

DESCRIPTION

TITLE OF INVENTION

5 SUPPORT STRUCTURE

TECHNICAL FIELD

[0001]

One embodiment of the present invention relates to a support
10 structure.

BACKGROUND ART

[0002]

Equipment such as pipes for transporting fluids, valves for
15 controlling fluids, and containers for storing fluids are moved by the flow
or storage of fluids inside them, causing changes in weight and
temperature. A support structure follows this movement while
generating a certain amount of reaction force. For example, the
support structure for pipes disclosed in Patent Literature 1, which
20 supports equipment such as a pipe, has a configuration in which springs
are arranged above and below the pipe as elastic members.

CITATION LIST

PATENT LITERATURE

25 [0003]

Patent Literature 1: Japanese Unexamined Patent Application
Publication No. 2011-12778

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0004]

One of the objectives of an embodiment of the present invention
5 is to provide a support structure with a novel structure. Alternatively,
one of the objectives of an embodiment of the present invention is to
provide a support structure that is highly corrosion resistant and easy to
maintain. Alternatively, one of the objectives of an embodiment of the
present invention is to provide a compact and inexpensive support
10 structure.

SOLUTION TO PROBLEM

[0005]

One embodiment of the present invention is a support structure.
15 The support structure includes at least one spring, a spring seat on the
spring, and a case having a pair of side surfaces having a protruding
edge portion protruding away from the spring and a bottom surface
located below the spring seat.

[0006]

20 One embodiment of the present invention is a support structure.
The support structure includes at least one spring, a spring seat above
the spring, a pair of support frames located below the spring seat,
sandwiching the spring seat and the spring and fastened to each other,
and a limit stop fastened on the spring seat and sandwiching the pair of
25 support frames.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

FIG. 1 is a schematic perspective view of a support structure according to one embodiment of the present invention.

FIG. 2 is a schematic top view of a support structure according to
5 one embodiment of the present invention.

FIG. 3 is a schematic side view of a support structure according to one embodiment of the present invention.

FIG. 4 is a schematic side view of a support structure according to one embodiment of the present invention.

10 FIG. 5 is a schematic perspective view of a support structure according to an embodiment of the present invention.

FIG. 6 is a schematic top view of a support structure according to one embodiment of the present invention.

15 FIG. 7 is a schematic side view of a support structure according to one embodiment of the present invention.

FIG. 8 is a schematic side view of a support structure according to one embodiment of the present invention.

FIG. 9 is a schematic perspective view of a support structure according to one embodiment of the present invention.

20 FIG. 10 is a schematic top view of a support structure according to one embodiment of the present invention.

FIG. 11 is a schematic side view of a support structure according to one embodiment of the present invention.

25 FIG. 12 is a schematic side view of a support structure according to one embodiment of the present invention.

FIG. 13 is a schematic perspective view of a support structure according to one embodiment of the present invention.

FIG. 14 is a schematic top view of a support structure according to one embodiment of the present invention.

FIG. 15 is a schematic side view of a support structure according to one embodiment of the present invention.

5 FIG. 16 is a schematic side view of a support structure according to one embodiment of the present invention.

FIG. 17 is a schematic perspective view of a support structure according to one embodiment of the present invention.

10 FIG. 18 is a schematic top view of a support structure according to one embodiment of the present invention.

FIG. 19 is a schematic side view of a support structure according to one embodiment of the present invention.

FIG. 20 is a schematic side view of a support structure according to one embodiment of the present invention.

15 FIG. 21 is a schematic perspective view of a support structure according to one embodiment of the present invention.

FIG. 22 is a schematic top view of a support structure according to one embodiment of the present invention.

20 FIG. 23 is a schematic side view of a support structure according to one embodiment of the present invention.

FIG. 24 is a schematic side view of a support structure according to one embodiment of the present invention.

FIG. 25 is a schematic perspective view of a support structure according to one embodiment of the present invention.

25 FIG. 26 is a schematic top view of a support structure according to one embodiment of the present invention.

FIG. 27 is a schematic side view of a support structure according to one embodiment of the present invention.

FIG. 28 is a schematic side view of a support structure according to one embodiment of the present invention.

5 DESCRIPTION OF EMBODIMENTS

[0008]

Hereinafter, each embodiment of the invention disclosed in the present application will be described with reference to the drawings. However, the present invention can be implemented in various forms
10 without departing from the gist thereof, and is not to be construed as limited to the content described in the embodiment illustrated below.

[0009]

In order to clarify the description, the drawings may be schematically represented in terms of the width, thickness, shape, and
15 the like of each unit, but the drawings are merely an example, and do not limit the interpretation of the present invention. In addition, in each of the specification and the drawings, elements provided with functions similar to those described with respect to existing drawings are denoted by the same reference numerals, and redundant descriptions may be
20 omitted.

[0010]

In the present specification and the drawings, when a plurality of configurations identical or similar are collectively referred to, the same reference number are used, and when these are described individually,
25 a hyphen and numbers are added after the reference number. When a plurality of portions of one configuration are described separately from each other, the same reference numbers are used, and a letter of the alphabet is further used.

[0011]

In the present specification and claims, when a plurality of elements are integrated, a plurality of elements have mutually different functions, which means that they are formed from one member and have
5 a continuous configuration. Thus, a plurality of integrated elements include the same material and have the same composition.

[0012]

<First Embodiment>

The following describes one embodiment of the support structure
10 of the present invention. The support structure 10 supports equipment and has a function to follow the movement of the equipment due to changes in heat or weight. Here, the support structure 10 is described in the case where the equipment is piping. In the drawings used in the following description, for convenience, the vertical direction is
15 designated as the z-direction, and the horizontal plane perpendicular to the z-direction is designated as the xy-plane. The x-direction and y-direction are orthogonal to the z-direction. Additionally, the x-direction, y-direction, and z-direction each represent both one direction and the orientation opposite to that direction.

20 [0013]

1. Overall Configuration

A perspective view of the support structure 10 is shown in FIG. 1, a top view as observed from the z-direction is shown in FIG. 2, a side view as observed from the x-direction is shown in FIG. 3, and a side view
25 as observed from the y-direction is shown in FIG. 4, respectively, in schematic form. The support structure 10 has a basic configuration comprising a case 100, a spring seat 102, and at least one spring 104. The support structure 10 further includes, as optional configurations, a

load 106, a flange 108, a universal lock device 110, and a limit stop 112. These configurations are formed using metals such as iron or stainless steel. The following sections provide detailed descriptions of these configurations.

5 [0014]

1-1. Case

The case 100 supports a spring 104 and can restrict movement of the spring 104 within the xy plane. As shown in FIG. 3, the case 100 is located below the spring seat 102 and has a pair of side surfaces 100S and a bottom surface 100B. The pair of side surfaces 100S extend
10 upward (in the z direction) from the bottom surface 100B and are arranged to sandwich the spring 104. This configuration prevents the spring 104 from moving within the xy plane when its z-direction expansion or contraction is accompanied by movement within the xy
15 plane. By preventing the spring 104 from moving within the xy plane, it is prevented from detaching from the support structure 10.

[0015]

The bottom surface 100B and the pair of side surfaces 100S form a U-shape, and the U-shape has an opening toward the spring seat 102.
20 In the example shown in FIG. 3, the width of the opening of the U-shaped configuration corresponds to the distance L1 between the pair of side surfaces 100S, and the distance L1 is shorter than the length L2 of the spring seat 102. Furthermore, the distance between the two ends of the case 100 may also be made shorter than the length L2 of the spring
25 seat 102.

[0016]

The pair of side surfaces 100S each have a protruding edge portion 100E. The protruding edge portion 100E protrudes away from the

spring 104. The protruding edge portion 100E protrudes in the opposite direction from the direction toward the center of the spring 104 from the side surface 100S. The protruding edge portion 100E is the portion where the side surface 100S is bent in the opposite direction from the spring 104 side and extends substantially parallel to the bottom surface 100B. The protruding edge portion 100E may be formed by bending a single sheet of metal, for example, or by welding another sheet of metal to the side surface 100S. In the example shown in FIG. 4, the protruding edge portion 100E overlaps in height with the side surface 100S of the spring seat 102, and the width L3 of the protruding edge portion 100E or the side surface 100S is smaller than the width L4 of the opening of the spring seat 102. By adjusting the height and width of the protruding edge portion 100E in this manner, even when the spring 104 is extended or compressed in the z-direction, the protruding edge portion 100E can be positioned at the opening of the spring seat 102. By positioning the protruding edge portion 100E at the opening of the spring seat 102, the movement of the spring seat 102 in the xy plane can be restricted.

[0017]

The protruding edge portion 100E can also function as a base for the universal lock device 110, as will be described in detail later. As shown in FIG. 1, etc., by placing the protruding edge portion 100E under the spring seat 102, the universal lock device 110 can be installed between the spring seat 102 and the protruding edge portion 100E.

[0018]

The case 100, although not shown in the drawings, has a plurality of holes provided in the bottom surface 100B, and the support structure 10 can be fastened by fastening members such as bolts and nuts through the plurality of holes. Alternatively, when installing the support structure

10 on the case 100, the support structure 10 may be fixed to the installation location by welding or the like on the bottom surface 100B.

[0019]

1-2. Spring seat

5 The spring seat 102 is arranged on the spring 104. The spring seat 102 is positioned such that it sandwiches the case 100 and spring 104. The spring seat 102 is arranged such that it faces the bottom surface 100B of the case 100 in the direction of the central axis of the spring 104 (hereinafter referred to as the spring axis), and is positioned
10 parallel or substantially parallel to the xy direction of the bottom surface 100B. When the support structure 10 is installed and the case 100 is fixed or secured to the installation location, the spring seat 102 moves in the vertical direction (z-direction) in conjunction with the expansion and contraction of the spring 104. At this time, as described above, the
15 movement of the spring 104 in the xy plane is restricted by the case 100. Therefore, there is no need to provide a structure (such as unevenness or ribs) on the lower surface of the spring seat 102 to prevent the movement of the spring 104.

[0020]

20 The spring seat 102 has an upper surface 102T and a pair of side surfaces 102S. The upper surface 102T and the pair of side surfaces 102S form a U-shape, and the U-shape has an opening toward the spring 104. The pair of side surfaces 102S extend downward (in the z-direction) from the upper surface 102T and are arranged to sandwich the spring
25 104. At this time, the pair of side surfaces 102S of the spring seat 102 are arranged to sandwich the spring 104 at a position different from the position of the spring 104 sandwiched by the pair of side surfaces 100S of the case 100. This configuration prevents the spring 104 from moving

in the xy plane when its z-direction expansion or contraction is accompanied by movement in the xy plane. By preventing the spring 104 from moving in the xy plane, it is prevented from detaching from the support structure 10.

5 [0021]

The spring seat 102 may have a plurality of holes in the upper surface 102T. The spring seat 102 can attach the universal lock device 110 through these holes. In the example shown in FIG. 1, the holes are not shown, but the universal lock device 110 is fastened to the spring
10 seat 102 through two holes in the upper surface 102T.

[0022]

1-3. Spring and Load

The spring 104 is positioned between the spring seat 102 and the case 100 so that the spring axis is in the z direction. The spring 104 is
15 held between the spring seat 102 and the case 100, but there is no need to weld or bolt it to them. In the example shown in FIG. 3, the spring 104 is positioned on the case 100 and is sandwiched between the spring seat 102 positioned on the spring 104.

[0023]

20 In the spring 104, the lower portion of the spring 104 is sandwiched between the pair of side surfaces 100S of the case 100, and the higher portion of the spring 104 is sandwiched between the pair of side surfaces 102S of the spring seat 102. The side surfaces 100S of the case 100 and the side surfaces 102S of the spring seat 102 are each
25 shorter than the length of the spring 104, so the spring 104 has portions exposed from each side surface, as shown in FIG. 3 and FIG. 4.

[0024]

In the examples shown in FIG. 1, etc., at least one spring is provided in the support structure 10, but this at least one spring 104 may include a plurality of springs 104. When a plurality of springs 104 are used, although not shown, the plurality of springs 104 overlapping each other in the z-direction may be provided between the bottom surface 100B of the spring seat 102 and the case 100 such that they are sandwiched between the pair of side surfaces 102S of the spring seat 102 and the pair of side surfaces 100S of the case 100.

[0025]

The spring 104 moves upward (in the z direction) and downward (in the -z direction). Since the spring seat 102 moves in conjunction with the movement of the spring 104, the spring seat 102 is restrained not only by the spring 104 but also by the limit stop 112.

[0026]

The load 106 is arranged such that its longitudinal direction faces the z-direction. A portion of the load 106 is arranged inside the spring 104 or surrounded by the spring 104.

[0027]

The load 106 passes through the center of the spring seat 102, and the flange 108 is positioned on the upper end of load 106 on the spring seat 102. The upper end is joined to the flange 108 on the spring seat 102. Here, the flange 108 is a part that supports the pipe. The load 106 may be connected to the flange 108, and in such a case, the method of connecting the load 106 and the flange 108 is optional. For example, the load 106 and the flange 108 may be joined using welding or fastening members such as a nut 114-1. The length of the load 106 from the spring seat 102 to the flange 108 can be adjusted using the nuts 114-1 and 114-2. The nut 114-1 can be used as a fastening member

for connecting to the flange 108. The load 106 can be fixed or fastened to the spring seat 102 using the nut 114-2.

[0028]

Normally, when connecting a pipe to the flange 108, the support
5 structure 10 is installed on the floor of a building, the case 100 is fixed to the floor of the building, and the pipe is connected to the flange 108 in this state. At this time, if the length of the spring 104 is its natural length, the weight of the pipe and the fastening members causes the spring 104 to contract, and as a result, the flange 108 moves downward
10 along with the spring seat 102. If such movement occurs, the pipe is positioned in a state shifted downward from the specified position. To prevent the spring seat 102 from moving in the z-direction due to the restoring force of the spring 104 even after the pipe is connected to the flange 108, it is preferable to set the spring 104 in a compressed state
15 in advance (preset).

[0029]

Therefore, the support structure 10 may further include a universal lock device 110 as a configuration for presetting the spring 104.

[0030]

20 1-4. Universal Lock Device

The universal lock device 110 is arranged between the spring seat 102 and the protruding edge portion 100E of the case 100. The universal lock device 110 is arranged below the spring seat 102 and above the case 100. In the example shown in FIG. 1, the universal lock device 110
25 is arranged below the upper surface 102T of the spring seat 102 and above the protruding edge portion 100E of the case 100. The universal lock device 110 is secured through a hole provided in the upper surface 102T of the spring seat 102 and a notch 100N-1 provided in the

protruding edge portion 100E of the case 100. A plurality of universal lock devices 110 may be provided. In the examples shown in FIG. 2 and FIG. 3, two universal lock devices 110 are arranged along a diagonal line passing through the center of the spring seat 102, with the universal lock devices 110 sandwiching the spring seat 102 in pairs. By configuring the spring seat 102 to be sandwiched between a pair of universal lock devices 110, the spring seat 102 can be aligned parallel to the bottom surface 100B of the case 100, and the spring axis of the spring 104 can be preset to be perpendicular to the bottom surface 100B.

10 [0031]

The universal lock device 110 includes fastening members such as bolts and nuts 116 as a basic configuration. In the examples shown in FIG. 1 and FIG. 4, the universal lock device 110 has the bolt head 110H arranged under the protruding edge portion 100E, and the rod 110R of the bolt passes through the notch 100N-1 of the protruding edge portion 100E and the hole of the spring seat 102, and is fastened to the protruding edge portion 100E and the upper surface 102T by a plurality of nuts 116. The bolt has at least one threaded portion with helical grooves. In the examples shown in FIG. 1 and FIG. 4, although not shown, threaded portions may be provided for fastening the universal lock device 110 to the upper surface 102T and for fastening it to the protruding edge portion 100E.

[0032]

The universal lock device 110 can adjust the distance between the spring seat 102 and the case 100 by using the nuts 110-1 and 110-2, which are used to fasten the universal lock device 110 to the upper surface 102T.

[0033]

The universal lock device 110 can also function as a limit stop. The universal lock device 110 has a plurality of fastening members between the spring seat 102 and the protruding edge portion 100E. In the examples shown in FIGS. 1 and 4, the universal lock device 110 has fastening members, namely the nuts 110-2 and 110-3, between the spring seat 102 and the protruding edge portion 100E. When the fastening of the nut 110-3 is released while the universal lock device 110 is attached to the support structure 10, the spring 104 can move upward and downward. When the spring 104 moves upward and downward, the rod 110R appears below the protruding edge portion 100E. In the example shown in FIG. 4, the spring 104 can be interpreted as having moved upward, and its upward movement is restricted by the bolt head 110H.

[0034]

As described above, when the universal lock device 110 also functions as a limit stop, the length of the rod 110R between the upper surface 102T and the protruding edge portion 100E corresponds to the range of upward and downward movement of the spring 104. The length of the rod 110R between the upper surface 102T and the protruding edge portion 100E can be adjusted by the nut 110-2.

[0035]

When the universal lock device 110 also functions as a limit stop, the configuration of the universal lock device 110 can be used as a configuration of the limit stop as described above, and the universal lock device 110 can be expressed as a limit stop. For example, the limit stop 112 is positioned between the upper surface 102T of the spring seat 102 and the protruding edge portion 100E of the case 100, and is fastened to each of them.

[0036]

In the support structure 10, the universal lock device 110 can be attached between the spring seat 102 and the protruding edge portion 100E, and the height of the support structure 10 can be reduced by providing the case 100 having a pair of side surfaces 100S located below the spring seat 102 and having the protruding edge portion 100 E protruding away from the spring 104. Therefore, by applying this embodiment, it is possible to provide a compact support structure.

[0037]

Furthermore, in the support structure 10, the number of parts constituting the support structure 10 can be reduced by combining the limit stop function with the universal lock device 110. Therefore, by applying this embodiment, it is possible to provide an inexpensive support structure.

[0038]

In addition, in the support structure 10, the case 100 is provided so that the upper part of the spring 104 is exposed, and the lower part of the spring 104 is provided so as to be exposed from the spring seat 102, so that the interior of the support structure 10 is visible, and air permeability is improved. Therefore, by applying this embodiment, it is possible to provide a support structure having high corrosion resistance and easy maintenance.

[0039]

Further, in the support structure 10, the parts constituting the support structure are fastened by the fastening member, so that the replacement and maintenance of the parts can be easily performed. Therefore, by applying this embodiment, it is possible to provide an inexpensive support structure.

[0040]

2. Modification Example

2-1. Modification Example 1

The structure of the support structure 10 is not limited to the
5 above-described structure. For example, as shown in FIG. 5, at least one
limit stop 112 may be provided separately from the universal lock device
210. In addition, a protruding portion 102P may be provided on the
support structure 10 to store the universal lock device 210. Furthermore,
a guide 122 may be provided on the case 100. Additionally, the case 100
10 may be provided with a bent portion having a notch 100N-2. Furthermore,
a base plate 126 for fixing the support structure 10 may be provided. A
perspective view of the support structure 10 is shown in FIG. 5, a top
view observed from the z-direction is shown in FIG. 6, a side view
observed from the x-direction is shown in FIG. 7, and a side view
15 observed from the y-direction is shown in FIG. 8, respectively, in a
schematic manner.

[0041]

2-1-1. Limit Stop

At least one limit stop 112 is arranged between the spring seat
20 102 and the protruding edge portion 100E of the case 100, and is
fastened to the spring seat 102 and the protruding edge portion 100E of
the case 100. At least one limit stop 112 includes a plurality of limit stops
112, and the plurality of limit stops 112 may be provided to the protruding
edge portion 100E. In the example shown in FIG. 5, the plurality of limit
25 stops 112 are arranged relative to the protruding edge portion 100E.
When the universal lock device 210 is attached between the spring seat
102 and the protruding edge portion 100E, the limit stops 112 are
arranged in pairs to sandwich the universal lock device 210. Furthermore,

when the protruding edge portions 100E face each other and the plurality of limit stops 112 are arranged so as to sandwich the universal lock device 210, two limit stops 112 are arranged on a diagonal line passing through the center of the spring seat 102, and the two limit stops 112 sandwich the spring seat 102 as a pair.

[0042]

The limit stop 112 may comprise fastening members. The limit stop 112 may limit upward movement of the spring 104 and spring seat 102 by means of the stopper 112A provided below the protruding edge portion 100E. When the spring 104 and spring seat 102 move upward and downward, the protruding edge portion 100E can apparently move within the range of the limit stop 112. In the example shown in FIG. 8, the limit stop 112 is composed of fastening members, such as bolts and the nuts 112-1 and nuts 112-2. The head 112H of the bolt used as the stopper 112A is located below the protruding edge portion 100E, and the rod 128R of the bolt passes through a hole provided in the protruding edge portion 100E (not shown) and a hole provided in the upper surface 102T of the spring seat 102 so that the limit stop 112 is secured by the nuts 112-1 and 112-2 that sandwich the upper surface 102T of the spring seat 102. At this time, the head 112H is not fastened to the protruding edge portion 100E, and the spring seat 102 is able to move in conjunction with the upward and downward movement of the spring 104. In the example shown in FIG. 8, the universal lock device 210 is attached to the support structure 10, the spring 104 is in a compressed state, and a gap or clearance is provided between the head 112H and the protruding edge portion 100E.

[0043]

2-1-2. Universal Lock Device

The universal lock device 210 includes fastening members and a spacer 210SP. The universal lock device 210 can adjust the compression of the spring 104 by placing the spacer 210SP on the upper surface 102T of the spring seat 102 and the protruding edge portion 100E of the case 100. In the example shown in FIG. 5, a plurality of washers are used for the spacer 210SP on the upper surface 102T of the spring seat 102 and the protruding edge portion 100E of the case 100 to adjust the distance between the spring seat 102 and the case 100, thereby adjusting the compression of the spring 104. The spacer 210SP may include not only washers but also a plurality of thin metal plate-shaped parts. By using thin metal plate-shaped parts in the spacer 210SP, the distance between the spring seat 102 and the case 100 can be finely adjusted in units of the thickness of each plate-shaped part.

[0044]

The universal lock device 210 is fastened to the spring seat 102 and the protruding edge portion 100E by fastening members. In the example shown in FIG. 8, the head 210H of the bolt is positioned on the spring seat 102 or on the upper surface 102T of the spring seat 102, the rod 210R of the bolt is arranged to pass through the spacer 210SP from the spring seat 102 to below the protruding edge portion 100E, and a nut 210-1 is arranged below the protruding edge portion 100E, thereby securing the universal lock device 210 to the spring seat 102 and the protruding edge portion 100E.

[0045]

The universal lock device 210 is constructed with fastening members so that it can be removed from between the spring seat 102 and the case 100, but it can be stored in the support structure 10. As shown in FIG. 5 or FIG. 6, the spring seat 102 has a protruding portion

102P that protrudes from the upper surface 102T, and the protruding portion 102P shares the hole 102O of the upper surface 102T. The hole 102O can be arranged from the upper surface 102T to the protruding portion 102P. The portion of the hole 102O located on the upper surface
5 102T can be arranged to overlap the protruding edge portion 100E, while the portion located on the protruding portion 102P can be arranged not to overlap the protruding edge portion 100E.

[0046]

The universal lock device 210 can also be stored by moving it
10 inside the hole 102O, in addition to being attached and detached. When the universal lock device 210 is attached between the spring seat 102 and the case 100, the universal lock device 210 is positioned in the hole 102O located on the upper surface 102T. When the universal lock device 210 is detached, the universal lock device 210 is positioned in the hole
15 102O located on the protruding portion 102P.

[0047]

In the examples shown in FIGS. 6 and 7, the head 210H is positioned in the hole 102O located in the upper surface 102T, and the nut 210-1 is positioned under the protruding edge portion 100E so that
20 the universal lock device 210 is attached. The universal lock device 210 is removed from between the spring seat 102 and the protruding edge portion 100E as the head 210H moves within the hole 102O and is positioned in the hole 102O located at the protruding portion 102P. As a result, the universal lock device 210 hangs from the protruding portion
25 102P, and the universal lock device 210 can be stored while it is not attached. Such storage is convenient because it is not necessary to bring the universal lock device 210 again when reattaching the universal lock device 210.

[0048]

2-1-3. Case

The case 100 may be provided with a notch 100N-2. During the molding process of the case 100, by performing a bending process with a notch in the bending portion between the side surface 100S and the bottom surface 100B, it is possible to suppress changes in shape associated with bending, such as misalignment of the side surface 100S and the bottom surface 100B of the case 100 and curling of the bending portion. Additionally, by providing the notch 100N-2, interference between bolts, nuts, or other fastening members installed in the hole 126O-1 of the base plate 126 and the case 100 can be avoided. As a result, the pitch of the hole 126O-1 and the outer dimensions of the base plate 126 can be reduced, enabling the support structure 10 to be compact in the XY plane.

[0049]

In the case 100, a guide 122 can be provided inside the spring 104 on the bottom surface 100B. The guide 122 can be fastened to the case 100 by fastening members or fixed by welding. In the example shown in FIG. 7, the guide 122 is fastened to the bottom surface 100B of the case 100 by bolts and the nuts 122-1. Alternatively, the guide 122 may be formed by plastic processing such as drawing on the bottom surface 100B. The guide 122 should have an inner diameter equal to or smaller than that of the spring 104 and should be in close contact with the spring 104. Since the spring 104 has a shape such as a cone, cylinder, or barrel, the guide 122 is preferably circular. The guide 122 may have a height or thickness equivalent to the end turn of the spring 104. The guide 122 can suppress the movement of the spring 104 in the xy plane when it moves upward and downward.

[0050]

2-1-4. Base Plate

The base plate 126 may be provided under the case 100. When the support structure 10 is installed in a building or the like, the base plate 126 is arranged between the case 100 and the building. The base plate 126 is larger than the bottom surface 100B of the case 100 and has a plurality of holes 126O-1 for fixing to the building in the portion that does not overlap with the bottom surface 100B of the case 100. In the example shown in FIG. 6, the base plate 126 is a rounded rectangle, with holes 126O-1 for fixing purposes provided at each of the four corners. By providing such a base plate 126, the support structure 10 can be stably installed in the building.

[0051]

2-2. Modification Example 2

Alternatively, as shown schematically in FIG. 9, a notch 102N may be provided in the spring seat 102. Furthermore, a stopper 146 may be provided in the spring seat 102, and the function of the limit stop 112 may be incorporated in the spring seat 102. A perspective view of the support structure 10 is shown schematically in FIG. 9, a top view as observed from the z-direction is shown in FIG. 10, a side view as observed from the x-direction is shown in FIG. 11, and a side view as observed from the y-direction is shown in FIG. 12.

[0052]

The spring seat 102 may have a notch 102N on the side surface 102S. The notch 102N is located at the center of the side surface 102S and closer to the bottom surface 100B of the case 100 than the upper surface 102T. An end portion 102M, which overlaps the side of the protruding edge portion 100E, is located on both sides of the notch 102N.

The end portion 102M extends from the upper surface 102T to the bottom of the protruding edge portion 100E in the spring axis direction of the spring 104, and overlaps the side of the protruding edge portion 100E. The distance between the end portion 102M overlapping the side surface of the protruding edge portion 100E corresponds to a width L6 of the notch 102N, and the notch 102N has the width L6, which is greater than the outer shape L5 of the spring 104. The notch 102N partially overlaps the side surface 100S of the case 100 and also partially overlaps the spring 104. In the example shown in FIG. 11, the notch 102N is provided in the side surface 102S, leaving the end portion 102M that overlaps the protruding edge portion 100E of the case 100, and the notch 102N overlaps the spring 104. By overlapping the notch 102N with the spring 104, the spring 104 can be further exposed from the side surface 102S. [0053]

The spring seat 102 may be provided with a stopper 146 fastened to the side surface 102S. At least one stopper 146 may be provided on each of the pair of side surfaces 102S of the spring seat 102. The stopper 146 may extend from the side surface 102S to below the protruding edge portion 100E. The stopper 146 may be composed of fastening members. In the example shown in FIG. 11, since a notch 102N is provided in the spring seat 102, the stoppers 146 are each provided at the end portions 102M sandwiching the notch 102N. These stoppers 146 are arranged at the same distance from the upper surface 102T so that they are located below the protruding edge portion 100E.

[0054]

In the example shown in FIG. 12, the stopper 146 is provided at each end portion 102M of the pair of side surfaces 102S. These stoppers 146 are arranged at the same distance from the upper surface 102T so

as to be located below the protruding edge portion 100E. The stoppers 146 pass through the side surfaces 102S of the spring seat 102 and extend below the protruding edge portion 100E. The stopper 146 comprises fastening members such as a bolt and the nut 146-1, wherein
5 the head 146H of the bolt is arranged outside the side surface 102S, the rod 146R of the bolt is arranged inside the side surface 102S, the nut 146-1 is arranged inside the side surface 102S, and the head 146H is fastened to the side surface 102S. In other words, the head 146H of the bolt is positioned on the opposite side of the surface facing the spring
10 104 on the side surface 102S, and the rod 146R of the bolt extends from the opposite side of the surface facing the spring 104 on the side surface 102S to the surface facing the spring 104. The nut 146-1 is positioned on the surface facing the spring 104 on the side surface 102S, and the head 146H is fastened to the side surface 102S. The length of the rod
15 146R is optional, but it should extend below the protruding edge portion 100E to suppress the downward movement of the protruding edge portion 100E.

[0055]

2-3. Modification Example 3

20 Alternatively, as shown schematically in FIGS. 13 to 16, a side plate 152 may be provided and fastened to the spring seat 102. FIG. 13 shows a perspective view of the support structure 10, FIG. 14 shows a top view as observed from the z direction, FIG. 15 shows a side view as observed from the x direction, and FIG. 16 shows a side view as
25 observed from the y direction, each schematically.

[0056]

The side plate 152 is fastened on the spring seat 102. The side plate 152 includes a pair of side plates 152, and the pair of side plates

152 can sandwich the spring 104. At this time, the pair of side plates 152 are arranged so as to sandwich the spring 104 at a position different from the position of the spring 104 sandwiched by the pair of side surfaces 100S of the case 100. The side plate 152 may have an upper surface 152T fastened to the spring seat 102, a side surface 152S sandwiching the spring 104, a first bending portion 152BN-1 between the upper surface 152T and the side surface 152S, and a second bending portion 152BN-2 below the protruding edge portion 100E. The second bending portion 152BN-2 bends downward from the side surface 152S toward the protruding edge portion 100E and extends further downward below the protruding edge portion 100E so that the protruding edge portion 100E is positioned between the second bending portion 152BN-2 and the spring seat 102. The second bending portion 152BN-2 is arranged so as to sandwich the upper surface 152T of the side plate 152, the spring seat 102, and the protruding edge portion 100E in the spring axis direction of the spring 104.

[0057]

In the example shown in FIG. 13, a pair of a first side plate 152-1 and a second side plate 152-2 are arranged so as to sandwich the spring seat 102. The upper surface 152T of the first side plate 152-1 and the upper surface 152T of the second side plate 152-2 are positioned above the spring seat 102 and are fastened by fastening members comprising bolts (the head 152 H and the rod 152 R of the bolt in the diagrams) and nuts 152NU1. As shown in FIG. 16, the upper surface portion 152T of the first side plate 152-1 and the upper surface portion 152T of the second side plate 152-2 are arranged above the spring 104. The side surfaces 152S of the first side plate 152-1 and the second side plate 152-2 are arranged to sandwich the spring 104.

[0058]

With regard to the first side plate 152-1, the first bending portion 152BN-1 is located between the upper surface 152T and the side surface 152S, and the side surface 152S is located between the first bending
5 portion 152BN-1 and the second bending portion 152BN-2. The second bending portion 152BN-2 has a portion extending under the protruding edge portion 100E. The first bending portion 152BN-1 and the second bending portion 152BN-2, or the portion extending under the protruding edge portion 100E of the second bending portion 152BN-2, are arranged
10 so as to sandwich the spring seat 102 and the protruding edge portion 100E.

[0059]

Regarding the second side plate 152-2, the first bending portion 152BN-1 is located between the upper surface 152T and the side surface
15 152S, and the side surface 152S is located between the first bending portion 152BN-1 and the second bending portion 152BN-2. The second bending portion 152BN-2 may have a portion extending below the protruding edge portion 100E. The first bending portion 152BN-1 and the second bending portion 152BN-2, or the portion of the second bending
20 portion 152BN-2 extending below the protruding edge portion 100E, are arranged so as to sandwich the spring seat 102 and the protruding edge portion 100E.

[0060]

The second bending portion 152BN-2 of the first side plate 152-1
25 and the second side plate 152-2 is located below the protruding edge portion 100E to suppress the upward movement of the spring 104 and the spring seat 102.

[0061]

The pair of side plates 152 may be provided with notches 152N similar to the notch 102N provided in the spring seat 102 described above.

[0062]

5 2-4. Modification Example 4

Furthermore, as schematically shown in FIGS. 17 to 20, the case 100 can be divided into a pair of side surfaces 100S. FIG. 17 shows a perspective view of the support structure 10, FIG. 18 shows a top view observed from the z direction, FIG. 19 shows a side view observed from the x direction, and FIG. 20 shows a side view observed from the y direction.

[0063]

The case 100 may be separated at the bottom surface 100B. By separating the bottom surface 100B, the case 100 may be composed of separate portions for each pair of side surfaces 100S. The bottom surface 100B has a gap 100I at positions equidistant or approximately equidistant from each side surface 100S, passing through the center of the spring 104 when viewed from above, and the gap 100I extends from one side surface of the bottom surface 100B to the other side surface.

20 The gap 100I is located below the spring 104. The gap 100I is located below the guide 122. At this time, the guide 122 is located above the gap 100I and the bottom surface 100B, and is fastened to the bottom surface 100B. The width of the gap 100I is optional and can be adjusted to match the size or shape of the spring 104, and may also be adjusted to set the distance between the spring 104 and side surface 100S to a desired distance.

[0064]

In the examples shown in FIG. 17 and FIG. 19, the case 100 is separated at the bottom surface 100B into a portion having a first side surface 100S-1 and a portion having a second side surface 100S-2 by the gap 100I. The gap 100I passes through the center of the spring 104,
5 as shown in FIG. 18, and is located at approximately equal distances D from the first side surface 100S-1 and the second side surface 100S-2, as shown in FIG. 19. The portion having the first side surface 100S-1 and the portion having the second side surface 100S-2 are fastened to the base plate 126 simultaneously with the fastening of the guide 122
10 and the case 100.

[0065]

2-5. Modification Example 5

Alternatively, as schematically shown in FIGS. 21 to 24, the case 100 may be separated at the bottom surface 100B, and a curved surface
15 100C may be provided on the separated bottom surface 100B. A perspective view of the support structure 10 is shown in FIG. 21, a top view observed from the z-direction is shown in FIG. 22, a side view observed from the x-direction is shown in FIG. 23, and a side view observed from the y-direction is shown in FIG. 24, respectively, in a
20 schematic manner.

[0066]

The case 100 is separated at the bottom surface 100B, and the separated bottom surface 100B may have curved surfaces 100C facing each other. The case 100 may include a portion having a first side
25 surface 100S-1 separated by a gap 100K and a portion having a second side surface 100S-2. The gap 100K can be located between the portion having the first side surface 100S-1 and the portion having the second side surface 100S-2. The bottom surface 100B of the portion having the

first side surface 100S-1 and the bottom surface 100B of the portion having the second side surface 100S-2 may have curved surfaces 100C facing each other. The curved surface 100C has a shape following the outer shape of the spring 104, and is arranged so as to sandwich the
5 spring 104, thereby surrounding the spring 104.

[0067]

In the example shown in FIG. 21, the case 100 has a gap 100K, and has a portion having a first side surface 100S-1 and a portion having a second side surface 100S-2 separated by the gap 100K. The portion
10 having the first side surface 100S-1 and the portion having the second side surface 100S-2 each have a curved surface 100C shaped along the outer shape of the spring 104 at the bottom surface 100B. The curved surface 100C is located on the outside of the spring 104, and the spring 104 is positioned in the gap 100K, so that the spring 104 is arranged on
15 the base plate 126 rather than on the case 100.

[0068]

When the spring 104 is arranged directly on the base plate 126, as shown in FIG. 21, a hole 126O-2 may be provided in the base plate 126 so that it overlaps the circular shape of the spring 104. The hole
20 126O-2 may be used for fastening or fixing the support structure 10 to a building, or it may be used as a ventilation hole or a rainwater drainage hole.

[0069]

In the above-described modification, the support structure 10
25 includes the case 100 having the pair of side surfaces 100S with the protruding edge portion 100E that protrudes away from the spring 104 and is located below the spring seat 102, thereby enabling the limit stop 112 and the universal lock device 210 to be attached between the spring

seat 102 and the protruding edge portion 100E. As a result, the height of the support structure 10 can be reduced. Therefore, it is possible to provide a compact support structure by applying this embodiment.

[0070]

5 Furthermore, in the above-described modified example, the case 100 is provided so that the upper portion of the spring 104 is exposed in the support structure 10, and the lower portion of the spring 104 is further exposed from the side plate 152 by the notch 152N. Thus, the interior of the support structure 10 can be visible, and air permeability is
10 improved. Therefore, by applying this embodiment, it is possible to provide a support structure that is highly corrosion resistant and easy to maintain.

[0071]

 Furthermore, in the above-mentioned modification example, each
15 part constituting the support structure 10 is fastened by fastening members, so that it is easy to replace parts and perform maintenance. Therefore, by applying this embodiment, it is possible to provide an inexpensive support structure.

[0072]

20 <Second Embodiment>

 In the present embodiment, a support structure 20 having a structure different from that of the support structure 10 described in the first embodiment will be described. Descriptions of configurations identical or similar to those described in the first embodiment may be
25 omitted.

[0073]

 A perspective view of the support structure 20 is shown in FIG. 25, a top view as observed from the z direction is shown in FIG. 26, a

side view as observed from the x direction is shown in FIG. 27, and a side view as observed from the y direction is shown in FIG. 28, respectively, in schematic form. As shown in these figures, the support structure 20 has a basic configuration comprising at least one spring 104, a spring seat 102, a pair of support frames 164, and a limit stop 212. The support structure 20 may further include, as an optional configuration, a base 166 and a universal lock device 210, and the limit stop 212 may have a stopper 212A.

[0074]

10 1. Support Frame

The support frame 164 is arranged below the spring seat 102, sandwiching the spring seat 102 and the spring 104, and is fastened to each other in pairs. As shown in FIG. 27, the support frame 164 sandwiches the spring seat 102 and the spring 104 in the spring axis direction or z-direction of the spring 104. Additionally, as shown in FIG. 28, the pair of support frames 164 are arranged such that the distance D1 between the pair of support frames 164 is smaller than the outer diameter D2 of the spring 104, thereby sandwiching the spring 104. As a result, the movement of the spring 104 in the xy plane is suppressed, and a buckling phenomena can be prevented.

[0075]

The support frame 164 may include a plurality of extension portions 164ST extending in the z direction, a bottom portion 164B sandwiching the spring seat 102 and the spring 104, and a protruding edge portion 164E protruding away from the spring 104.

[0076]

The plurality of extension portions 164ST are arranged between the protruding edge portion 164E and the bottom portion 164B, and

extend in the z-direction from both ends of the bottom portion 164B toward the spring seat 102. The distance D3 between the extension portions 164ST is arranged to be smaller than the outer diameter D2 of the spring 104. By adopting such an arrangement, the spring 108 cannot
5 pass through the extension portions 164ST, and it is possible to prevent the spring 108 from falling off the support structure 10.

[0077]

The support frame 164 has an opening 164O extending from the upper end to the lower end of each of the plurality of extension portions
10 164ST. Here, the support frame 164 has a hole 164G below the opening 164O, and the pair of support frames 164 are fastened to each other through the hole 164G. Furthermore, the pair of support frames 164 that are fastened to each other are connected to a limit stop 212 above the opening 164O. The fastening of the pair of support frames 164 and their
15 connection to the limit stop 212 can be performed using fastening members.

[0078]

As shown in FIGS. 25 and 27, the plurality of extension portions 164ST have openings 164O extending in the z direction, and the bolts
20 and nuts 170-1 and 170-2 of the rod 170R passing through the holes 164G below the openings 164O fasten the pair of support frames 164. Above the opening 164O, the plurality of extension portions 164ST are connected by a stopper 212A using a limit stop 212 and fastening members. At this time, the stopper 212A allows z-direction sliding within
25 the opening 164O while fastening the limit stop 212 and the support frame 164.

[0079]

The support frame 164 may have a hook 164F at the bottom portion 164B. The hook 164 F is located on the surface in contact with the spring 104 by the bottom portion 164B and is positioned inside the spring. The hook 164F protrudes toward the spring seat 102. The hook
5 164F may have a height or thickness equivalent to the end turn of the spring 104. As shown in FIGS. 25 and 27, at the bottom portion 164B, the hook 164F is positioned inside the spring 104, while the rest are positioned outside the spring 104. With this arrangement of the hook 164F, the spring 104 is supported by the hook 164F catching its lower
10 end, so the movement of the spring 104 is stabilized.

[0080]

The pair of support frames 164 can support the base 166 at the protruding edge portions 164E. The base 166 is clamped between the pair of support frames 164 and supported by each protruding edge
15 portion 164E. As shown in FIG. 28, the base 166 is supported by engaging with notches 164N provided in each of the protruding edge portions 164E of the support frame 164-1 and the support frame 164-2. In the examples shown in FIG. 25 or FIG. 27, the notch 164N of the protruding edge portion 164E has an opening facing the same direction
20 as the protruding direction of the protruding edge portion 164E. The base 166 has the same function as the protruding edge portion 100E shown in modification examples 1 to 5, and can support the universal lock device 210. The universal lock device 210 is supported by being positioned between the base 166 and the spring seat 102. The base 166
25 further has a notch 166N that allows the universal lock device 210 to be attached and detached.

[0081]

2. Limit Stop

The limit stop 212 is fastened on the spring seat 102 and arranged so as to sandwich the pair of support frames 164. The limit stop 212 has a side portion 212S across the spring seat 102 and extending from both ends of the upper portion 212T in the z direction toward the bottom portion 164B of the support frame 164. In the example shown in FIG. 28, the limit stop 212 is fastened at the upper portion 212T by the spring seat 102 and a bolt (the head 212H of the bolt in the diagrams), and at the side portion 212S, it sandwiches the pair of support frames 164 and the base 166 and is fastened to the pair of support frames 164. Additionally, the limit stop 212 may have a stopper 212A, and as described above, the limit stop 212 and the pair of support frames 164 are fastened by the stopper 212A below the base 166.

[0082]

In the examples shown in FIGS. 27 and 28, the end of the side portion 212S of the limit stop 212 and the pair of support frames 164 overlapping therewith are fastened. A gap is provided between the end portion of the side portion 212S of the limit stop 212 and the pair of support frames 164 overlapping therewith. As a result, the stopper 212A can slide within the opening 164O of the pair of support frames 164, as described above, and the limit stop 212 can move upward and downward in conjunction with the upward and downward movement of the spring 104.

[0083]

In the example shown in FIG. 25, the stopper 212A is composed of fastening members. Specifically, the stopper 212A is composed of a bolt and a nut 212A-1, and the head 212AH of the bolt and the nut 212A-1 sandwich the side portion 212S of the limit stop 212 and the pair of support frames 164. At this time, the rod 212AR of the bolt is located

below the base 166. Furthermore, the stopper 212A has a nut 212A-2 between the pair of support frames 164, which can be fastened to the support frame 164-2. As a result, the interval between the pair of support frames 164 can be fixed.

5 [0084]

3. Spring Seat

The spring seat 102 may have the protruding portion 102P. The spring seat 102 is circular in shape and may have the protruding portion 102P that protrudes from a portion that overlaps the spring 104 and the
10 portion that overlaps the spring 104. The protruding portion 102P may include a portion 102W that overlaps the upper portion 212T of the limit stop 212 and a portion having a hole 102O. With regard to the protruding portion 102P, the width of the portion 102W that overlaps the limit stop 212 is greater than the width of the portion having the hole 102O, as
15 shown in FIG. 25 or FIG. 28. As a result, durability can be provided for the fastening of the limit stop 212 and the spring seat 102.

[0085]

The hole 102O of the protruding portion 102P has, as shown in FIG. 26, a portion that overlaps the base 166 and a portion that does not
20 overlap the base 166. When the universal lock device 210 is arranged in the portion that overlaps the base 166, the spring 104 is in a preset state, and when the universal lock device 210 is arranged in the portion that does not overlap the base 166, the spring 104 is in a state where it can move upward and downward.

25 [0086]

The support structure 20 includes the pair of support frames 164 located below the spring seat 102 and fastened to each other with the spring seat 102 and spring 104 sandwiched therebetween, and the limit

stop 212 fastened onto the spring seat 102 and sandwiching the pair of support frames 164. As a result, the universal lock device 210 can be attached between the spring seat 102 and the base 166, and the height of the support structure 20 can be reduced. Therefore, by applying this embodiment, a compact support structure can be provided.

[0087]

Furthermore, the support structure 20 includes the pair of support frames 164 and the limit stops 212 that are fastened onto the spring seats 102 and sandwich the pair of support frames 164, thereby exposing the springs 104 to a large extent, allowing visual observation of the inside of the support structure 20 and improving ventilation. Therefore, by applying this embodiment, it is possible to provide a support structure that is highly corrosion resistant and easy to maintain.

[0088]

Furthermore, since each part of the support structure 20 is composed of fastening members, it is easy to replace parts and perform maintenance. Therefore, by applying this embodiment, it is possible to provide an inexpensive support structure.

[0089]

The aforementioned modes described as the embodiments of the present invention can be implemented by appropriately combining with each other as long as no contradiction is caused. Furthermore, embodiments realized by a person skilled in the art by appropriately adding, deleting, or making design changes to the components based on the embodiments described above are also included within the scope of the present invention, as long as they encompass the gist of the present invention.

[0090]

It is understood that another effect different from that provided by each of the aforementioned embodiments is achieved by the present invention if the effect is obvious from the description in the specification or readily conceived by persons ordinarily skilled in the art.

5

REFERENCES SIGNS LIST

[0091]

10 10: Support structure, 20: Support structure, 100: Case, 100B: Bottom surface, 100C: Curved surface, 100E: Protruding edge portion, 100K: Gap, 100L: Gap, 100S: Side surface, 100S-1: First side surface, 100S-2: Second side surface, 102: Spring seat, 102M: End portion, 102O: Hole, 102P: Protruding portion, 102S: Side surface, 102T: Upper surface, 102W: Portion, 106: Load, 108: Flange, 110: Universal lock device, 110-1: Nut, 110-2: Nut, 110-3: Nut, 110H: Head, 110R: Rod, 112: Limit stop, 112-1: Nut, 112-2: Nut, 112A: Stopper, 112H: Head, 114-1: Nut, 114-2: Nut, 116: Nut, 122: Guide, 122-1: Nut, 126: Base plate, 126O-1: Hole, 126O-2: Hole, 128: Stopper, 128R: Rod, 130: Nut, 146: Stopper, 146-1: Nut, 146H: Head, 146R: Rod, 152: Side plate, 152-1: First side plate, 152-2: Second side plate, 152BN-1: First bending portion, 152BN-2: Second bending portion, 152NU1: Nut, 152S: Side surface, 152T: Upper surface, 164: Support frame, 164-1: Support frame, 164-2: Support frame, 164B: Bottom portion, 164E: Protruding edge portion, 164F: Hook, 164G: Hole, 164O: Opening, 164ST: Extension portion, 166: Base, 170: Nut, 170-1: Nut, 170-2: Nut, 170R: Rod, 172: Stopper, 210: Universal lock device, 210-1: Nut, 210H: Head, 210R: Rod, 210SP: Spacer, 212: Limit stop, 212A: Stopper, 212A-1: Nut, 212A-2: Nut, 212AH: Head, 212AR: Rod, 212S: Side portion, 212S-1: Nut, 212SH: Head, 212T: Upper portion

CLAIMS

1. A support structure comprising:
at least one spring;
5 a spring seat on the at least one spring;
a case having a pair of side surfaces having a protruding edge
portion that protrudes in a direction away from the central axis of the
spring relative to the spring and a bottom surface, and located below the
spring seat, and
10 a universal lock device arranged between the spring seat and the
protruding edge portion.
2. The support structure according to claim 1,
wherein the universal lock device compresses the spring and is
15 fastened to the spring seat and the protruding edge portion while the
spring is in a state where the spring does not move, and
the spring can move when the universal lock device is released
from at least one of the spring seat and the protruding edge portion.
- 20 3. The support structure according to claim 1,
wherein the universal lock device sandwiches the spring in pairs.
4. The support structure according to claim 1,
wherein the universal lock device has a spacer with a plurality of
25 washers between the spring seat and the protruding edge portion.
5. The support structure according to claim 1,

wherein the spring seat has a pair of side surfaces that sandwich the spring and an upper surface, and

the pair of side surfaces sandwich both sides of the protruding edge portion.

5

6. A support structure comprising:

at least one spring;

a spring seat on the at least one spring, and

10 a case having a pair of side surfaces having a protruding edge portion extending away from a center axis of the spring and a bottom surface, and located below the spring seat,

wherein the spring seat has a pair of side surfaces that sandwich the spring and an upper surface,

15 the pair of side surfaces sandwich both sides of the protruding edge portion, and

the spring seat has a protruding portion that protrudes in a direction away from the central axis of the spring from the upper surface and shares a hole with the upper surface.

20 7. The support structure according to claim 6, further comprising, at least one limit stop fastened to the upper surface of the spring seat and the protruding edge portion of the case.

8. The support structure according to claim 1,
25 wherein the universal lock device has a plurality of fastening members between the spring seat and the protruding edge portion.

9. The support structure according to claim 6, further comprising,

a stopper that extends below the protruding edge portion and is fastened to a side of the spring seat,

wherein the side surface of the spring seat has a notch with a width greater than the outer shape of the spring.

5

10. The support structure according to claim 1, further comprising,
a pair of side plates fastened on top of the spring seat,
sandwiching the spring, and having a bent portion below the protruding
edge portion,

10 wherein the protruding edge portion is located between the spring
seat and the bending portion.

11. The support structure according to claim 1, further comprising,
a guide located on the bottom surface of the case and positioned
15 inside the spring.

12. The support structure according to claim 1,
wherein the bottom surfaces are separated from each other.

20 13. The support structure according to claim 1,
wherein the bottom surfaces are separated from each other, and
the separated bottom surfaces have curved surfaces that follow the outer
shape of the springs, respectively., and
the curved surfaces sandwich the spring.

25

14. A support structure comprising:
at least one spring;
a spring seat on the spring;

a pair of support frames located below the spring seat, sandwiching the spring and fastened to each other, and

a limit stop fastened onto the spring seat and sandwiching the pair of support frames.

5

15. The support structure according to claim 14, further comprising, a base sandwiched between the pair of support frames below the spring seat,

wherein the limit stop has a stopper that fastens the pair of support frames below the base.

10

16. The support structure according to claim 15, further comprising, a pair of universal lock devices positioned between the spring seat and the base and sandwiching the spring.

15

17. The support structure according to claim 16, wherein the universal lock device has a spacer having a plurality of washers between the spring seat and the base.

20

18. The support structure according to claim 15, wherein the spring seat has a protruding portion having at least one hole that overlaps the base in a top view.

25

19. The support structure according to claim 14, wherein the pair of support frames have a hook arranged inside the spring.