided on an outer peripheral surface of the ring portion 46a while being provided at an end portion on the base portion 3 side in the direction along the axes O. The flange portion 46b projects radially outward from the outer peripheral surface of the ring portion 46a. The flange portion 46b abuts against the second member 45b in the direction along the axes O and abuts against the inner peripheral surface of the first member 45a from the radially inner side.

The ring portion 46a and the flange portion 46b are integrally formed with each other to form the attached piece 46.

[0032]

The inner peripheral groove 42a of the outer tubular portion 42 is formed by the inner peripheral surface of the second member 45b, the end surface of the third member 45c that is on the base portion 3 side in the direction along the axes O, and an end surface of the attached piece 46 that is on the side opposite to the base portion 3 in the direction along the axes O.

The end surface groove 42c is formed by the inner peripheral surface of the first member 45a and the end surface of the attached piece 46 that is on the base portion 3 side in the direction along the axes O.

10 [0033]

The attached piece 46 is provided to be attachable to and detachable from the main body portion 45 in the direction along the axes O. For example, the attached piece 46 may be removed from the main body portion 45 when the bush 41 is to be fitted into the inner peripheral groove 42a.

15 [0034]

(Spring Members)

The spring members 7 urge the slider 40 against movement of the slider 40.

The spring members 7 of the present embodiment are coil springs that are expandable and contractible in the direction along the axes O. The guide bar 10 is inserted through

20 the spring members 7. The spring members 7 are provided on both sides in the direction along the axes O with one slider 40 interposed therebetween. End portions of the spring members 7 that are on the slider 40 side in the direction along the axes O are fixed in the end surface grooves 42c of the outer member 44. End portions of the spring members 7 that are on sides opposite to the slider 40 in the direction along the axes O are
25 fixed to the locking members 12.

[0035]

When the supporting target body 20 generates a pressure wave toward the container 2 of the furnace 1 in the direction along the axes O, an impact load in the direction along the axes O acts on the supporting target body 20 as a reaction. The impact load is transmitted to the slider 40 and the spring members 7 through a load path L as shown in FIG. 3. As a result, the slider 40 moves in the direction along the axes O along the guide bar 10. Then, the spring members 7 expand and contract in the direction along the axes O and urge the slider 40 and the supporting target body 20 in such a direction that the impact load is canceled out. In this way, the impact load is attenuated.

[0036]

(Centering Mechanism)

In addition, as shown in FIG. 4, the centering mechanisms 60 are fixed to the base portion 3 and are disposed outside the supporting target body 20. The centering mechanisms 60 are provided to be capable of coming into contact with the supporting target body 20 in a direction intersecting the direction along the axes O and to be capable of sliding relative to the supporting target body 20 in the direction along the axes O. Specifically, the centering mechanisms 60 are fixed to the base portion 3 via the attachment wall portion 4. In addition, the centering mechanisms 60 are disposed on an outer peripheral side (a radially outer side with respect to the center axis O1) of the supporting target body 20, and a plurality of (four in the example shown in the drawing) centering mechanisms 60 are provided around the supporting target body 20. The plurality of centering mechanisms 60 are disposed at equal intervals on the same circle C2. That is, the plurality of centering mechanisms 60 are disposed at equal intervals in the circumferential direction with respect to the center axis O1. The circle C2 on which

the plurality of centering mechanisms 60 are positioned is positioned inside the circle C1 on which the plurality of guide bars 10 are positioned. More specifically, one centering mechanism 60 is provided on each of both sides of the supporting target body 20 in the vertical direction and each of both sides of the supporting target body 20 in a horizontal direction orthogonal to the direction along the axes O (both sides of the supporting target body 20 in a lateral direction).

[0037]

(Action and Effect)

In the present embodiment, the shock-absorbing device 100 includes the base portion 3, the guide bars 10, the supporting target body 20, the sliders 40, and the spring members 7. The guide bars 10 are connected to the base portion 3 and extend in the direction along the axes O. The supporting target body 20 is disposed along the guide bars 10 and is provided to be movable relative to the base portion 3 in the direction along the axes O. The sliders 40 are fixed to the supporting target body 20 and are provided to be slidable with respect to the guide bars 10 in the direction along the axes O. The spring members 7 urge the sliders 40 against movement of the sliders 40. Furthermore, the sliders 40 include the bushes 41 that can automatically align the relative angle θ with respect to the axes O, with respect to the guide bars 10.

[0038]

Since the sliders 40 move along the guide bars 10 in the direction along the axes O, the supporting target body 20 can be made less likely to be shifted in a direction intersecting the direction along the axes O. Accordingly, it is possible to maintain the posture of the supporting target body 20 while allowing movement of the supporting target body 20 in the direction along the axes O. Therefore, it is possible to suppress strong contact between the supporting target body 20 and the base portion 3 in the

direction intersecting the direction along the axes O. That is, it is possible to avoid the occurrence of strong friction between the supporting target body 20 and the base portion

3. Furthermore, the bushes 41 of the sliders 40 enable automatic alignment of the relative angle θ with respect to the axes O, with respect to the guide bars 10.

- 5 Accordingly, even in a case where the axes O of the guide bars 10 and the center axes O2 of the sliders 40 are not completely parallel to each other, the sliding motion of the sliders 40 is not hindered. Therefore, even in a state where the posture of the supporting target body 20 is slightly inclined, the sliders 40 can move relative to the guide bars 10 and the spring members 7 can also expand and contract in the direction along the axes O.
- 10 Therefore, the spring members 7 can urge the supporting target body 20 in a direction opposite to the direction of an impact load regardless of the posture of the supporting target body 20, so that a shock-absorbing function can be favorably exhibited.

Furthermore, the automatic alignment function of the bushes 41 makes it unnecessary to perform alignment adjustment during installation of the shock-absorbing

15 device 100. Alternatively, it is possible to lower alignment accuracy required during installation of the shock-absorbing device 100, and it is possible to easily adjust the alignment of the shock-absorbing device 100.

[0039]

- In the present embodiment, each bush 41 includes the inner member 43 and the
- 20 outer member 44. The inner member 43 covers the guide bar 10 from an outer peripheral side, is attached to the outer peripheral surface of the guide bar 10 to be slidable in the direction along the axes O, and includes the spherical surface 43b formed on the outer peripheral side. The outer member 44 covers the inner member 43 from the outer peripheral side, is attached to the inner member 43 to be slidable along the
- 25 spherical surface 43b, and is fixed to the supporting target body 20.

[0040]

The inner member 43 is attached to the guide bar 10 to be slidable in the direction along the axes O. Therefore, the slider 40 is allowed to move in the direction along the axes O along the guide bar 10. Furthermore, the outer member 44 is allowed to move relative to the inner member 43 along the spherical surface 43b. Accordingly, the bush 41 can automatically adjust inclination with respect to the axis O. Therefore, even in a case where the supporting target body 20 is inclined with respect to the axis O, the inclination is automatically canceled out since the outer member 44 slides along the spherical surface 43b of the inner member 43. In addition, it is possible to suppress generation of a local frictional force which is caused by contact between the outer member 44 and the guide bar 10. Therefore, the slider 40 can smoothly move along the guide bar 10.

[0041]

In the present embodiment, the supporting target body 20 is formed in a tubular shape extending in the direction along the axes O.

[0042]

As a result, it is easy to evenly dispose the sliders 40 around the supporting target body 20. Therefore, it is possible to easily improve the accuracy of installation of the shock-absorbing device 100. Furthermore, since the supporting target body 20 is hollow, the weight of the shock-absorbing device 100 can be reduced.

[0043]

In the present embodiment, the shock-absorbing device 100 further includes the centering mechanisms 60 that are fixed to the base portion 3, are disposed outside the supporting target body 20, are capable of coming into contact with the supporting target

body 20 in the direction intersecting the direction along the axes O, and are slidable relative to the supporting target body 20 in the direction along the axes O.

[0044]

Accordingly, the posture of the supporting target body 20 can be adjusted to
5 extend along the guide bars 10 by means of the centering mechanisms 60. Furthermore, it is possible to suppress runout of the supporting target body 20 in the direction intersecting the direction along the axes O.

When an impact load acts on the supporting target body 20 in a state where the supporting target body 20 is hung in midair as in the present embodiment, there is runout
10 (yaw or pitch) of the supporting target body 20 around the center of gravity of the supporting target body 20. In the present embodiment, the centering mechanisms 60 are fixed to the base portion 3 at which an end portion of the supporting target body 20 in the direction along the axes O is positioned. That is, the centering mechanisms 60 are fixed at positions that are separated from the center of gravity of the supporting target body 20
15 in the direction along the axes O. Therefore, it is possible to favorably suppress runout of the supporting target body 20 around the center of gravity of the supporting target body 20.

In addition, the base portion 3 to which the centering mechanisms 60 are fixed is a stable and firm wall portion constituting the container 2 of the furnace 1. Therefore,
20 the centering mechanisms 60 can receive a contact reaction force caused by runout of the supporting target body 20 with high supporting stiffness.

[0045]

In the present embodiment, coil springs are used as the spring members 7.

Accordingly, the cost of manufacturing the shock-absorbing device 100 can be
25 reduced.

[0046]

<Second Embodiment>

Hereinafter, a shock-absorbing device 200 according to a second embodiment of the present disclosure will be described with reference to FIGS. 5 and 6. The same configurations as those in the above-described embodiment are denoted by the same names and the same reference numerals, and the description thereof will be omitted as appropriate.

[0047]

In the present embodiment as well, one centering mechanism 260 is provided on each of both sides of the supporting target body 20 in the vertical direction and each of both sides of the supporting target body 20 in the horizontal direction orthogonal to the direction along the axes O (both sides of the supporting target body 20 in a lateral direction). The centering mechanisms 260 of the present embodiment are so-called leveling blocks. Each centering mechanism 260 includes a casing 261, a first block 262, a second block 263, a first bolt 264, second bolts 265, and a sliding portion 270.

The casing 261 is fixed to the base portion 3 via the attachment wall portion 4. The casing 261 is fixed to an end surface of the attachment wall portion 4 that is on the side opposite to the base portion 3 in the direction along the axes O. A storage recess portion 261a open on the supporting target body 20 side is formed in the casing 261.

[0048]

The first block 262 is stored in the storage recess portion 261a. The entire first block 262 is disposed in the storage recess portion 261a. The first block 262 is stored in the storage recess portion 261a with empty spaces provided on both sides in the direction along the axes O. Accordingly, the first block 262 is movable in the direction along the axes O in the storage recess portion 261a. An inner surface 262a of the first block 262

that faces the supporting target body 20 side is formed in a planar shape that gradually becomes closer to the supporting target body 20 side toward the base portion 3 side in the direction along the axes O.

[0049]

5 The second block 263 is stored in the storage recess portion 261a and is mounted on the first block 262. Both end surfaces of the second block 263 in the direction along the axes O abut against inner surfaces of the storage recess portion 261a. The second block 263 protrudes toward the supporting target body 20 side from the storage recess portion 261a. The second block 263 includes a main body portion 263a
10 and a protrusion portion 263b. The main body portion 263a is mounted on the first block 262. An outer surface 263c of the main body portion 263a that faces a side opposite to the supporting target body 20 is formed in a planar shape that gradually becomes closer to the supporting target body 20 side toward the base portion 3 side in the direction along the axes O. The outer surface 263c of the main body portion 263a is
15 formed along the inner surface 262a of the first block 262. The protrusion portion 263b protrudes toward the side opposite to the base portion 3 in the direction along the axes O from an end portion of the main body portion 263a that is on the supporting target body 20 side. The protrusion portion 263b and the main body portion 263a are integrally formed with each other to form one second block 263.

20 [0050]

 The first bolt 264 is inserted in a direction from a bottom surface of the casing 261 to the supporting target body 20 side (radially inward with respect to the center axis O1). The first bolt 264 penetrates the casing 261 and the first block 262, and a distal end portion thereof is screwed into the second block 263. A screw portion is formed on
25 an outer peripheral surface of the first bolt 264.

[0051]

The second bolts 265 are inserted in a direction from a side surface of the casing 261 to the base portion 3 in the direction along the axes O, the side surface being on the side opposite to the base portion 3 in the direction along the axes O. The second bolts 5 265 penetrate the casing 261, and the first bolt 264 is inserted into distal end portions thereof. The second bolts 265 are disposed on both sides in the circumferential direction with respect to the center axis O1, with respect to the first bolt 264. Screw portions are formed on outer peripheral surfaces of the second bolts 265.

[0052]

10 The sliding portion 270 is disposed to face the supporting target body 20. The sliding portion 270 is a member that is slidable in the direction along the axes O with respect to the supporting target body 20 and that is flexibly deformable. The sliding portion 270 of the present embodiment is a sliding material 271 having lower stiffness than the supporting target body 20, and is formed in a flat plate-like shape. Examples of 15 the sliding material 271 include polytetrafluoroethylene (PTFE).

[0053]

A surface of the sliding material 271 that faces the supporting target body 20 is formed in a shape extending along an outer peripheral surface of the supporting target body 20. The sliding material 271 has a structure that is designed in advance on an 20 assumption that the sliding material 271 will be worn as the sliding material 271 slides along the supporting target body 20. For example, a thickness t of the sliding material 271 is set to be large enough to maintain a sliding function of the centering mechanism 260 even in a case where the sliding material 271 is worn as the sliding material 271 slides along the supporting target body 20. In addition, a block material that is less 25 likely to be worn may also be adopted as the sliding material 271.

[0054]

In the present embodiment, the position of the sliding portion 270 with respect to the supporting target body 20 can be adjusted. Hereinafter, an example of a method for positional adjustment of the sliding portion 270 will be described.

5 The first block 262 moves in the direction along the axes O when the second bolts 265 are rotated. Accordingly, the second block 263 approaches the supporting target body 20 or is separated from the supporting target body 20. Since the sliding portion 270 is mounted on the second block 263, the sliding portion 270 approaches the supporting target body 20 or is separated from the supporting target body 20 as the
10 second block 263 approaches the supporting target body 20 or is separated from the supporting target body 20. After the position of the sliding portion 270 is adjusted, the first bolt 264 is inserted to fix the positions of the first block 262 and the second block 263. Accordingly, the position of the sliding portion 270 is fixed. Through the above-described procedure, the position of the sliding portion 270 with respect to the supporting
15 target body 20 is adjusted.

[0055]

(Action and Effect)

In the second embodiment as well, the same configurations as those in the first embodiment described above can exhibit the same operations and effects.

20 In the present embodiment, the centering mechanism 260 may include the sliding portion 270 that is disposed to face the supporting target body 20, that is slidable relative to the supporting target body 20, and that is more flexibly deformable than the supporting target body 20.

 Accordingly, it is possible to impart, to the centering mechanism 260, slidability
25 with respect to the supporting target body 20 with a simple configuration.

[0056]

The sliding portion 270 of the present embodiment is the sliding material 271 having lower stiffness than the supporting target body 20 as in the present embodiment.

Accordingly, damage to the supporting target body 20 can be avoided when
5 there is a slide between the supporting target body 20 and the centering mechanism 260.

[0057]

<Third Embodiment>

Hereinafter, a shock-absorbing device 300 according to a third embodiment of the present disclosure will be described with reference to FIGS. 7 and 8. The same
10 configurations as those in the above-described embodiment are denoted by the same names and the same reference numerals, and the description thereof will be omitted as appropriate.

[0058]

In the present embodiment as well, one centering mechanism 360 is provided on
15 each of both sides of the supporting target body 20 in the vertical direction and each of both sides of the supporting target body 20 in the horizontal direction orthogonal to the direction along the axes O (both sides of the supporting target body 20 in the lateral direction). In the present embodiment, each centering mechanism 360 further includes a second spring member 361 in addition to the casing 261, the first block 262, the second
20 block 263, the first bolt 264, the second bolts 265, and the sliding portion 270.

An inner surface of the second block 263 in the present embodiment that faces the supporting target body 20 side is flush with an inner surface of the casing 261 that faces the supporting target body 20.

[0059]

The second spring member 361 urges the sliding portion 270 with respect to the supporting target body 20 in a direction intersecting the direction along the axes O. In the present embodiment, the second spring member 361 is provided on the outer peripheral side of the supporting target body 20 while being provided between the second block 263 and the sliding portion 270. That is, the second spring member 361 is positioned on a side opposite to the supporting target body 20 with the sliding portion 270 interposed therebetween. The second spring member 361 urges the sliding portion 270 and presses the sliding portion 270 against the supporting target body 20.

Examples of the second spring member 361 include an elastic material such as rubber or urethane, a disc spring, a bump foil, and a mesh foil.

[0060]

(Action and Effect)

In the third embodiment as well, the same configurations as those in the first and second embodiments described above can exhibit the same operations and effects.

In the present embodiment, the centering mechanism 360 further includes the second spring member 361 that urges the sliding portion 270 with respect to the supporting target body 20 in a direction intersecting the direction along the axes O.

[0061]

Accordingly, it is possible to attenuate an impact that is caused when there is runout of the supporting target body 20 and the supporting target body 20 comes into contact with the sliding portion 270 of the centering mechanism. In addition, it is possible to apply pre-compression to the sliding portion 270 and press the sliding portion 270 against the supporting target body 20 with the second spring member 361.

Accordingly, the supporting target body 20 and the sliding portion 270 can always be in

contact with each other, and friction can always be applied to the supporting target body

20. Therefore, runout of the supporting target body 20 can be quickly reduced. In addition, even when the sliding portion 270 is worn and the thickness thereof is reduced, the centering mechanism 360 can urge, with the second spring member 361, the sliding portion 270 against the supporting target body 20 with the same force as before the wear of the sliding portion 270.

[0062]

In addition, as shown in FIGS. 9 and 10, a centering mechanism 360A may include, as a sliding portion 270A, a brush 271A instead of the sliding material 271, the brush 271A facing the supporting target body 20 side.

[0063]

<Fourth Embodiment>

Hereinafter, a shock-absorbing device 400 according to a fourth embodiment of the present disclosure will be described with reference to FIGS. 11 and 12. The same configurations as those in the above-described embodiment are denoted by the same names and the same reference numerals, and the description thereof will be omitted as appropriate.

[0064]

In the present embodiment as well, one centering mechanism 460 is provided on each of both sides of the supporting target body 20 in the vertical direction and each of both sides of the supporting target body 20 in the horizontal direction orthogonal to the direction along the axes O (both sides of the supporting target body 20 in the lateral direction). In the present embodiment, each centering mechanism 460 includes supporting portions 461, a rotary shaft 462, and a wheel 463 in addition to the casing 261, the first block 262, the second block 263, the first bolt 264, and the second bolts 265.

[0065]

The supporting portions 461 are provided on the inner surface of the second block 263 that faces the supporting target body 20 side. A pair of the supporting portions 461 is provided such that the supporting portions 461 are separated from each other in the circumferential direction with respect to the center axis O1. The supporting portions 461 extend toward the supporting target body 20 side. Each supporting portion 461 is formed in a triangular shape that becomes narrower toward the supporting target body 20 side as seen in the circumferential direction with respect to the center axis O1.

[0066]

The rotary shaft 462 is provided between the pair of supporting portions 461. The rotary shaft 462 connects top portions of the pair of supporting portions 461 that are on the supporting target body 20 side.

[0067]

The wheel 463 is provided between the pair of supporting portions 461. The wheel 463 is inserted onto the rotary shaft 462. The wheel 463 is provided to be rotatable about the rotary shaft 462. Accordingly, the wheel 463 can roll in the direction along the axes O while being in contact with the outer peripheral surface of the supporting target body 20.

[0068]

(Action and Effect)

In the fourth embodiment as well, the same configurations as those in the first to third embodiments described above can exhibit the same operations and effects.

In the present embodiment, the centering mechanism 460 includes the wheel 463 that is rollable in the direction along the axes O while being in contact with the supporting target body 20.

[0069]

Accordingly, since the wheel 463 is less likely to be worn than the sliding material 271, a frequency at which the wheel 463 is replaced can be significantly reduced. Therefore, the maintainability can be improved. In addition, in a case where
5 a speed at which the supporting target body 20 moves as an impact load is applied is high, an impact load applied to the centering mechanism 460 can be favorably redirected.

[0070]

(Other Embodiments)

The embodiments of the present disclosure have been described in detail with
10 reference to the accompanying drawings, but the specific configuration is not limited to the embodiments, and design changes and the like within the concept of the present disclosure are also included.

In the above-described embodiments, the shock-absorbing devices 100, 200, 300, 300A, and 400 are used for the furnace 1 for coal, petroleum, waste, and the like.
15 However, the present disclosure is not limited thereto. For example, the shock-absorbing devices 100, 200, 300, 300A, and 400 may be used for a boiler, a gasification apparatus, a reactor, a heat exchanger, a transmission, and the like.

[0071]

In the above-described embodiments, the guide bars 10 are indirectly connected
20 to the base portion 3 via the attachment wall portion 4. However, the present disclosure is not limited thereto. The attachment wall portion 4 may not be provided, and the guide bars 10 may be directly connected to the base portion 3.

[0072]

In the above-described embodiments, each of the guide bars 10 of the present
25 embodiment is formed in a shaft-like shape extending in the direction along the axes O.

However, the present disclosure is not limited thereto. The shape of the guide bars 10 can be changed as appropriate. Each of the guide bars 10 may be formed in a prism-like shape extending in the direction along the axes O, for example.

[0073]

5 In the above-described embodiments, the supporting target body 20 is formed in a cylindrical shape extending in the direction along the axes O. However, the present disclosure is not limited thereto. The shape of the supporting target body 20 can be changed as appropriate. The supporting target body 20 may be formed in a prism-like shape or a block-like shape extending in the direction along the axes O, for example.

10 [0074]

In the above-described embodiments, a case where the shock-absorbing devices 100, 200, 300, 300A, and 400 include the retaining members 5 has been described. However, the shock-absorbing devices 100, 200, 300, 300A, and 400 may not include the retaining members 5.

15 [0075]

In the above-described embodiments, the embodiments have been described using a case where the bushes 41 are spherical bushes as an example. However, the present disclosure is not limited thereto. For example, the bushes 41 may be other bushes such as rubber bushes having a function of automatically aligning (adjusting) the relative angle θ with respect to the axis O.

20 [0076]

In the present embodiment, a case where four sets of the guide bar 10 and the sliders 40 are disposed on the same circle C1 as seen in the direction along the axes O has been described. However, the present disclosure is not limited thereto. The

number and the disposition of the guide bars 10 and the sliders 40 can be changed as appropriate.

[0077]

In the present embodiment, a case where four centering mechanisms 60, 260,
5 360, 360A, and 460 are disposed on the same circle C2 as seen in the direction along the axes O has been described. However, the present disclosure is not limited thereto.

The number and the disposition of the centering mechanisms 60, 260, 360, 360A, and 460 can be changed as appropriate.

[0078]

10 <Additional Notes>

The shock-absorbing devices 100, 200, 300, 300A, and 400 described in each embodiment are understood as follows, for example.

[0079]

(1) The shock-absorbing devices 100, 200, 300, 300A, and 400 according to a
15 first aspect include the base portion 3, the guide bars 10 that are connected to the base portion 3 and that extend in the direction along the axes O, the supporting target body 20 that is disposed along the guide bars 10 and that is configured to move relative to the base portion 3 in the direction along the axes O, the sliders 40 that are fixed to the supporting target body 20 and that are configured to slide with respect to the guide bars
20 10 in the direction along the axes O, and the spring members 7 that are configured to urge the sliders 40 against movement of the sliders 40, and the sliders 40 include the bushes 41 that are configured to automatically align the relative angle θ with respect to the axes O, with respect to the guide bars 10.

Examples of the base portion 3 include a wall portion or the like of the furnace 1
25 in the above-described embodiments.

Examples of the supporting target body 20 include a combustion tube or the like in the above-described embodiments, which generates a pressure wave.

Examples of the spring members 7 include a coil spring in the above-described embodiments.

5 Examples of the bushes 41 include a spherical bush in the above-described embodiments, a rubber bush, and the like.

[0080]

Since the sliders 40 move along the guide bars 10 in the direction along the axes O, the supporting target body 20 can be made less likely to be shifted in the direction
10 intersecting the direction along the axes O. Furthermore, the bushes 41 of the sliders 40 can automatically align the relative angle θ with respect to the axes O, with respect to the guide bars 10. Accordingly, even in a case where the axes O of the guide bars 10 and the center axes O1 of the sliders 40 are not completely parallel to each other, the sliding motion of the sliders 40 is not hindered.

15 [0081]

(2) The shock-absorbing devices 100, 200, 300, 300A, and 400 according to a second aspect are the shock-absorbing devices 100, 200, 300, 300A, and 400 according to the first aspect, in which each of the bushes 41 may include the inner member 43 that is configured to cover the guide bar 10 from an outer peripheral side, that is attached to
20 the outer peripheral surface of the guide bar 10 to be slidable in the direction along the axes O, and that includes the spherical surface 43b formed on the outer peripheral side and the outer member 44 that is configured to cover the inner member 43 from the outer peripheral side, that is attached to the inner member 43 to be slidable along the spherical surface 43b, and that is fixed to the supporting target body 20.

25 [0082]

The inner member 43 is attached to the guide bar 10 to be slidable in the direction along the axes O. Therefore, the slider 40 is allowed to move in the direction along the axes O along the guide bar. Furthermore, the outer member 44 is allowed to move relative to the inner member 43 along the spherical surface 43b. Accordingly, the bush 41 can automatically adjust inclination with respect to the axis O.

[0083]

(3) The shock-absorbing devices 100, 200, 300, 300A, and 400 according to a third aspect are the shock-absorbing devices 100, 200, 300, 300A, and 400 according to the first or second aspect, in which the supporting target body 20 may be formed in a tubular shape extending in the direction along the axes O.

[0084]

As a result, it is easy to evenly dispose the sliders 40 around the supporting target body 20. Furthermore, since the supporting target body 20 is hollow, the weight of the shock-absorbing devices 100, 200, 300, 300A, and 400 can be reduced.

[0085]

(4) The shock-absorbing devices 100, 200, 300, 300A, and 400 according to a fourth aspect are the shock-absorbing devices 100, 200, 300, 300A, and 400 according to any one of the first to third aspects and may further include the centering mechanisms 60, 260, 360, 360A, and 460 that are fixed to the base portion 3, that are disposed outside the supporting target body 20, that are configured to come into contact with the supporting target body 20 in the direction intersecting the direction along the axes O, and that are configured to slide relative to the supporting target body 20 in the direction along the axes O.

[0086]

Accordingly, the posture of the supporting target body 20 can be adjusted to extend along the guide bars by means of the centering mechanisms 60, 260, 360, 360A, and 460. Furthermore, it is possible to suppress runout of the supporting target body 20 in the direction intersecting the direction along the axes O.

5 [0087]

(5) The shock-absorbing devices 200, 300, and 300A according to a fifth aspect are the shock-absorbing devices 200, 300, and 300A according to the fourth aspect, in which the centering mechanisms 260, 360, and 360A may include the sliding portions 270 and 270A that are disposed to face the supporting target body 20, that are configured
10 to slide relative to the supporting target body 20, and that are more flexibly deformable than the supporting target body 20.

[0088]

Accordingly, it is possible to impart, to the centering mechanisms 260, 360, and 360A, slidability with respect to the supporting target body 20 with a simple
15 configuration.

Examples of the sliding portions 270 and 270A include the sliding material 271 and the brush 271A of the above-described embodiments.

[0089]

(6) The shock-absorbing devices 300 and 300A according to a sixth aspect are
20 the shock-absorbing devices 300 and 300A according to the fifth aspect, in which the centering mechanisms 360 and 360A may further include the second spring member 361 that is configured to urge the sliding portions 270 and 270A with respect to the supporting target body 20 in the direction intersecting the direction along the axes O.

Examples of the second spring member 361 include an elastic material such as
25 rubber or urethane, a disc spring, a bump foil, and a mesh foil.

[0090]

Accordingly, it is possible to attenuate an impact that is caused when there is runout of the supporting target body 20 and the supporting target body 20 comes into contact with the sliding portions 270 and 270A of the centering mechanism. In

5 addition, it is possible to apply pre-compression to the sliding portions 270 and 270A and press the sliding portions 270 and 270A against the supporting target body 20 with the second spring member 361. Accordingly, the supporting target body 20 and the sliding portions 270 and 270A can always be in contact with each other, and friction can always be applied to the supporting target body 20. Therefore, runout of the supporting target
10 body 20 can be quickly reduced.

[0091]

(7) The shock-absorbing device 400 according to a seventh aspect is the shock-absorbing device 400 according to the fourth aspect, in which the centering mechanism 460 may include the wheel 463 that is configured to roll in the direction along the axes O
15 while being in contact with the supporting target body 20.

[0092]

Accordingly, since the wheel 463 is less likely to be worn than the sliding material 271, a frequency at which the wheel 463 is replaced can be significantly reduced. In addition, in a case where a speed at which the supporting target body 20
20 moves as an impact load is applied is high, an impact load applied to the centering mechanism 460 can be favorably redirected.

INDUSTRIAL APPLICABILITY

[0093]

According to a shock-absorbing device of the present disclosure, it is possible to
25 favorably exhibit a shock-absorbing function.

REFERENCE SIGNS LIST

[0094]

	1: furnace
	2: container
5	3: base portion
	3a: opening portion
	4: attachment wall portion
	4a: opening portion
	5: retaining member
10	6: flange
	6a: fitting groove
	7: spring member
	10: guide bar
	11: guide bar main body
15	12: locking member
	13: fixed end
	20: supporting target body
	21: tubular portion
	22: outer ring
20	30: supporting mechanism
	31: fixation tool
	32: wire
	40: slider
	41: bush
25	42: outer tubular portion

	42a: inner peripheral groove
	42b: outer peripheral groove
	42c: end surface groove
	43: inner member
5	43a: inner surface
	43b: spherical surface
	44: outer member
	44a: inner surface
	44b: outer surface
10	45: main body portion
	45a: first member
	45b: second member
	45c: third member
	46: attached piece
15	46a: ring portion
	46b: flange portion
	60: centering mechanism
	100: shock-absorbing device
	C1: circle
20	C2: circle
	L: load path
	O: axis
	O1: center axis
	O2: center axis
25	200: shock-absorbing device

	260: centering mechanism
	261: casing
	261a: storage recess portion
	262: first block
5	262a: inner surface
	263: second block
	263a: main body portion
	263b: protrusion portion
	263c: outer surface
10	264: first bolt
	265: second bolt
	270: sliding portion
	271: sliding material
	t: thickness
15	300: shock-absorbing device
	360: centering mechanism
	361: second spring member
	300A: shock-absorbing device
	360A: centering mechanism
20	270A: sliding portion
	271A: brush
	400: shock-absorbing device
	460: centering mechanism
	461: supporting portion
25	462: rotary shaft

463: wheel

CLAIMS

[Claim 1] A shock-absorbing device comprising:

a base portion;

a guide bar that is connected to the base portion and that extends in a direction

5 along an axis;

a supporting target body that is disposed along the guide bar and that is configured to move relative to the base portion in the direction along the axis;

a slider that is fixed to the supporting target body and that is configured to slide with respect to the guide bar in the direction along the axis; and

10 a spring member that is configured to urge the slider against movement of the slider,

wherein the slider includes a bush that is configured to automatically align a relative angle with respect to the axis, with respect to the guide bar.

[Claim 2] The shock-absorbing device according to Claim 1,

15 wherein the bush includes

an inner member that is configured to cover the guide bar from an outer peripheral side, that is attached to an outer peripheral surface of the guide bar to be slidable in the direction along the axis, and that includes a spherical surface formed on the outer peripheral side, and

20 an outer member that is configured to cover the inner member from the outer peripheral side, that is attached to the inner member to be slidable along the spherical surface, and that is fixed to the supporting target body.

[Claim 3] The shock-absorbing device according to Claim 1 or 2,

25 wherein the supporting target body is formed in a tubular shape extending in the direction along the axis.

[Claim 4] The shock-absorbing device according to Claim 1 or 2, further comprising:

a centering mechanism that is fixed to the base portion, that is disposed outside the supporting target body, that is configured to come into contact with the supporting target body in a direction intersecting the direction along the axis, and that is configured to slide relative to the supporting target body in the direction along the axis.

[Claim 5] The shock-absorbing device according to Claim 4,

wherein the centering mechanism includes a sliding portion that is disposed to face the supporting target body, that is configured to slide relative to the supporting target body, and that is more flexibly deformable than the supporting target body.

[Claim 6] The shock-absorbing device according to Claim 5,

wherein the centering mechanism further includes a second spring member that is configured to urge the sliding portion with respect to the supporting target body in the direction intersecting the direction along the axis.

[Claim 7] The shock-absorbing device according to Claim 4,

wherein the centering mechanism includes a wheel that is configured to roll in the direction along the axis while being in contact with the supporting target body.