

DESCRIPTION

TITLE OF INVENTION

PIPE SUPPORT

5

TECHNICAL FIELD

[0001]

An embodiment of the present invention relates to a pipe support.

BACKGROUND ART

[0002]

One method for transporting fluids is a piping. When fluid flows in a piping, weight and temperature changes cause the piping to move. A pipe support follows such movement while generating a certain reaction force. For example, the pipe support disclosed in Patent Document 1 has a structure in which springs are arranged as elastic members over and under the piping.

CITATION LIST

PATENT LITERATURE

20 [0003]

Japanese Patent Application Publication No. 2011-12778

SUMMARY OF INVENTION

TECHNICAL PROBLEM

25 [0004]

An object of an embodiment of the present invention is to provide a pipe support with a novel structure. Alternatively, an object of an embodiment of the present invention is to provide a pipe support which is durable, easy to maintain, and

lightweight.

SOLUTION TO PROBLEM

[0005]

5 An embodiment of the present invention is a pipe support. The pipe support includes a hanger plate, a base plate, a spring seat, a pair of connecting rods, a spring, a turnbuckle, and at least one of a lower spring guide and an upper spring guide. The base plate is located under the hanger plate and has a through hole. The spring seat is sandwiched by the hanger plate and the base plate and is
10 configured to reversibly slide between the hanger plate and the base plate. The pair of connecting rods connects the hanger plate to the base plate, maintains a distance between the hanger plate and the base plate, and passes through the spring seat. The spring is located between the base plate and the spring seat. The turnbuckle is connected to the spring seat and is surrounded by the spring and
15 the through hole. The lower spring guide includes a pair of first guides located over and in contact with the base plate. The pair of first guides each has a first opening through which the connecting rod passes and face each other so as to sandwich the spring in a direction in which a first straight line connecting the first openings extends. The upper spring guide includes a pair of second guides located under and in contact
20 with the spring seat. The pair of second guides each has a second opening through which the connecting rod passes and face each other so as to sandwich the spring in a direction in which a second straight line connecting the second openings extends.

[0006]

 An embodiment of the present invention is a pipe support. The pipe support
25 includes a hanger plate, a base plate, a spring seat, a pair of connecting rods, a spring, and at least one of a lower guide ring and an upper guide ring. The base plate is located under the hanger plate and has a through hole. The spring seat is sandwiched by the hanger plate and the base plate and is configured to reversibly

slide between the hanger plate and the base plate. The pair of connecting rods connects the hanger plate to the base plate, maintains a distance between the hanger plate and the base plate, and passes through the spring seat. The spring is located between the base plate and the spring seat. The turnbuckle is connected to the spring seat and is surrounded by the spring and the through hole. The lower guide ring is located over and in contact with the base plate, is surrounded by the spring, and surrounds the turnbuckle. The upper guide ring is located under and in contact with the spring seat, is surrounded by the spring, and surrounds the turnbuckle.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

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

FIG. 2 is a schematic side view of a pipe support according to an embodiment of the present invention.

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

FIG. 4A is a schematic top view of a pipe support according to an embodiment of the present invention.

FIG. 4B is a schematic top view of a pipe support according to an embodiment of the present invention.

FIG. 4C is a schematic top view of a pipe support according to an embodiment of the present invention.

FIG. 5A is a schematic bottom view of a pipe support according to an embodiment of the present invention.

FIG. 5B is a schematic bottom view of a pipe support according to an embodiment of the present invention.

FIG. 5C is a schematic bottom view of a pipe support according to an embodiment of the present invention.

FIG. 6A is a schematic side view of a pipe support according to an embodiment of the present invention.

5 FIG. 6B is a schematic side view of a pipe support according to an embodiment of the present invention.

FIG. 7A is a schematic side view of a pipe support according to an embodiment of the present invention.

10 FIG. 7B is a schematic side view of a pipe support according to an embodiment of the present invention.

FIG. 8A is a schematic side view of a pipe support according to an embodiment of the present invention.

FIG. 8B is a schematic side view of a pipe support according to an embodiment of the present invention.

15 FIG. 9A is a schematic side view of a pipe support according to an embodiment of the present invention.

FIG. 9B is a schematic side view of a pipe support according to an embodiment of the present invention.

20 FIG. 10A includes schematic top and bottom views of a pipe support according to an embodiment of the present invention.

FIG. 10B includes schematic top and bottom views of a pipe support according to an embodiment of the present invention.

FIG. 11 is a schematic perspective view of a pipe support according to an embodiment of the present invention.

25 FIG. 12 is a schematic view showing a relationship between a spring and connecting rods of a pipe support according to an embodiment of the present invention.

FIG. 13 is a schematic side view of a pipe support according to an

embodiment of the present invention.

FIG. 14A includes schematic top and bottom views of a pipe support according to an embodiment of the present invention.

FIG. 14B includes schematic top and bottom views of a pipe support
5 according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0008]

Hereinafter, each embodiment of the present invention is explained with
10 reference to the drawings. The invention can be implemented in a variety of different modes within its concept and should not be interpreted only within the disclosure of the embodiments exemplified below.

[0009]

The drawings may be illustrated so that the width, thickness, shape, and the
15 like are illustrated more schematically compared with those of the actual modes in order to provide a clearer explanation. However, they are only an example, and do not limit the interpretation of the invention. In the specification and the drawings, the same reference number is provided to an element that is the same as that which appears in preceding drawings, and a detailed explanation may be omitted as
20 appropriate.

[0010]

In the specification and drawings, when a plurality of the same or similar structures is collectively represented, the reference number is used, while a hyphen and a natural number follow the reference number when the structures are
25 independently represented. When a plurality of portions of one component is independently represented, the same reference number is used and a letter of the alphabet is further used.

[0011]

In the specification and drawings, a phrase that a plurality of elements is integrated means that the plurality of elements has functions different from each other but is formed from one member and has a continuous structure. Hence, a plurality of integrated elements includes the same material and has the same composition as each other.

[0012]

<First Embodiment>

Hereinafter, a pipe support 100 according to an embodiment of the present invention is explained. The pipe support 100 supports a piping and has a function of following the movement of the piping due to the changes in heat and weight. In the drawings used in the following description, the vertical direction is defined as a z direction and the horizontal plane perpendicular to the z direction is defined as a xy plane for convenience. As described below in detail, a direction connecting center axes of a pair of connecting rods and perpendicular to the z direction is defined as a x direction. The y direction is orthogonal to the z direction and the x direction.

[0013]

1. Overall Structure

A schematic perspective and side views of the pipe support 100 are respectively shown in FIG. 1 and FIG. 2. The pipe support 100 includes, as fundamental components, a hanger plate 104, a base plate 110, a spring seat 106, a spring 108, a turnbuckle 116, and a pair of connecting rods 118. The pipe support 100 further includes at least one of a lower spring guide 112 and an upper spring guide 114. These components are formed using a metal such as iron and stainless steel. Hereinafter, these components are explained in detail.

[0014]

1-1. Hanger Plate

The hanger plate 104 is a part for suspending the pipe support 100. A suspension ring 102 may be disposed over the hanger plate 104 for suspending the

pipe support 100. As can be easily understood from the following description, a piping supported by the pipe support 100 is placed under the turnbuckle 116. Therefore, when the hanger plate 104 is arranged, the pipe support 100 is suspended using a suspension ring 102, and the base plate 110, the spring seat 106, the spring 108, the turnbuckle 116, and the like are located under the hanger plate 104. There are no restrictions on the configuration of the suspension ring 102, and the suspension ring 102 may be designed appropriately in consideration of the sizes and the weights of the pipe support 100 and the piping to be supported.

[0015]

10 The hanger plate 104 is provided with through holes through which the pair of connecting rods 118 can pass, and the connecting rods 118 and the hanger plate 104 are secured by nuts 120. Thus, the relative positions of the hanger plate 104 and the connecting rods 118 are fixed.

[0016]

15 1-2. Base Plate

 The base plate 110 is located under the hanger plate 104 and faces the hanger plate 104 in the z direction. The hanger plate 104 is also provided with a pair of openings through which the pair of connecting rods 118 passes, and the connecting rods 118 and the base plate 110 are secured by nuts 122. Thus, the relative positions of the base plate 110 and the connecting rods 118 are also fixed. The pair of openings formed in the base plate 110 are provided so as to respectively overlap the pair of openings formed in the hanger plate 104 in the z direction. Therefore, the pair of connecting rods 118 can be vertically arranged, and the base plate 110 and the hanger plate 104 can be arranged parallel to each other by penetrating the connecting rods 118 through the openings of the base plate 110 and the hanger plate 104 and securing the connecting rods 118 to the base plate 110 and the hanger plate 104 respectively using the nuts 120 and 122. At the same time, the distance between the base plate 110 and the hanger plate 104 is

maintained.

[0017]

The base plate 110 is further provided with a through hole 110a between the pair of openings (see FIG. 1). The through hole 110a is provided in order to prevent
5 interference with the base plate 110 when the turnbuckle 116 slides up and down. In other words, the through hole 110a is formed so as to surround the turnbuckle 116 and to have a size sufficient to prevent the interference with the base plate 110 even if the turnbuckle 116 moves in the x direction and/or the y direction during the movement in the z direction. Preferably, the pair of openings and the through hole
10 110a are formed such that the center of the through hole 110a is located on a straight line connecting the centers of the pair of openings in the base plate 110.

[0018]

1-3. Connecting Rod

As described above, the connecting rod 118 is a part which passes through
15 the opening of the hanger plate 104 and the base plate 110 to secure the hanger plate 104 and the base plate 110 and has a function to maintain the constant distance therebetween. A thread is provided on the side surface of the connecting rod 118, which allows the nuts 120 and 122 to engage with the connecting rod 118. As described above, the direction which connects the center axes of the pair of
20 connecting rods 118 extending in the z direction and is perpendicular to the z direction is the x direction.

[0019]

1-4. Spring Seat

The spring seat 106 is located between the hanger plate 104 and the base
25 plate 110 in the z direction and is configured to reversibly slide in the z direction with the vertical movement of the piping. More specifically, the spring seat 106 is also provided with a pair of openings overlapping in the z direction with the openings of the hanger plate 104 and the base plate 110, and the spring seat 106 is arranged so

that the connecting rods 118 pass through these openings. A pair of nuts 124 and 126 engaged with the connecting rod 118 is disposed over and under the spring seat 106, respectively. The positions of both nuts 124 and 126 in the z direction are determined by rotating them around the connecting rod 118. Therefore, the upper
5 and lower limit positions of the spring seat 106 are determined by adjusting the positions of the nuts 124 and 126, and the spring seat slides in the z direction between the nuts 124 and 126.

[0020]

1-5. Spring and Turnbuckle

10 The spring 108 is provided between the base plate 110 and the spring seat 106. The spring 108 is preferably arranged between the base plate 110 and the spring seat 106 in a compressed state. Although the spring 108 is sandwiched between the base plate 110 and the spring seat 106, it is not welded or bolted thereto. The turnbuckle 116 is arranged so that its longitudinal direction is in the z direction
15 with its upper end to be secured to the spring seat 106 by welding, a bolt 128, or the like and is arranged to pass through an opening 110b in the base plate 110. On the other hand, a pipe clamp 150 connecting a piping to the turnbuckle 116 is connected to its lower end. The method of fixing the turnbuckle 116 and the pipe clamp 150 is arbitrarily determined, and the turnbuckle 116 and the pipe clamp 150 may be
20 connected by bolting using an opening 116a provided at the lower end of the turnbuckle 116, for example.

[0021]

When fluid passes through a piping, the weight and the heat of the fluid causes downward displacement to the piping. In response, the turnbuckle 116
25 moves downward (see the arrow in FIG. 2), and the spring 108 is compressed (FIG. 3). Since the restoring force generated at this time acts upward, it is possible to follow the vertical displacement of the piping. As a result, breakage of the piping and damage to equipment caused by the vertical displacement of the piping can be

effectively prevented.

[0022]

1-6. Lower Spring Guide and Upper Spring Guide

As described above, although the spring 108 is sandwiched between the
5 base plate 110 and the spring seat 106, it is not welded or bolted. Therefore, as
the spring 108 is extended or retracted, a force of rotation around its center axis
extending in the z direction is also applied to the spring 108, which may cause the
spring 108 to move in the xy plane. Such movement may cause the spring 108 to
drop out. In addition, the expansion and contraction process may cause a buckling
10 phenomenon depending on the number of turns, the pitch, the length, the coil
diameter d (see FIG. 2), the center diameter, and the like of the spring 108. At least
one of the lower spring guide 112 and the upper spring guide 114 is provided in the
pipe support 100 in order to prevent such dropout and buckling of the spring 108.

[0023]

15 (1) Lower Spring Guide

FIG. 4A shows a schematic top view of the pipe support 100. In this drawing,
only the base plate 110, the spring 108, and the lower spring guide 112 are shown
in solid lines, and the turnbuckle 116 is shown in dotted lines for visibility. The lower
spring guide 112 may be composed of, for example, a pair of guides (hereinafter
20 referred to as first guides) 112-1 and 112-2. The lower spring guide 112 is provided
over and in contact with the base plate 110. Each of the pair of first guides 112-1
and 112-2 is provided with an opening 112b overlapping in the z direction with the
opening 110b of the base plate 110, and the connecting rod 118 passes through the
opening 114b and the opening 112b. Thus, each of the first guides 112-1 and 112-
25 2 is secured to the base plate 110 by being sandwiched between the nut 122 and
the base plate 110. The thickness of each of the pair of first guides 112-1 and 112-
2 (length in the z direction. The same is applied hereinafter.) is, for example, equal
to or greater than 0.5 times the coil diameter d of the spring 108, thereby preventing

the spring 108 from moving over the pair of first guides 112-1 and 112-2. Note that the upper limit of the thickness of the pair of first guides 112-1, 112-2 may be twice the coil diameter d .

[0024]

5 In the direction in which a straight line connecting the centers of the two openings 114b of the base plate 110 extends (*i.e.*, the x direction), the pair of first guides 112-1, 112-2 faces each other and sandwiches the spring 108. As shown in FIG. 4B, the surfaces of the pair of first guides 112-1 and 112-2 facing each other may be curved to follow the shape of the spring 108. The curved surfaces 112a
10 allow a portion of the spring 108 to be surrounded by the pair of first guides 112-1 and 112-2 so that the spring 108 can also overlap the first guides 112-1 and 112-2 in the y direction. As a result, the movement in the x direction is restricted by the curved surfaces 112a, and at the same time, the movement in the y direction is also restricted, preventing the spring 108 from falling out. The pair of first guides 112-1
15 and 112-2 may be provided so as to be in contact with the spring 108 or may be provided so as to be spaced away from the spring 108. However, the distance between the pair of first guides 112-1 and 112-2 is adjusted so as to overlap a portion of the spring 108 in the y direction in order to prevent the spring 108 from moving in the y direction and dropping out.

20 [0025]

 The lower spring guide 112 may be integrated with the base plate 110. This structure reduces the number of parts of the pipe support 100. In addition, the pair of first guides 112-1, 112-2 may be integrated with each other. For example, the pair of first guides 112-1 and 112-2 may be integrated with a pair of bridges 112c
25 shown in FIG. 4C. The bridge 112c has an arc shape following the shape of the spring 108 and is configured to contact the base plate 110. The bridges 112c are also spaced away from the spring seat 106. It is more effective in preventing the spring 108 from falling out or buckling by integrating the pair of first guides 112-1 and

112-2 with the bridges 112c.

[0026]

(2) Upper Spring Guide

The same is applied to the upper spring guide 114. FIG. 5A shows a
5 schematic bottom view of the pipe support 100. In this drawing, only the spring seat
106, the spring 108, and the upper spring guide 114 are shown for visibility. Similar
to the lower spring guide 112, the upper spring guide 114 may be composed of, for
example, a pair of guides (hereinafter referred to as second guides) 114-1 and 114-
2. The upper spring guide 114 is provided under and in contact with the spring seat
10 106. Each of the pair of second guides 114-1 and 114-2 is provided with an opening
114b overlapping in the z direction with the opening 106b of the spring seat 106, and
the connecting rod 118 passes through the opening 106b and the opening 114b.
Each of the second guides 114-1 and 114-2 may be secured to the spring seat 106
by welding or using a bolt and a nut which are not illustrated. The thickness of each
15 of the pair of second guides 114-1 and 114-2 may also be selected from a range, for
example, equal to or greater than 0.5 and equal to or less than 2 times the coil
diameter d of the spring 108.

[0027]

In the direction in which a straight line connecting the centers of the two
20 openings 106b of the spring seat 106 extends (*i.e.*, the x direction), the pair of second
guides 114-1 and 114-2 faces each other and sandwiches the spring 108. As
shown in FIG. 5B, the surfaces of the pair of second guides 114-1 and 114-2 facing
each other may also be curved to follow the shape of the spring 108. The curved
surfaces 114a allow a portion of the spring 108 to be surrounded by the pair of
25 second guides 114-1 and 114-2 so that the spring 108 can overlap the pair of second
guides 114-1 and 114-2 in the y direction. As a result, movement with respect to
the x direction and the y direction is restricted, and the spring 108 can be prevented
from falling out. The pair of second guides 114-1 and 114-2 may be provided so as

to be in contact with the spring 108 or may be provided so as to be spaced away from the spring 108. However, the distance between the pair of second guides 114-1 and 114-2 is adjusted so as to overlap a portion of the spring 108 in the y direction in order to prevent the spring 108 from moving in the y direction and dropping out.

5 [0028]

Similar to the lower spring guide 112, the upper spring guide 114 may also be integrated with the spring seat 106. Furthermore, the pair of second guides 114-1 and 114-2 may also be integrated with each other. For example, the pair of second guides 114-1 and 114-2 may be integrated with a pair of bridges 114c as
10 shown in FIG. 5C. Similar to the bridge 112c, the bridge 114c also has an arc shape following the shape of spring 108 and is configured to contact the spring seat 106. The bridge 114c is also spaced away from the base plate 110. It is possible to more effectively prevent the spring 108 from falling out or buckling by integrating the pair of second guides 114-1 and 114-2 with the bridges 114c.

15 [0029]

In the pipe support 100 having the aforementioned structure, it is possible to effectively prevent the spring 108 from falling out or buckling without the use of a cover or the like covering the side of the spring 108. Therefore, the pipe support 100 can be made lighter, and at the same time, high air permeability can be secured
20 for the spring 108 and the turnbuckle 116 disposed therein. As a result, corrosion caused by rainwater or the like can be significantly suppressed, and the durability of the pipe support 100 is improved. In addition, since almost all the portions of the spring 108 and turnbuckle 116 can be visually observed from the outside, the condition of the spring 108 and the turnbuckle 116 can be easily grasped.
25 Therefore, even if damage occurs to each part such as the spring 108, the turnbuckle 116, and the like, the damage can be detected at an early stage. This feature enables easy maintenance work and contributes to higher efficiency of maintenance work.

[0030]

<Second Embodiment>

In this embodiment, a modified example of the pipe support 100 described in the First Embodiment is explained. An explanation of the structures the same as
5 or similar to those described in the First Embodiment may be omitted.

[0031]

As shown in the schematic side views of FIG. 6A and FIG. 6B, the pipe support 100 may further include a pair of lower stoppers 130 as a mechanism to prevent the springs 108 from falling out or buckling, either instead of the lower spring
10 guide 112 and the upper spring guide 114 or together with at least one of the lower spring guide 112 and the upper spring guide 114. Each lower stopper 130 is secured to the base plate 110 by welding or bolting. Each lower stopper 130 extends from the base plate 110 in the z direction, *i.e.*, toward the spring seat 106. The pair of lower stoppers 130 is arranged to sandwich the spring 108 when
15 observed from the z direction. The width w (length in the x direction or the y direction) of each lower stopper 130 may be selected from a range equal to or greater than 5% and equal to or less than 30% or equal to or greater than 10% and equal to or less than 20% of the outer diameter D_0 of the spring 108, for example (see FIG. 6A). The height of each lower stopper 130, more specifically, the length l in the z
20 direction of a portion of each lower stopper 130 above the top surface of the base plate 110 may be selected from a range equal to or greater than 20% and equal to or less than 50% or equal to or greater than 25% and equal to or less than 40% of the length L of the spring 108 (see FIG. 6B). Hence, each lower stopper 130 is spaced away from the spring seat 106.

25 [0032]

Each lower stopper 130 may be fixed to a side surface of the base plate 110 as shown in FIG. 6A and FIG. 6B or may overlap a portion of the bottom surface of the base plate 110 as shown in FIG. 7A. Alternatively, as shown in FIG. 7B, each

lower stopper 130 may pass through the base plate 110 in the z direction. In this case, the lower stopper 130 may be a bolt secured to the base plate 110 in combination with a nut. Although not illustrated, the pipe support 100 may have three or more lower stoppers 130. In this case, the lower stoppers 130 are preferably arranged radially from the center of the through hole 110a or the center axis of the spring 108 extending in the z direction.

[0033]

As shown in the schematic side views of FIG. 8A and FIG. 8B, the pipe support 100 may further include a pair of upper stoppers 132 in place of the lower stoppers 130. Each upper stopper 132 is secured to the spring seat 106 by welding or bolting. Each upper stopper 132 extends from the spring seat 106 in the z direction, *i.e.*, toward the base plate 110. The pair of upper stoppers 132 is arranged to sandwich the spring 108 when observed from the z direction. The width w' of each upper stopper 132 (length in the x direction or the y direction) may be selected from a range equal to or greater than 5% and equal to or less than 30% or equal to or greater than 10% and equal to or less than 20% of the outer diameter D_0 of the spring 108, for example (see FIG. 8A). The height of each upper stopper 132, more specifically, the length l in the z direction of a portion of each upper stopper 132 below the lower surface of the spring seat 106, may be selected from a range equal to or greater than 20% and equal to or less than 50% or equal to or greater than 25% and equal to or less than 40% of the length L of the spring 108. Thus, each upper stopper 132 is spaced away from the base plate 110.

[0034]

Each upper stopper 132 may be fixed to a side surface of the base plate 110 as shown in FIG. 8A and FIG. 8B. Alternatively, similar to the lower stopper 130, each upper stopper 132 may overlap a portion of the top surface of the spring seat 106 or may pass through the spring seat 106, although not illustrated. Although not illustrated, the pipe support 100 may have three or more upper stoppers 132

arranged radially from the center axis of the spring 108.

[0035]

Alternatively, the pipe support 100 may have both the lower stopper 130 and the upper stopper 132 as shown in the schematic side views of FIG. 9A and FIG. 9B.

5 [0036]

Even if the spring 108 moves in the xy plane as it expands or contracts, it is possible to effectively prevent the spring 108 from falling out because the lower stopper 130 and/or the upper stopper 132 contacts the spring 108. In addition, buckling of the spring 108 can also be prevented at the same time. Therefore, when
10 the lower stopper 130 and/or the upper stopper 132 is provided, it is not necessary to dispose the lower spring guide 112 and/or the upper spring guide 114 having the structure described in the First Embodiment. Even in the case where the lower spring guide 112 and/or the upper spring guide 114 is provided, the spring 108 can be prevented from falling out or buckling even if these components do not overlap
15 the spring 108 in the y direction. For example, as can be understood from the schematic top and bottom views respectively shown in FIG. 10A and FIG. 10B, the pair of first guides 112-1 and 112-2 structuring the lower spring guide 112 and the pair of second guides 114-1 and 114-2 structuring the upper spring guide 114 may have a shape which overlaps the spring 108 in the x direction but does not overlap
20 the spring 108 in the y direction. For example, the pair of first guides 112-1 and 112-2 and the pair of second guides 114-1 and 114-2 may have a ring shape respectively centered on the openings 110b and 106b and surrounding the connecting rod 118.

[0037]

25 In the aforementioned modified example, the spring 108 can be effectively prevented from falling out without the use of a cover or the like covering the side surface of the spring 108. In addition, almost the entire spring 108 and turnbuckle 116 can be observed from the outside. Therefore, the pipe support 100 according

to this modified example can also have the same effect as the pipe support 100 having the structure described in the First Embodiment.

[0038]

<Third Embodiment>

5 In this embodiment, a pipe support 140 having a different structure from the pipe support 100 and its modified example described in the First and Second embodiments is explained. An explanation of the structures the same as or similar to those described in the First and Second Embodiments may be omitted.

[0039]

10 As shown in the schematic perspective view in FIG. 11, the pipe support 140 may have three or four or more connecting rods 118. In this case, the connecting rods 118 are provided such that their center axes extend in the z direction and are arranged radially around the center axis of the spring 108. Each of the hanger plate 104, the spring seat 106, and the base plate 110 also has a plurality of branches
15 extending radially from the center axis of the spring 108 in the xy plane, and each connecting rod 118 is arranged to pass through the branches of the hanger plate 104, the spring seat 106, and the base plate 110.

[0040]

 At this time, the plurality of connecting rods 118 is preferred to be arranged
20 so that the spring 108 cannot pass between adjacent connecting rods 118. That is, as schematically demonstrated in FIG. 12, it is preferable to arrange the plurality of connecting rods 118 so that the distance D_1 in the xy plane between adjacent connecting rods 118 is smaller than the outer diameter D_0 of the spring 108 between the base plate 110 and the spring seat 106. Employment of such an arrangement
25 can effectively prevent the spring 108 from falling out or buckling. Therefore, the pipe support 140 does not necessarily require the lower spring guide 112, the upper spring guide 114, the lower stopper 130, and the upper stopper 132 described in the First and Second Embodiments, and some or all of these components may not be

provided.

[0041]

In the pipe support 140 in this embodiment, it is also possible to effectively prevent the spring 108 from falling out or buckling without the use of a cover or the like covering the side surface of the spring 108. In addition, almost the entire spring 108 and turnbuckle 116 can be observed from the outside. Therefore, the pipe support 140 can also achieve the same effects as the pipe support 100 having the structure described in the First embodiment. Furthermore, the x component and the y component of the vibration vector of the turnbuckle 116 can be significantly reduced by providing the plurality of connecting rods 118, thereby effectively preventing vibration of the piping in the xy plane.

[0042]

<Fourth Embodiment>

In this embodiment, a pipe support 142 having a different structure from the pipe support 100, the modified example thereof, and the pipe support 140 respectively described in the First to Third Embodiments is explained. An explanation of the structures the same as or similar to those described in the First to Third Embodiments may be omitted. As shown in the schematic side view in FIG. 13, one of the differences of the pipe support 142 from the pipe support 100, the pipe support 140, and the like is that the pipe support 142 includes at least one of a lower guide ring 144 and an upper guide ring 146 as a mechanism to prevent the spring 108 from falling out or buckling.

[0043]

The lower guide ring 144 is located over and in contact with the base plate 110. The lower guide ring 144 may be integrated with the base plate 110 or may be secured to the base plate 110 by welding or bolting as an independent component. As can be understood from FIG. 13 and FIG. 14A, the lower guide ring 144 is surrounded by the spring 108. That is, the outer diameter D_2 in the xy plane of the

lower guide ring 144 is smaller than the inner diameter D_1 of the spring 108. The height of the lower guide ring 144, *i.e.*, the height from the top surface of the base plate 110, may be selected from a range equal to or greater than 0.5 times and equal to or less than 2 times the coil diameter d of the spring 108. Thus, the lower guide ring 144 is spaced away from the spring seat 106. The lower guide ring 144 may be in contact with or spaced away from the spring 108. Preferably, the lower guide ring 144 is arranged so that its center is located on a straight line connecting the centers of the pair of openings 110b in the base plate 110 and/or that the lower guide ring 144 overlaps the center of the through hole 110a of the base plate 110. Employment of such a configuration and arrangement effectively prevents the spring 108 from falling off caused by the movement of the spring 108 because the spring 108 and the lower guide ring 144 interfere with each other even if the spring 108 moves due to expansion or contraction.

[0044]

The upper guide ring 146 may have a similar configuration and arrangement. Specifically, the upper guide ring 146 is provided under and in contact with the spring seat 106 as shown in FIG. 13 and FIG. 14B. The upper guide ring 146 may be integrated with the spring seat 106 or may be secured to the spring seat 106 by welding or bolting as an independent component. As shown in FIG. 13 and FIG. 14B, the upper guide ring 146 is surrounded by the spring 108. That is, the outer diameter D_3 in the xy plane of the upper guide ring 146 is smaller than the inner diameter D_1 of the spring 108. The height of the upper guide ring 146, *i.e.*, the length from the bottom surface of the spring seat 106, may be selected from a range equal to or greater than 0.5 times and equal to or less than 2 times the coil diameter d of the spring 108. Thus, the upper guide ring 146 is spaced away from the base plate 110. The upper guide ring 146 may be in contact with or spaced away from the spring 108. Preferably, the upper guide ring 146 is arranged so that its center is located over a straight line connecting the centers of the pair of openings 106b of

the spring seat 106. Employment of such a configuration and arrangement makes it possible to effectively prevent the spring 108 from falling off caused by the movement of the spring 108 because the spring 108 and the upper guide ring 146 interfere with each other even if the spring 108 moves due to expansion or contraction. In addition, the buckling of the spring seat 106 can also be effectively prevented by providing both the lower guide ring 144 and the upper guide ring 146. [0045]

Note that one or a plurality of the lower spring guide 112, the upper spring guide 114, the lower stopper 130, and the upper stopper 132 described in the First and Second Embodiments may be provided in the pipe support 142. [0046]

In the pipe support 142 according to the present embodiment, it is also possible to effectively prevent the spring 108 from falling out or buckling without the use of a cover or the like covering the side surface of the spring 108. In addition, almost the entire spring 108 and turnbuckle 116 can be observed from the outside. Therefore, the pipe support 142 can realize the same effects as the pipe support 100, 140, or the modified examples thereof having the structure described in the First to Second embodiments. [0047]

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, any mode which is realized by persons ordinarily skilled in the art through the appropriate addition, deletion, or design change of elements or through the addition, deletion, or condition change of a process on the basis of each embodiment is included in the scope of the present invention as long as they possess the concept of the present invention. [0048]

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 REFERENCE SIGN LIST

[0049]

100: Pipe support, 102: Suspension ring, 104: Hanger plate, 106: Spring seat, 106b: Opening, 108: Spring, 110: Base plate, 110a: Through hole, 110b: Opening, 112: Lower spring guide, 112-1: First guide, 112 -2: First guide, 112a: Curved surface, 112b: Opening, 112c: Bridge, 114: Upper spring guide, 114-1: Second guide, 114-2: Second guide, 114a: Curved surface, 114b: Opening, 11 4c: Bridge, 116: Turnbuckle, 116a: Opening, 118: Connecting rod, 120: Nut, 122: Nut, 124: Nut, 126: Nut, 128: Bolt, 130: Lower stopper, 132: Upper stopper, 140: Pipe support, 142: Pipe support, 144: Lower guide ring, 146: Upper guide ring, 150: Pipe clamp

CLAIMS

1. A pipe support comprising:
 - a hanger plate;
 - a base plate located under the hanger plate and having a through hole;
 - 5 a spring seat sandwiched by the hanger plate and the base plate and configured to reversibly slide between the hanger plate and the base plate;
 - a pair of connecting rods connecting the hanger plate to the base plate, maintaining a distance between the hanger plate and the base plate, and passing through the spring seat;
 - 10 a spring between the base plate and the spring seat;
 - a turnbuckle connected to the spring seat and surrounded by the spring and the through hole; and
 - at least one of a lower spring guide and an upper spring guide,
 - wherein the lower spring guide comprises a pair of first guides located over
 - 15 and in contact with the base plate,
 - wherein the pair of first guides each has a first opening through which the connecting rod passes and faces each other in a direction in which a first straight line connecting the first openings extends so as to sandwich the spring,
 - wherein the upper spring guide comprises a pair of second guides located
 - 20 under and in contact with the spring seat, and
 - wherein the pair of second guides each has a second opening through which the connecting rod passes and faces each other in a direction in which a second straight line connecting the second openings extends so as to sandwich the spring.
- 25 2. The pipe support according to claim 1,
 - wherein the lower spring guide is integrated with the base plate.
3. The pipe support according to claim 1,

wherein the upper spring guide is integrated with the spring seat.

4. The pipe support according to claim 1,
wherein the lower spring guide is in contact with the spring.

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5. The pipe support according to claim 1,
wherein the upper spring guide is in contact with the spring.

6. The pipe support according to claim 1,
10 wherein the pair of first guides overlaps the spring in a direction which is perpendicular to the first straight line and which is perpendicular to a center axis of the spring.

7. The pipe support according to claim 1,
15 wherein the pair of second guides overlaps the spring in a direction which is perpendicular to the second straight line and which is perpendicular to a center axis of the spring.

8. The pipe support according to claim 1,
20 wherein the pair of first guides is connected to each other by a pair of arc-shaped bridges sandwiching the spring, and
wherein the pair of arc-shaped bridges is located over and in contact with the base plate.

- 25 9. The pipe support according to claim 1,
wherein the pair of second guides is connected to each other by a pair of arc-shaped bridges sandwiching the spring, and
wherein the pair of arc-shaped bridges is located under and in contact with

the spring seat.

10. The pipe support according to claim 1, further comprising at least one lower stopper extending toward the spring seat from the base plate.

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11. The pipe support according to claim 1, further comprising at least one upper stopper extending toward the base plate from the spring seat.

12. A pipe support comprising:

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a hanger plate;

a base plate located under the hanger plate and having a through hole;

a spring seat sandwiched by the hanger plate and the base plate and configured to reversibly slide between the hanger plate and the base plate;

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a pair of connecting rods connecting the hanger plate to the base plate, maintaining a distance between the hanger plate and the base plate, and passing through the spring seat;

a spring between the base plate and the spring seat;

a turnbuckle connected to the spring seat and surrounded by the spring and the through hole; and

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at least one of a lower guide ring and an upper guide ring,

wherein the lower guide ring is located over and in contact with the base plate, is surrounded by the spring, and surrounds the turnbuckle, and

wherein the upper guide ring is located under and in contact with the spring seat, is surrounded by the spring, and surrounds the turnbuckle.

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13. The pipe support according to claim 12,

wherein the lower guide ring is integrated with the base plate.

14. The pipe support according to claim 12,
wherein the upper guide ring is integrated with the spring seat.
- 5 15. The pipe support according to claim 12,
wherein the lower guide ring is in contact with the spring.
16. The pipe support according to claim 12,
wherein the upper guide ring is in contact with the spring.
- 10 17. The pipe support according to claim 12,
wherein the lower guide ring is spaced away from the spring seat.
18. The pipe support according to claim 12,
wherein the upper guide ring is spaced away from the base plate.