

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 at least one spring, a spring seat over the spring, a plurality of supporting frames, a pair of hanger plates, a second hanger plate, and a turnbuckle. The plurality of supporting frames extends parallel to a spring axis of the spring and is arranged to surround a portion of the spring seat and the spring. The pair of hanger
10 plates is connected to the plurality of supporting frames. The turnbuckle is suspended from the spring seat through a shaft and is surrounded by the spring. A lower end of each of the plurality of supporting frames has a hook shape hooking and supporting the spring.

[0006]

15 An embodiment of the present invention is a pipe support. The pipe support includes a base plate, at least one spring, a spring seat, a hanger plate, a plurality of supporting frames, and a turnbuckle. The base plate has a through hole. The spring is located over the base plate and overlaps an upper surface of the base plate. The spring seat is located over the spring, and the hanger plate is located over the
20 spring seat. The plurality of supporting frames extends parallel to a spring axis of the spring, is secured to the base plate and the hanger plate, and is arranged so as to surround a portion of the spring seat and the spring. The turnbuckle is suspended from the spring seat through a shaft and is surrounded by the spring and the base plate.

25

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 top view of a pipe support according to an embodiment of the present invention.

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

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

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

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

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

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

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

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

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

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

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

FIG. 12 is a schematic perspective view 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. 14 is a schematic side view of a pipe support according to an embodiment of the present invention.

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

FIG. 15B is a schematic top view of a pipe support according to an embodiment of the present invention.

FIG. 16A is a schematic top view of a pipe support according to an embodiment of the present invention.

10 FIG. 16B is a schematic bottom view of a pipe support according to an embodiment of the present invention.

FIG. 17 is a schematic perspective view of a portion of a pipe support according to an embodiment of the present invention.

15 FIG. 18 is a schematic perspective view of a portion of a pipe support according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0008]

Hereinafter, each embodiment of the present invention is explained with
20 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
25 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 appropriate.

[0010]

5 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 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.

10 [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, the 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. The x direction and the y direction are orthogonal to the z direction.

25 [0013]

1. Overall Structure

A schematic perspective view of the pipe support 100 is shown in FIG. 1. The pipe support 100 includes, as fundamental components, a pair of hanger plates

102, a spring seat 106, at least one spring 108, a plurality of supporting frames 110, and a turnbuckle 116. These components are formed using a metal such as iron and stainless steel. Hereinafter, these components are explained in detail.

[0014]

5 1-1. Hanger Plate

The pair of hanger plates 102 including a first hanger plate 102-1 and a second hanger plate 102-2 is a component for suspending the pipe support 100 including the spring seat 106, the spring 108, the supporting frames 110, and the turnbuckle 116. The pair of hanger plates 102 is fixed so as to face each other with
10 their main surfaces parallel in the z direction. The method of fixing the hanger plates 102 to each other is arbitrarily determined, and a bolt 130 and a nut 132 may be used, for example. Each of the pair of hanger plates 102 may be provided with an opening 102a for suspending the pipe support 100 from a post or the like. The openings 102a are provided so as to overlap each other in a direction perpendicular
15 to the z direction (y direction in the example of FIG. 1). Although not illustrated, the pair of hanger plates 102 may be a single integrated component.

[0015]

1-2. Spring Seat

The spring seat 106 is a plate-like member located under the hanger plate
20 102 and partially overlapping the hanger plate 102 and is arranged so that its main surface is parallel or substantially parallel to the xy plane. As can be understood from the schematic top view of the spring seat 106 shown in FIG. 2, the spring seat 106 includes a center portion 106a overlapping the spring 108 depicted by dashed lines as well as a pair of end portions 106b sandwiching the center portion 106a.
25 The end portions 106b are portions protruding in the xy plane from the center portion 106a and are opposite each other through the center portion 106a. Therefore, the end portions 106b do not overlap the spring 108 in the z direction. As described later in detail, the movement of the spring 108 in the xy plane is restricted by the

supporting frames 110. Hence, there is no need to provide a structure (depressions, projections, ribs, or the like) on the lower surface of the spring seat 106 to prevent the movement of the spring 108, and the lower surface may be flat over the entire spring seat 106. Hereafter, the direction in which the end portions 106b extend from the center portion 106a is defined as the x direction.

[0016]

1-3. Supporting Frame

In the pipe support 100, two or more supporting frames 110 are provided. There is no restriction on the number of supporting frames 110, and the plurality of supporting frames 110 may include four supporting frames 110 as shown in FIG. 1, for example. Hereinafter, the explanation is continued using the example where the plurality of supporting frames 110 includes first through fourth supporting frames 110-1 to 110-4.

[0017]

The plurality of supporting frames 110 is each connected and secured to one of the pair of hanger plates 102. In the example shown in FIG. 1, the first supporting frame 110-1 and the second supporting frame 110-2 are connected and secured to the first hanger plate 102-1 and extend downward (*i.e.*, in the z direction) from the first hanger plate 102-1. The first supporting frame 110-1 and the second supporting frame 110-2 may be connected and secured to the first hanger plate 102-1 by welding or bolting or may be integrated with the first hanger plate 102-1. Similarly, the third supporting frame 110-3 and the fourth supporting frame 110-4 are also connected and secured to the second hanger plate 102-2 and extend downward from the second hanger plate 102-2. The third supporting frame 110-3 and the fourth supporting frame 110-4 may also be connected and secured to the second hanger plate 102-2 by welding or bolting or may be integrated with the second hanger plate 102-2. The first supporting frame 110-1 and the third supporting frame 110-3, and the second supporting frame 110-2 and the fourth supporting frame 110-

4 are secured to each other using, for example, bolts 134 and nuts 136.

[0018]

The plurality of supporting frames 110 is arranged to surround a portion of the spring seat 106 and the spring 108. More specifically, the plurality of supporting frames 110 surrounds the spring 108 as well as the center portion 106a of the spring seat 106 in the xy plane as shown in FIG. 2. Furthermore, the plurality of supporting frames 110 is arranged to sandwich the end portions 106b of the spring seat 106. In the example shown in FIG. 2, the first supporting frame 110-1 and the third supporting frame 110-3 face each other through one of the end portions 106b in the y direction. Similarly, the second supporting frame 110-2 and the fourth supporting frame 110-4 also face each other through the other end portion 106b in the y direction. Thus, one of the end portions 106b is sandwiched between the first supporting frame 110-1 and the third supporting frame 110-3 in the y direction, while the other end portion 106b is sandwiched between the second supporting frame 110-2 and the fourth supporting frame 110. Although FIG. 2 shows an example where the end portions 106b are in contact with the supporting frames 110, the width (length in the y direction) of the end portion 106b may be shorter than the distance d_1 between the supporting frames 110 sandwiching the end portion 160. In this case, the spring seat 106 may not exist in a state where it is in contact with the supporting frames 110.

[0019]

Here, the length of the center portion 106a in the y direction is longer than the width (length in the y direction) of the end portion 106b as shown in FIG. 2. In addition, a distance d_1 between two supporting frames 110 sandwiching one end portion 106b in the y direction, that is, two supporting frames 110 sandwiching one end portion 106b (*e.g.*, the first supporting frame 110-1 and the third supporting frame 110-3 or the second supporting frame 110-2 and the fourth supporting frame 110-4), is equal to or greater than the width of the end portion 106b but is less than

the length of the center portion 106a in the y direction. Therefore, the movement of the spring seat 106 in the xy plane is restricted by the supporting frames 110, while the spring seat 106 is allowed to slide in the z direction with the end portion 106b sandwiched between the pair of supporting frames 110.

5 [0020]

Furthermore, the supporting frames 110 are arranged so that a distance d_1 between two supporting frames 110 sandwiching one end portion 106b is smaller than the outer diameter D of the spring 108. At the same time, the supporting frames 110 are arranged so that a distance d_2 between the z directionally extending portions of two supporting frames 110 overlapping in the x direction, that is, two supporting frames sandwiching the center portion 106a (*e.g.*, the first supporting frame 110-1 and the second supporting frame 110-2 or the third supporting frame 110-3 and the fourth supporting frame 110-4), is also smaller than the outer diameter D of the spring 108. Employment of such an arrangement inhibits the spring 108 to pass between adjacent supporting frames 110, thereby preventing the spring 108 from falling out of the pipe support 100.

[0021]

As shown in FIG. 1, the lower end of each supporting frame 110 is bent and has a hook shape. Specifically, as shown in FIG. 3A and FIG. 3B, each supporting frame 110 bends to have a first portion 110a extending in the z direction from the hanger plate 102 and surrounding the spring seat 106 and the spring 108, a third portion 110c arranged inside the spring 108 and surrounded by the spring 108, and a second portion located between the first portion 110a and the third portion 110c and overlapping the spring 108 on the lower side of the spring 108. The spring 108 is supported and the position of the lower end of the spring 108 is determined by the second portion 110b. As described in detail below, such a hooked shape hooks the lower end of the spring 108 and stabilizes the behavior of the spring 108.

[0022]

1-4. Spring and Turnbuckle

The spring 108 is arranged between the second portions 110b of the supporting frames 110 and the spring seat 106 so that its center axis (hereinafter referred to as a spring axis) extends in the z direction. Although sandwiched
5 between the second portions 110b and the spring seat 106, it is not necessary to weld or bolt the spring 108 to these components.

[0023]

FIG. 4 and FIG. 5 show schematic side views of the pipe support 100. The turnbuckle 116 is arranged so that a longitudinal direction thereof is directed in the z
10 direction, and its upper end is suspended from the spring seat 106 via a shaft 118. The shaft 118 may be welded to the spring seat 106, or a bolt passing through the spring seat 106 may be used as the shaft 118 as shown in FIG. 5 and FIG. 6. The turnbuckle 116 is arranged to be surrounded by the spring 108 while suspended from the spring seat 106.

15 [0024]

A pipe clamp 150 for fixing a piping to the turnbuckle 116 is connected to the lower end of the turnbuckle 116. The method of connecting the turnbuckle 116 and the pipe clamp 150 is arbitrary, and the turnbuckle 116 may be connected to the pipe clamp 150 by bolting or the like using an opening 116a (see FIG. 1) provided at the
20 lower end of the turnbuckle 116, for example.

[0025]

Generally, when connecting a piping 152, the pipe support 100 is suspended from a post or the like using the opening 102a, and the piping 152 is attached to the turnbuckle 116 via the pipe clamp 150 in this state. At this time, if the length of the
25 spring 108 is a natural length, the weights of the piping 152 and pipe clamp 150 causes the spring 108 to be compressed, which in turn causes the turnbuckle 116 as well as the pipe clamp 150 and the piping 152 attached to the turnbuckle 116 to move downward. If such movement occurs, the piping 152 is arranged at a position

downwardly shifted from the predetermined position. Therefore, it is preferable to set (preset) the spring 108 in a compressed state in advance so that the turnbuckle 116 is not moved in the z direction by the restoring force of the spring 108 even after the piping 152 and pipe clamp 150 are connected.

5 [0026]

Therefore, the pipe support 100 may further include a pair of securing plates 114 sandwiching the plurality of supporting frames 110 as a component for presetting the spring 108 (FIG. 6). There is no restriction on the shape or the structure of the securing plates 114, as long as the securing plates 114 are configured to have a function to fix the distance between the spring seat 106 and the supporting frames 110 and/or the distance between the hanger plates 102. For example, the securing plate 114 may be a plate-shaped member having openings 114a and 114b through which at least one of the pair of hanger plates 102 and the end portion 106b of the spring seat 106 respectively pass as shown in FIG. 6. In the example shown in FIG. 6, the pair of hanger plates 102 simultaneously passes through the opening 114a. The spring 108 can be accommodated between the second portions 110b of the supporting frames 110 and the spring seat 106 at an arbitral length by appropriately adjusting the distance between the openings 114a and 114b. Therefore, the securing plate 114 is used when connecting the piping 152 and the pipe clamp 150 to the turnbuckle 116 in a state where an appropriate compressed state determined by taking into account the weights of the piping 152 and the pipe clamp 150 is maintained, and then the securing plate 114 is removed, by which the piping 152 can be arranged at a predetermined position.

[0027]

25 When fluid flows through the piping 152, the weight of the fluid applies a downward force to the piping 152, which in turn pulls the turnbuckle 116 downward. When the spring seat 106 moves downward as a result, the restoring force of the spring 108 increases, and an upward force is applied, by which a certain restoring

force can be added as shown in FIG. 7.

[0028]

When the spring 108 is extended or compressed, a rotational force is also applied to the spring 108 around the spring axis extending in the z direction, which may cause the spring 108 to move in the xy plane. Such movement may cause the spring 108 to drop out. In addition, a buckling phenomenon may occur during the expansion and compression process, depending on the number of turns, pitch, length, coil diameter, and center diameter of the spring 108. However, as described above, since the supporting frames 110 are arranged so that the distances d_1 and d_2 between two supporting frames 110 (see FIG. 3A and FIG. 3B) are smaller than the outer diameter D of the spring 108, the body bending and buckling of the spring 108 can be prevented. Furthermore, the third portion 110c surrounded by the spring 108 is formed in each supporting frame 110. Thus, the spring 108 is prevented from falling out even if the movement of the spring 108 occurs in the xy plane.

15 [0029]

The pipe support 100 having the aforementioned structure can 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. Therefore, the pipe support 100 can be made lighter, and at the same time, high air permeability can be secured for the spring 108 and the turnbuckle 116 disposed inside the spring 108. 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 of the portions of the spring 108 and the turnbuckle 116 can be visually observed from the outside, the condition of the spring 108 and the turnbuckle 116 can be easily grasped. Therefore, even if damage occurs in each part such as the spring 108 and the turnbuckle 116, it can be detected at an early stage. These features enable easy maintenance work and contribute to higher efficiency of maintenance work. In addition, the pipe support 100 can be manufactured at low cost because each

component can be connected and fixed just by bolting without welding.

[0030]

2. Modified Example

2-1. Modified Example 1

5 The structure of the pipe support 100 is not limited to that described above. For example, a pair of guide rods 112 may be provided to more precisely control the position of the spring seat 106 as shown in FIG. 8 to FIG. 9B. In this case, a cover plate 104 connecting the pair of hanger plates 102 may be provided, and the guide rods 112 may be fixed to the cover plate 104 so as to extend downward from the
10 cover plate 104, for example. For instance, the cover plate 104 is secured over the hanger plates 102 as in the example shown in FIG. 8 through FIG. 9B. Fixing may be carried out by welding or bolting. The guide rod 112 is a bolt with a head 112a at its upper end, and its thread portion is provided with threads which are not illustrated. An opening is provided in the cover plate 104 through which the thread
15 portion of the guide rod 112 passes but through which the head 112a does not pass. The guide rod 112 is inserted into this opening and secured with the nut 120, by which the cover plate 104 and the guide rod 112 are secured to each other with the guide rod 112 extending downward (z direction) from the cover plate 104. Note that the direction connecting the z directionally extending center axes of the pair of guide
20 rods 112 and perpendicular to the z direction is the x direction.

[0031]

Each of the pair of end portions 106b of the spring seat 106 is provided with a pair of cutoffs sandwiching the guide rod 112. Although not illustrated, a pair of openings into which the guide rods 112 can be inserted may be provided at the end
25 portions 106b instead of the pair of cutoffs. As an optional component, a bolt 124 with a hole and a nut 126 may be attached to the cutoff or the opening of the spring seat 106 so as to sandwich the spring seat 106. A washer is inserted between the bolt 124 with a hole and the spring seat 106 and between the nut 126 and the spring

seat 106 as appropriate. Although the bolt 124 with a hole and the nut 126 surround the guide rod 112, they slide on the guide rod 112. Therefore, the spring seat 106 is able to slide reversibly in the z direction (*i.e.*, up and down) along the guide rod 112 during the vertical movement of the piping, *i.e.*, the vertical movement of the turnbuckle 116, without dropping from the guide rods 112. Each guide rod 112 may be provided with two vertically shifted nuts 122 and 128 engaging the threads. The positions in the z direction of the nuts 122 and 128 can be determined by rotating them around the guide rods 112. Therefore, the initial position of the spring seat 106 can be determined by adjusting the positions of the nuts 122 and 128.

10 [0032]

2-2. Modified Example 2

Alternatively, a single cover plate 104 may be connected to the hanger plate 102 as schematically shown in FIG. 10. In this case, there is no need to provide the opening 102a to the hanger plate 102, and instead, a suspension ring 138 may be placed over the cover plate 104. The guide rods 112 are provided so as to downwardly extend from the single cover plate 104.

[0033]

2-3. Modified Example 3

As described above, at least one spring 108 is provided in the pipe support 100 in the example shown in FIG. 1 and the like, but the at least one spring 108 may include a plurality of springs 108. Specifically, a plurality of springs (here, a first spring 108-1 and a second spring 108-2) overlapping each other in the z direction may be provided between the third portions 110c of the supporting frames 110 and the spring seat 106 as shown in FIG 11. In this case, an intermediate ring 109 with an opening through which the shaft 118 can pass may be placed between adjacent springs 108. The pipe support 100 can be used at a position where there is a large amount of piping movement by providing the plurality of springs 108.

25 [0034]

In the aforementioned modified examples, the supporting frames 110 restrict the movement of the spring 108 in the xy plane and effectively prevent the spring 108 from falling out and buckling while allowing the spring 108 to slide in the z direction without using a cover covering the side surface of the spring 108. This feature contributes to weight reduction of the pipe support, reduction of manufacturing cost, and reduction of a burden in maintenance work.

[0035]

<Second Embodiment>

In this embodiment, a pipe support 160 having a different structure from the pipe support 100 described in the First Embodiment is explained. An explanation of the structures the same as or similar to those described in the First Embodiment may be omitted.

[0036]

A schematic perspective view of the pipe support 160 is shown in FIG. 12, and side views thereof are shown in FIG. 13 and FIG. 14. As demonstrated in these drawings, the pipe support 160 includes, as its fundamental components, a base plate 146, at least one spring 108, a spring seat 106, a hanger plate 102, a plurality of supporting frames 142, and a turnbuckle 116. The pipe support 160 may further include a first band plate 140 and a second band plate 144 as optional components.

[0037]

1. Hanger Plate

Schematic top views of the pipe support 160 are shown in FIG. 15A and 15B. In FIG. 15B, the hanger plate 102 is illustrated as a chain line for visibility. The hanger plate 102 is a component for suspending the pipe support 160 including the base plate 146, the spring 108, the spring seat 106, the supporting frames 142, the turnbuckle 116, and the like. A suspension ring 138 is provided on the top surface of hanger plate 102 in order to realize the aforementioned function. The shape of the hanger plate 102 in the xy plane may be arbitrarily determined. As shown in

FIG. 15B, the shape of the hanger plate 102 in the xy plane may be a cruciform or, although not illustrated, may be a polygon including a square and a rectangle.

[0038]

2. Base Plate

5 Schematic top and bottom views of the pipe support 160 are respectively shown in FIG. 16A and FIG. 16B. The hanger plate 102, the spring seat 106, and the like are not illustrated in FIG. 16A for visibility. The base plate 146 is a part having a function to support the spring 108, where the base plate 146 has a through hole 146a through which the turnbuckle 116 can pass and is configured so that a top surface thereof overlaps the spring 108 as shown in FIG. 16A and FIG. 16B. As
10 shown in FIG. 16B, the base plate 146 may also have a cruciform shape. However, the shape thereof may be arbitrarily determined as long as the above functions can be expressed and may be a polygon including a square and a rectangle, a circle, or an oval.

15 [0039]

3. Spring Seat

 The spring seat 106 is located between the spring 108 and the hanger plate 102 and overlaps at least partially with the hanger plate 102. Since the configuration of the spring seat 106 of the pipe support 160 is similar to the spring
20 seat 106 of the pipe support 100 described in the First Embodiment, a detailed explanation is omitted.

[0040]

4. Supporting Frame

 The plurality of supporting frames 142 extending in the z direction has the
25 functions of suppressing the movement of the spring 108 in the xy plane and preventing the buckling phenomenon. There is no restriction on the number of the plurality of supporting frames 110, and the plurality of supporting frames 142 may include first to fourth supporting frames 142-1 to 142-4 as shown in FIG. 12 to FIG.

15B, for example. Hereinafter, the explanation is continued using the example in which the plurality of supporting frames 142 includes the first to fourth supporting frames 142-1 to 142-4.

[0041]

5 In the example shown in these drawings, the length (length in the z direction) of each supporting frame 142 is longer than the distance between the base plate 146 and the hanger plate 102. Thus, the plurality of supporting frames 142 surrounds the base plate 146 and the hanger plate 102 with the upper end and the lower end of each supporting frame 142 respectively existing over the base plate 146 and under
10 the hanger plate 102. However, the length of each supporting frame 142 may be the same as the distance between the base plate 146 and the hanger plate 102. In this case, the plurality of supporting frames 142 may be arranged so as to be sandwiched by the base plate 146 and the hanger plate 102. The supporting frames 142 are secured to the hanger plate 102 and the base plate 146 by welding
15 or bolting.

[0042]

 Similar to the supporting frames 110 of the pipe support 100, the supporting frames 142 of the pipe support 160 are arranged to surround a part of the spring seat 106 and the spring 108. More specifically, the plurality of supporting frames
20 142 surrounds the spring 108 as well as the center portion 106a of the spring seat 106 in the xy plane. Furthermore, the first supporting frame 142-1 and the third supporting frame 142-3 face each other in the y direction through one end portion 106b and a part of the center portion 106a. Similarly, the second supporting frame 142-2 and the fourth supporting frame 142-4 also face each other in the y direction
25 through the other end portion 106b and a part of the center portion 106a. Hence, one of the end portions 106b is sandwiched between the first supporting frame 142-1 and the third supporting frame 142-3, while the other end portion 106b is sandwiched between the second supporting frame 142-2 and the fourth supporting

frame 142 in the y direction. In addition, the center portion 106a is sandwiched between two arbitrarily selected supporting frames 142 (see FIG. 15B). Note that although the supporting frames 142 do not contact the spring seat 106 in FIG. 15B, the supporting frames 142 and the spring seat 106 may be configured so that at least one of the supporting frames 142 contacts the spring seat 106.

[0043]

Here, the supporting frames 142 are arranged so that the distance d_3 in the xy plane between two supporting frames 142 adjacent in the x direction or the y direction is smaller than the outer diameter D of the spring 108 as shown in FIG. 16A.

10 The distance in the x direction between two supporting frames 142 adjacent in the x direction (e.g., the first supporting frame 142-1 and the second supporting frame 142-2, or the third supporting frame 142-2 and the fourth supporting frame 142-4) may be the same as or different from the distance d_3 in the y direction between two supporting frames adjacent in the y direction (e.g., the first supporting frame 142-1

15 and the third supporting frame 142-3, or the second supporting frame 142-2 and the fourth supporting frame 142-4). Employment of such an arrangement inhibits the spring 108 from passing between adjacent supporting frames 142, by which the spring 108 can be prevented from falling out of the pipe support 160.

[0044]

20 The shape of the supporting frame 142 (shape in the xy plane) may also be arbitrarily determined. The shape may be L-shaped as shown in Figs. 15A to FIG. 16B or may be a circle, an oval, or a rectangle although not illustrated. In the case of the L-shape, it is preferred that the supporting frames 142 be formed with angle steel and the inside (acute angle side) thereof faces the spring 108. Such an

25 arrangement of the L-shaped supporting frames 142 allows the reduction of the distance d_3 , which more efficiently suppresses the movement of the spring 108 in the xy plane.

[0045]

5. Spring and Turnbuckle

Since the spring 108 and turnbuckle 116 may respectively have the same configuration as the spring 108 and turnbuckle 116 of the pipe support described in the First Embodiment, a detailed explanation is omitted. Note that, although the at least one spring 108 includes a plurality of springs 108 and adjacent springs 108 vertically overlap each other via the intermediate ring 109 in the example shown in FIG. 12 or the like, the number of springs 108 is not restricted and may be one or three or more.

[0046]

10 6. Other Component

The first band plate 140 is arranged over the second band plate 144 and is secured to the plurality of supporting frames 142 by welding or bolting. As shown in FIG. 12 through FIG. 14, the first band plate 140 may be arranged over the hanger plate 102, in which case an opening is provided to expose the suspension ring 138. When the upper end of the supporting frame 142 is positioned above the hanger plate 102, the supporting frames 142 pass through this opening. Note that the first band plate 140 may be positioned below the hanger plate 102. Furthermore, the first band plate 140 and the hanger plate 102 may be in contact with each other or may be spaced away from each other. In the former case, the first band plate 140 and the hanger plate 102 are secured to each other by welding or bolting.

[0047]

The second band plate 144 is arranged under the first band plate 140 and is secured to the supporting frames 142 by welding or bolting. Although the second band plate 144 may be arranged over the base plate 146 as shown in FIG. 12 through FIG. 14, the second band plate 144 may be arranged under the base plate 146. Moreover, the second band plate 144 and the base plate 146 may be in contact with each other or may be spaced away from each other. In the former case, the second band plate 144 and base plate 146 are secured to each other by

welding or bolting.

[0048]

Since the supporting frames 142 are surrounded by the first band plate 140 and the second band plate 144, the supporting frames 142 can be more securely
5 fixed to the hanger plate 102 and the base plate 146 by providing the first band plate 140 and the second band plate 144.

[0049]

In the pipe support 160 having the aforementioned structure, the end portion 106b of the spring seat is sandwiched by the adjacent supporting frames 142.
10 Therefore, the supporting frames 142 act as a guide, which allows the spring seat 106 to slide up and down along the supporting frames 142 as the spring 108 expands and contracts. Note that, similar to the pipe support 100, a pair of guide rods 112 may be provided to the pipe support 100. In this case, the pair of guide rods 112 is attached to the hanger plate 102 and arranged to extend downward from the hanger
15 plate 102 as shown in FIG. 17. Since the structure of the guide rods 112 is similar to that of the pipe support 100, a detailed description is omitted.

[0050]

Similar to the pipe support 100, a pair of securing plates 114 sandwiching the plurality of supporting frames 142 may be provided in order to preset the spring
20 108 (FIG. 18). Each securing plate 114 is provided with an opening through which the spring seat 106 passes and an opening through which the hanger plate 102 passes. When the first band plate 140 is provided, the opening through which the hanger plate 102 passes may be configured so that the first band plate 140 also passes therethrough at the same time.

25 [0051]

In the pipe support 160, the turnbuckle 116 and the spring seat 106 also vertically oscillate due to the mass change of the fluid transported in the piping 152, which causes the spring 108 to expand and contract. As a result, a force of rotation

about the spring axis is also applied to the spring 108, which may cause the spring 108 to move in the xy plane. In addition, a buckling phenomenon may occur when the spring 108 expands or contracts. However, since the pipe support 160 is provided with the supporting frames 142 to prevent the spring 108 from falling out as described above, it is possible to effectively prevent the spring 108 from falling out. In addition, since the supporting frames 142 suppress deformation of the springs 108 other than the expansion and contraction thereof, the buckling phenomenon can also be effectively prevented.

[0052]

Similar to the pipe support 100, the dropout and buckling phenomenon of the spring 108 can be effectively prevented in the pipe support 160 without the use of a cover or the like covering the side surface of the spring 108. This feature contributes to weight reduction of the pipe support, reduction of manufacturing costs, and reduction of the burden in maintenance work.

[0053]

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.

[0054]

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.

REFERENCE SIGN LIST

[0055]

- 100: Pipe support, 102: Hanger plate, 102-1: First hanger plate, 102-2: Second hanger plate, 102a: Opening, 104: Cover plate, 106: Spring seat, 106a: Center portion, 106b: End portion, 108: Spring, 108-1: First spring, 108-2: Second spring, 109: Intermediate ring, 110: Supporting frame, 110-1: First supporting frame, 110-2: Second supporting frame, 110-3: Third supporting frame, 110-4: Fourth supporting frame, 110a: First part, 110b: Second part, 110c: Third part, 112: Guide rod, 112a: Head, 114: Securing plate, 114a: Opening, 114b: Opening, 116: Turnbuckle, 116a: Opening, 118: Shaft, 120: Nut, 122: Nut, 124: Bolt, 126: Nut, 128: Nut, 130: Bolt, 132: Nut, 134: Bolt, 136: Nut, 138: Suspension ring, 140: First band plate, 142: Supporting frame, 142-1: First supporting frame, 142-2: Second supporting frame, 142-3: Third supporting frame, 142-4: Fourth supporting frame, 144: Second band plate, 146: Base plate, 146a: Through hole, 150: Pipe clamp, 152: Piping, 160: Pipe support

CLAIMS

1. A pipe support comprising:
 - at least one spring;
 - a spring seat over the spring;
 - 5 a plurality of supporting frames extending parallel to a spring axis of the spring and arranged to surround a portion of the spring seat and the spring;
 - a pair of hanger plates connected to the plurality of supporting frames; and
 - a turnbuckle suspended from the spring seat through a shaft and surrounded by the spring,
 - 10 wherein a lower end of each of the plurality of supporting frames has a hook shape hooking and supporting the spring.
2. The pipe support according to claim 1,
 - wherein the spring seat includes:
 - 15 a center portion overlapping the spring and surrounded by the plurality of supporting frames; and
 - a pair of end portions sandwiching the center portion and sandwiched by the plurality of supporting frames.
- 20 3. The pipe support according to claim 1, further comprising a pair of securing plates sandwiching the plurality of supporting frames,
 - wherein each of the pair of securing plates has a first opening through which at least one of the pair of hanger plates passes and a second opening through which one of the pair of end portions passes.
 - 25
4. The pipe support according to claim 1,
 - wherein each of the pair of hanger plates has an opening, and
 - the openings overlap each other in a direction perpendicular to the spring

axis.

5. The pipe support according to claim 1,
wherein the plurality of supporting frames is each integrated with any one of
5 the pair of hanger plates.

6. The pipe support according to claim 1,
wherein at least one spring includes a plurality of springs vertically
overlapping each other, and
10 wherein an intermediate ring surrounding the shaft is provided between
adjacent springs.

7. The pipe support according to claim 1, further comprising:
a pair of cover plates connecting the pair of hanger plates to each other,
15 located over the spring seat, and overlapping the spring seat; and
a pair of guide rods each downwardly extending from the pair of cover plates,
respectively, and sandwiching the spring,
wherein the spring seat has a cutoff or an opening through which the pair of
guide rods passes.

20

8. The pipe support according to claim 1, further comprising:
A cover plate connecting the pair of hanger plates to each other, located over
the spring seat, and overlapping the spring seat; and
a pair of guide rods downwardly extending from the cover plate and
25 sandwiching the spring,
wherein the spring seat has a cutoff or an opening through which the pair of
guide rods passes.

9. The pipe support according to claim 8, further comprising a suspension ring over the cover plate.
10. A pipe support comprising:
- 5 a base plate having a through hole;
at least one spring located over the base plate and overlapping an upper surface of the base plate;
a spring seat over the spring;
a hanger plate over the spring seat;
- 10 a plurality of supporting frames extending parallel to a spring axis of the spring, secured to the base plate and the hanger plate, and arranged so as to surround a portion of the spring seat and the spring; and
a turnbuckle suspended from the spring seat through a shaft and surrounded by the spring and the base plate.
- 15
11. The pipe support according to claim 10,
wherein the spring seat includes:
- a center portion overlapping the spring and surrounded by the plurality of supporting frames; and
- 20 a pair of end portions sandwiching the center portion and sandwiched by the plurality of supporting frames.
12. The pipe support according to claim 10,
wherein the plurality of supporting frames further surrounds the base plate
- 25 and the hanger plate.
13. The pipe support according to claim 10, further comprising:
a first band plate located over or under the base plate and surrounding the

plurality of supporting frames; and

a second band plate located over or under the hanger plate and surrounding the plurality of supporting frames.

5 14. The pipe support according to claim 10,
 wherein each of the supporting frames is an angle steel, and
 wherein the plurality of supporting frames is arranged so that an inside of the
 angle steel faces the spring.

10 15. The pipe support according to claim 10, further comprising a pair of securing
 plates sandwiching the plurality of supporting frames,
 wherein each of the pair of securing plates has a first opening through which
 the hanger plate passes and a second opening through which the spring seat passes.

15 16. The pipe support according to claim 10, further comprising a suspension ring
 over the hanger plate.

 17. The pipe support according to claim 10,
 wherein the at least one spring includes a plurality of springs overlapping
20 one another, and
 wherein an intermediate ring surrounding the shaft is provided between
 adjacent springs.

 18. The pipe support according to claim 10, further comprising a pair of guide
25 rods downwardly extending from the hanger plate and sandwiching the spring,
 wherein the spring seat has a cutoff or an opening through which the pair of
 guide rods passes.