DESCRIPTION

TITLE OF INVENTION: COLLECTIVE JOINT

TECHNICAL FIELD

[0001]

The present invention relates to a collective joint.

Priority is claimed on Japanese Patent Application No. 2024-057121, filed in Japan March 29, 2024, and Japanese Patent Application No. 2024-125232 filed in Japan July 31, 2024, the contents of both of which are incorporated herein by reference.

BACKGROUND ART

[0002]

A configuration has conventionally been known in which a collective joint is configured by fitting a separately formed joint body and blade unit to each other in order to provide a swirl blade in the collective joint (see, for example, Patent Document 1).

The blade unit includes a vertical pipe connecting portion, a protruding portion, a blade support portion, and the swirl blade.

[0003]

A lower end portion of the vertical pipe connecting portion is fitted to an inner circumferential surface of an upper end portion of the joint body. The protruding portion is provided on an inner circumferential surface of the lower end portion of the vertical pipe connecting portion so as to protrude radially inward.

The blade support portion extends downward from the lower end portion of the vertical pipe connecting portion. The swirl blade is provided on an inner circumferential surface of the blade support portion so as to protrude radially inward.

A lower end portion of a vertical pipe is disposed inside the vertical pipe

connecting portion. At this time, the vertical pipe is engaged with the protruding portion from above the protruding portion via a packing.

[0004]

Drainage water (liquid) flowing out of drainage equipment flows into the collective joint through the vertical pipe. The drainage water impinges on the swirl blade and flows downward through the joint body while swirling around the axis.

Citation List

Patent Document

[0005]

Patent Document 1: Japanese Unexamined Patent Application, First Publication No. 2019-112869

SUMMARY OF INVENTION

Technical Problem

[0006]

In a conventional collective joint, the joint body and the vertical pipe connecting portion of the blade unit are fixed to each other by a bonded portion formed by bonding. In this case, the swirl blade, against which drainage water mainly impinges in the collective joint, is relatively spaced apart from the vertical pipe connecting portion being fixed. Consequently, noise generated by the swirl blade and the like may increase.

[0007]

The present invention has been made in view of such a problem, and an object of the present invention is to provide a collective joint in which noise generated by liquid is reduced.

Solution to Problem

[0008]

To solve the problem, the present invention proposes the following means.

(1) Aspect 1 of the present invention is a collective joint including: a joint body that is disposed such that an axis of the joint body extends along an up-down direction; a blade unit that has a blade support portion disposed on an inner circumferential surface of the joint body and a swirl blade protruding radially inward from the blade support portion; and a vibration reducing portion that is provided on at least the blade support portion and reduces vibration of the blade support portion.

[0009]

In the present invention, for example, liquid flowing into the joint body through a vertical pipe connected to the joint body impinges on the swirl blade. Accordingly, the liquid can be caused to flow downward through the joint body while being swirled around the axis by the swirl blade.

At this time, the vibration reducing portion provided on at least the blade support portion reduces vibration of the blade support portion. Because the vibration reducing portion is provided on the blade support portion, which is closer to the swirl blade than the vertical pipe connecting portion of Patent Document 1, vibration of the swirl blade, which is a principal source of noise, can be reduced more effectively, thereby reducing noise generated by the liquid.

[0010]

(2) Aspect 2 of the present invention may be the collective joint according to (1), in which the vibration reducing portion is provided on the joint body and the blade support portion and fixes the joint body and the blade support portion to each other by an interference fit.

In the present invention, the joint body and the blade support portion can be fixed to each other by an interference fit using the vibration reducing portion provided on

the joint body and the blade support portion.

[0011]

(3) Aspect 3 of the present invention may be the collective joint according to (2), in which the vibration reducing portion fixes the joint body and the blade support portion to each other by the interference fit in a radial direction.

In the present invention, the joint body and the blade support portion can be fixed to each other by the interference fit in the radial direction using the vibration reducing portion.

[0012]

(4) Aspect 4 of the present invention may be the collective joint according to (2), in which the vibration reducing portion fixes the joint body and the blade support portion to each other by the interference fit in an axial direction.

In the present invention, the joint body and the blade support portion can be fixed to each other by the interference fit in the axial direction using the vibration reducing portion.

[0013]

(5) Aspect 5 of the present invention may be the collective joint according to any one of (2) to (4), in which the swirl blade is disposed at an end of the blade support portion in an axial direction, the blade unit has a second blade support portion disposed on a side opposite to the blade support portion in the axial direction across the swirl blade, and the collective joint includes a second vibration reducing portion that fixes the joint body and the second blade support portion to each other by at least one of bonding, fitting, and interference fitting.

In the present invention, in addition to the blade support portion, the second blade support portion fixed to the joint body by at least one of bonding, fitting, and

interference fitting enables the swirl blade, which is a principal source of noise, to be fixed to the joint body more reliably.

[0014]

(6) Aspect 6 of the present invention may be the collective joint according to (5), including: a second reinforcing portion that is connected to each of the swirl blade and the second blade support portion.

In the present invention, the second reinforcing portion enables the swirl blade and the second blade support portion to be connected to each other more reliably.

[0015]

(7) Aspect 7 of the present invention may be the collective joint according to (6), in which the second reinforcing portion is formed in a plate shape having a thickness direction extending along a circumferential direction.

In the present invention, for example, when a volume of the second reinforcing portion is constant, deformation of the swirl blade in the axial direction relative to the second blade support portion can be efficiently suppressed.

[0016]

(8) Aspect 8 of the present invention may be the collective joint according to (1), in which the vibration reducing portion is provided on the blade support portion and reinforces the blade support portion.

In the present invention, because the vibration reducing portion that reinforces the blade support portion is provided on the blade support portion, which is closer to the swirl blade than the vertical pipe connecting portion of Patent Document 1, vibration of the blade support portion supporting the swirl blade, which is a principal source of noise, can be further suppressed, thereby reducing noise generated by the liquid.

[0017]

(9) Aspect 9 of the present invention may be the collective joint according to (8), in which the blade unit has a main-body connecting portion connected to an end portion of the blade support portion and attachable to the joint body, and the vibration reducing portion protrudes in a circumferential direction from an end of the blade support portion in the circumferential direction so as to be spaced apart from the blade support portion and is connected to the main-body connecting portion.

In the present invention, the main-body connecting portion can be attached to the joint body together with the blade support portion and the swirl blade. The blade support portion can be reinforced by the vibration reducing portion without obstructing the liquid flowing through the joint body.

[0018]

(10) Aspect 10 of the present invention may be the collective joint according to (9), including two vibration reducing portions, in which the two vibration reducing portions respectively protrude in the circumferential direction from ends of the blade support portion in the circumferential direction.

In the present invention, the blade support portion can be reinforced more efficiently by the two vibration reducing portions.

[0019]

(11) Aspect 11 of the present invention may be the collective joint according to (9), in which, when the vibration reducing portion is viewed in a radial direction from a position facing the vibration reducing portion, an outer edge of the vibration reducing portion is formed in an arc shape.

In the present invention, for example, when an external force caused by the liquid acts on the swirl blade, concentration of stress caused by the external force in the vibration reducing portion connected to each of the blade support portion and the main-

body connecting portion can be suppressed.

Advantageous Effects of Invention

[0020]

The collective joint of the present invention can reduce noise generated by liquid.

BRIEF DESCRIPTION OF DRAWINGS

[0021]

[FIG. 1] A sectional view, as viewed from the front, of a main portion of a piping structure in which a collective joint according to a first embodiment of the present invention is used.

[FIG. 2] A sectional view, as viewed from the front, of a main portion of a collective joint according to a first modification of the first embodiment of the present invention.

[FIG. 3] A sectional view, as viewed from the front, of a main portion of a collective joint according to a second modification of the first embodiment of the present invention.

[FIG. 4] A sectional view, as viewed from the front, of a main portion of a collective joint according to a third modification of the first embodiment of the present invention.

[FIG. 5] A sectional view, as viewed from the front, of a main portion of a collective joint according to a fourth modification of the first embodiment of the present invention.

[FIG. 6] A perspective view of a main portion of a collective joint according to a second embodiment of the present invention.

[FIG. 7] A perspective view of a main portion of a collective joint according to a

first modification of the second embodiment of the present invention.

[FIG. 8] A sectional view, as viewed from the front, of a main portion of a collective joint according to a third embodiment of the present invention.

[FIG. 9] A cutaway perspective view of a main portion of the collective joint.

[FIG. 10] A cutaway perspective view of a unit main body of the collective joint as viewed from a predetermined direction.

[FIG. 11] A cutaway perspective view of the unit main body of the collective joint as viewed from another direction.

[FIG. 12] A cutaway perspective view of a unit main body of a collective joint according to a first modification of the third embodiment of the present invention.

[FIG. 13] A perspective view of a main portion of the unit main body as viewed from another direction.

[FIG. 14] A perspective view of a unit main body of a collective joint according to a second modification of the third embodiment of the present invention.

[FIG. 15] A sectional view taken along cutting line A1-A1 in FIG. 14.

[FIG. 16] A side view of a unit main body of a collective joint according to a third modification of the third embodiment of the present invention.

[FIG. 17] A partially cutaway sectional view of a floor structure including a collective joint according to a fourth embodiment of the present invention.

[FIG. 18] A sectional view of the floor structure of FIG. 17, taken along the plane of the drawing sheet and viewed toward a far side.

[FIG. 19] A sectional view of the floor structure of FIG. 17, taken along the plane of the drawing sheet and viewed toward a near side.

[FIG. 20] A sectional view of the joint body of FIG. 19 taken along line A11-A11.

[FIG. 21] A front view showing a unit main body included in the collective joint according to the fourth embodiment.

[FIG. 22] A perspective view of the unit main body of FIG. 21 from the rear.

[FIG. 23] A perspective view of the unit main body of FIG. 21 cut along line A12-A12.

[FIG. 24] A perspective view of the unit main body of FIG. 21 cut along line A13-A13.

[FIG. 25] A sectional view showing an upper connecting pipe and a lateral pipe connecting portion of FIG. 19.

[FIG. 26] A sectional view showing an upper connecting pipe and a lateral pipe connecting portion of FIG. 18.

[FIG. 27] A perspective view showing an intermediate pipe according to the fourth embodiment.

[FIG. 28] A perspective view of the intermediate pipe of FIG. 27 cut along line A16-A16.

[FIG. 29] A partially cutaway perspective view of an intermediate pipe according to Modification 1.

[FIG. 30] A partially cutaway perspective view of an intermediate pipe according to Modification 2.

[FIG. 31] A front view showing a lower connecting pipe provided in the collective joint according to the fourth embodiment.

[FIG. 32] A sectional view of the lower connecting pipe of FIG. 31 cut along the axis.

[FIG. 33] A bottom view of the lower connecting pipe of FIG. 31 as viewed in the direction of arrow A19.

[FIG. 34] A side view showing a third swirl blade of FIG. 32.

[FIG. 35] A sectional view showing a state in which the collective joint according to the fourth embodiment is installed in a floor slab having a thickness of 150 mm by raised-branch installation.

[FIG. 36] A sectional view showing a state in which the collective joint according to the fourth embodiment is installed in a floor slab having a thickness of 150 mm by ordinary installation.

[FIG. 37] A sectional view showing a state in which the collective joint according to the fourth embodiment is installed in a floor slab having a thickness of 100 mm by raised-branch installation.

[FIG. 38] A sectional view showing a state in which the collective joint according to the fourth embodiment is installed in a floor slab having a thickness of 100 mm by ordinary installation.

[FIG. 39] A sectional view showing a state in which the collective joint according to the fourth embodiment is installed in a floor slab having a thickness of 75 mm by raised-branch installation.

[FIG. 40] A sectional view showing a state in which the collective joint according to the fourth embodiment is installed in a floor slab having a thickness of 75 mm by ordinary installation.

[FIG. 41] A side view showing a fire-resistant sheet provided on the collective joint according to the fourth embodiment.

[FIG. 42] A side view showing a fire-resistant sheet according to Modification 1 provided on the collective joint.

[FIG. 43] A sectional view showing a collective joint including a blade unit according to a fifth embodiment of the present invention.

[FIG. 44] A sectional view showing a unit main body of FIG. 43.

[FIG. 45] A perspective view of the unit main body of FIG. 44 as viewed from below.

[FIG. 46] A side view of the unit main body of FIG. 44 as viewed from the side.

[FIG. 47] A perspective view of the unit main body of FIG. 44 as viewed from above.

[FIG. 48] A sectional view showing a collective joint including a fire-resistant pipe according to a sixth embodiment of the present invention.

[FIG. 49] A sectional view showing a state in which a lower connecting pipe is connected to an upper connecting pipe as a collective joint according to a seventh embodiment of the present invention and a fire-resistant material is provided.

[FIG. 50] A sectional view, as viewed from the front, of a building including a collective joint according to an eighth embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0022]

(First Embodiment)

Hereinafter, a piping structure in which a collective joint according to a first embodiment of the present invention is used will be described with reference to FIGS. 1 to 4. In FIG. 2 and subsequent figures, configurations other than a main portion of the collective joint may be shown in a simplified form or as slightly different configurations.

As shown in FIG. 1, a piping structure 1 includes a first vertical pipe 10, a second vertical pipe (not shown), a lateral pipe 20, and a collective joint 120 according to the present embodiment. In FIG. 1, the first vertical pipe 10 and the lateral pipe 20 are indicated by two-dot chain lines. Furthermore, FIG. 1 indicates, by a two-dot chain line, a shape of a unit main body 122 described below in a natural state in which no

external force acts on the unit main body 122.

[0023]

The first vertical pipe 10, the second vertical pipe, and the lateral pipe 20 are formed in tubular shapes from a vinyl chloride resin or the like.

The first vertical pipe 10 and the second vertical pipe extend along an up-down direction. Here, a first object extending along a second object means that an angle formed by the first object and the second object is 30° or less. The angle formed is more preferably 15° or less. The first vertical pipe 10 is disposed above the second vertical pipe.

[0024]

In the present description, the "up-down direction" merely means a direction serving as a convenient reference for describing shapes and the like of respective portions and components of the collective joint according to the present invention. The "up-down direction" assumes an up-down direction when the collective joint according to the present invention is used in an ordinary manner, but does not limit an orientation in which the collective joint according to the present invention is used.

[0025]

A lower end of a collective joint 120 on an upper floor is connected to an upper end portion of the first vertical pipe 10. A lower end portion of the second vertical pipe is connected to an upper end portion of a collective joint 120 on a lower floor or a leg fitting (not shown).

The lateral pipe 20 is disposed along a horizontal plane while having a drainage gradient. Drainage equipment is connected to a first end portion of the lateral pipe 20.

[0026]

The collective joint 120 includes a joint body 26, a lateral pipe connecting

portion 47, and a blade unit 121.

Here, the joint body 26 and the blade unit 121 are formed in tubular shapes. The respective central axes of the joint body 26 and the blade unit 121 are disposed coaxially with a common axis. Hereinafter, the common axis is referred to as an axis O1. A direction along the axis O1 is referred to as an axis O1 direction. A direction orthogonal to the axis O1 is referred to as a radial direction, and a direction extending around the axis O1 is referred to as a circumferential direction.

[0027]

The joint body 26 includes an upper joint body 27, a connecting pipe 37, and a lower joint body (not shown). The upper joint body 27 includes an upper main body 28, an engaging portion 29, a vertical rib 30, and a lateral rib 31.

The upper main body 28 is formed in a tubular shape and disposed on the axis O1. An opening (reference sign omitted) penetrating a circumferential wall of the upper main body 28 is formed in an intermediate portion of the upper main body 28 in the up-down direction. The number of openings formed in the upper main body 28 is not limited.

In the present embodiment, because the upper main body 28 of the joint body 26 is formed by injection molding, an inner circumferential surface 28c of the upper main body 28 is inclined relative to the axis O1. Specifically, the inner circumferential surface 28c is inclined so as to gradually approach the axis O1 toward the lower side.

Here, in a cross section taken along a plane including the axis O1, an angle formed by the axis O1 and the inner circumferential surface 28c is defined as $\theta 1$. For example, the angle $\theta 1$ is 1°.

[0028]

The engaging portion 29 is provided at an upper end portion of a portion of the

inner circumferential surface of the upper main body 28 that is located below the opening. The engaging portion 29 is formed in an annular shape and protrudes radially inward from the upper main body 28. A surface 29a of the engaging portion 29 facing radially inward is inclined so as to gradually approach the axis O1 toward the lower side.

[0029]

The vertical rib 30 is provided on the inner circumferential surface of the upper main body 28 and extends along the up-down direction. The vertical rib 30 is formed in a range corresponding to the opening and the engaging portion 29 in the up-down direction.

The lateral rib 31 is provided on a portion of an outer circumferential surface of the upper main body 28 that is located above the opening. The lateral rib 31 extends along the circumferential direction. For example, the lateral rib 31 is provided to hold the upper main body 28.

A sealing member 32 having an annular shape is disposed inside a portion of the upper main body 28 that is located below the engaging portion 29. The sealing member 32 is engaged with the engaging portion 29 from below the engaging portion 29.

[0030]

The connecting pipe 37 is formed in a tubular shape and disposed on the axis O1.

The connecting pipe 37 is made of a polyvinyl chloride-based resin and preferably contains a resin composition containing a polyvinyl chloride-based resin and thermally expandable graphite. That is, the connecting pipe 37 is produced by molding the resin composition. The connecting pipe 37 is ordinarily produced by extrusion-molding or injection-molding the resin composition.

The connecting pipe 37 may have a single-layer structure in which the entire

connecting pipe 37 is made of the resin composition or may have a multilayer structure including a plurality of layers. In the case of the multilayer structure, any one of the layers may be formed from the resin composition. For example, when the connecting pipe 37 has a three-layer structure including a surface layer, an intermediate layer, and an inner layer, the intermediate layer may be formed from the resin composition, and the surface layer, the intermediate layer, and the inner layer may contain an endothermic agent.

When the connecting pipe 37 does not contain thermally expandable graphite, a sheet-shaped fire-resistant material containing thermally expandable graphite may be wound around an outer surface of the connecting pipe 37 or an outer surface of an acoustic insulation material covering the connecting pipe 37, and the fire-resistant material may be embedded in a slab through-hole of a floor slab not shown.

[0031]

As an example, a single-layer structure made of a resin composition containing thermally expandable graphite at a proportion of 1 to 20 parts by weight relative to 100 parts by weight of a polyvinyl chloride-based resin can be employed. Alternatively, a three-layer structure can be employed that includes a thermally expandable fire-resistant layer made of a resin composition containing thermally expandable graphite at a proportion of 1 to 20 parts by weight relative to 100 parts by weight of a polyvinyl chloride-based resin, and coating layers made of a polyvinyl chloride-based resin composition containing no thermally expandable graphite and covering inner and outer surfaces of the thermally expandable fire-resistant layer.

[0032]

When the connecting pipe 37 has a single-layer structure, when the amount of the thermally expandable graphite is less than 1 part by weight, sufficient thermal

expansion may not be obtained during combustion, and desired fire resistance may not be obtained; when the amount exceeds 20 parts by weight, excessive thermal expansion may occur due to heating, the shape may not be maintained, residue may fall out of the slab through-hole, and the fire resistance may decrease.

[0033]

When the connecting pipe 37 has a multilayer structure, the resin composition containing a thermally expandable fire-resistant material is not particularly limited, but preferably contains thermally expandable graphite at a proportion of 1 to 20 parts by weight relative to 100 parts by weight of a polyvinyl chloride-based resin. The content of the thermally expandable graphite is more preferably 4 to 18 parts by weight and still more preferably 6 to 16 parts by weight.

When the connecting pipe 37 is present over the entire slab through-hole, even when the content of the thermally expandable graphite is relatively high at 15 parts by weight or more and the residue is brittle, the residue closes the entire slab through-hole and the residue after thermal expansion is retained in the floor slab, thereby making the residue less likely to fall out. Accordingly, a length of the connecting pipe 37 in a pipe axial direction is set to 100 mm or more, preferably 140 mm or more, and most preferably 160 mm or more.

[0034]

When the intermediate layer contains thermally expandable graphite, the intermediate layer exhibits a black color. Therefore, the surface layer and the inner layer preferably contain a colorant other than black so as to be distinguishable from the intermediate layer.

The thicknesses of the surface layer/inner layer are each preferably 0.3 mm or more and 3.0 mm or less, and more preferably 0.6 mm or more and 1.5 mm or less.

When a thickness of the coating layer is 0.3 mm or more, sufficient mechanical strength as a pipe can be ensured, and when the thickness is 3.0 mm or less, a decrease in fire resistance can be suppressed.

The connecting pipe 37 preferably satisfies the performance requirements specified in JIS K 6741.

That is, when the amount of the thermally expandable graphite is less than 1 part by weight, sufficient thermal expansion may not be obtained during combustion, and desired fire resistance may not be obtained. When the amount of the thermally expandable graphite exceeds 20 parts by weight, excessive thermal expansion may occur due to heating, the shape may not be maintained, residue may fall out of the slab through-hole, and the fire resistance may decrease.

[0035]

As an example of the thermally expandable graphite used in the present embodiment, a crystalline compound obtained by subjecting powders of natural flake graphite, pyrolytic graphite, kish graphite, or the like to acid treatment using an inorganic acid and a strong oxidizing agent to insert the inorganic acid between graphite layers and then adjusting the pH can be used.

Concentrated sulfuric acid, nitric acid, selenic acid, or the like can be used as the inorganic acid. Concentrated nitric acid, perchloric acid, a perchlorate, a permanganate, a dichromate, hydrogen peroxide, or the like can be used as the strong oxidizing agent.

[0036]

Through the pH adjustment, thermally expandable graphite that is a crystalline compound maintaining a layered carbon structure and is adjusted to a pH of 1.5 to 7.0, and thermally expandable graphite having a 1.3-fold expansion temperature of 180°C to 280°C can be used.

[0037]

When the pH of the thermally expandable graphite is less than 1.5, the acidity is excessively high, and corrosion of a molding apparatus and the like is likely to occur; when the pH exceeds 7.0, an effect of promoting carbonization of the polyvinyl chloride-based resin decreases, and sufficient fire-resistant performance may not be obtained.

A particle size of the thermally expandable graphite is not particularly limited, but thermally expandable graphite having a particle size within a range of, for example, 100 to 400 μm, and preferably 120 to 350 μm, can be used.

[0038]

Additives such as a stabilizer, an inorganic filler, a flame retardant, a lubricant, a processing aid, an impact modifier, a heat resistance improver, an antioxidant, a light stabilizer, an ultraviolet absorber, a pigment, a plasticizer, and a thermoplastic elastomer may be added, as necessary, to the resin composition forming the connecting pipe 37 within a range that does not impair an object of the present embodiment.

[0039]

An upper end portion of the connecting pipe 37 is disposed inside a lower end portion of the upper main body 28 of the upper joint body 27. The connecting pipe 37 is engaged with the engaging portion 29 of the upper main body 28 from below the engaging portion 29 via the sealing member 32.

The connecting pipe 37 protrudes downward beyond the upper main body 28.

The connecting pipe 37 is fixed to the upper main body 28 by an adhesive or the like.

[0040]

The lower joint body is formed in a tubular shape. The lower joint body is made of a vinyl chloride resin or the like.

A lower end portion of the connecting pipe 37 is disposed inside an upper end portion of the lower joint body. The connecting pipe 37 is fixed to the lower joint body by an adhesive or the like.

The joint body 26 configured as described above is disposed such that the axis O1, which is an axis of the joint body 26, extends along the up-down direction.

[0041]

The lateral pipe connecting portion 47 is formed in a tubular shape. The lateral pipe connecting portion 47 is disposed such that an axis O2 of the lateral pipe connecting portion 47 extends along a horizontal plane. The lateral pipe connecting portion 47 is connected to a peripheral edge portion of the opening in the upper main body 28.

The upper joint body 27 and the lateral pipe connecting portion 47 are integrally made of a vinyl chloride resin or the like.

[0042]

The blade unit 121 is fitted to an upper end portion of the joint body 26. The blade unit 121 includes the unit main body 122, a sealing member 62, and a retaining member (not shown).

The unit main body 122 includes an upper vertical pipe connecting portion (main-body connecting portion) 53, a protruding portion 54, a blade support portion (first blade support portion) 55, and a swirl blade 56.

[0043]

The upper vertical pipe connecting portion 53 includes a large-diameter portion (reference sign omitted) and a small-diameter portion (reference sign omitted). The large-diameter portion and the small-diameter portion are each formed in a tubular shape and disposed on the axis O1.

An inner diameter and an outer diameter of the large-diameter portion are

substantially equal to an inner diameter and an outer diameter, respectively, of the upper main body 28 of the upper joint body 27. An outer diameter of the small-diameter portion is substantially equal to the inner diameter of the upper main body 28 of the upper joint body 27. The small-diameter portion is fixed to an inner circumferential surface of a lower end portion of the large-diameter portion. The small-diameter portion protrudes downward from the large-diameter portion.

The small-diameter portion is fitted to an inner circumferential surface of an upper end portion of the upper joint body 27 of the joint body 26.

As described above, the upper vertical pipe connecting portion 53 is attached to the joint body 26 by an adhesive.

[0044]

The protruding portion 54 is provided on an inner circumferential surface of a lower end portion of the small-diameter portion of the upper vertical pipe connecting portion 53 so as to protrude radially inward. The protruding portion 54 is formed in an annular shape and is formed over the entire circumference of the small-diameter portion.

The protruding portion 54 may be formed only in a portion in the circumferential direction.

The blade support portion 55 extends downward from a portion in the circumferential direction of the lower end portion of the small-diameter portion of the upper vertical pipe connecting portion 53. That is, the upper vertical pipe connecting portion 53 is connected to an upper end portion of the blade support portion 55.

The blade support portion 55 is formed in a curved flat plate shape and is formed in an arc shape as viewed in the up-down direction. The blade support portion 55 extends in the up-down direction. That is, a length of the blade support portion 55 in the circumferential direction is substantially constant regardless of a position in the up-

down direction.

[0045]

A lower end portion of the blade support portion 55 gradually extends farther downward toward a first side D1 in the circumferential direction (hereinafter, simply referred to as the first side). Hereinafter, a side opposite to the first side D1 in the circumferential direction is referred to as a second side D2 in the circumferential direction (hereinafter, simply referred to as the second side).

[0046]

The swirl blade 56 is formed, for example, in a curved plate shape and is provided on an inner circumferential surface (a surface facing radially inward) of a lower end portion of the blade support portion 55. The swirl blade 56 protrudes radially inward from the blade support portion 55. An upper surface of the swirl blade 56 is inclined so as to gradually extend downward toward the first side D1.

The upper vertical pipe connecting portion 53, the protruding portion 54, the blade support portion 55, and the swirl blade 56 included in the unit main body 122 are integrally made of a vinyl chloride resin or the like.

[0047]

In the present embodiment, because the unit main body 122 is formed by injection molding, an outer circumferential surface 55c of the blade support portion 55 is inclined relative to the axis O1 in the natural state. Specifically, the outer circumferential surface 55c is inclined so as to gradually approach the axis O1 toward the lower side.

Here, in a cross section taken along a plane including the axis O1, an angle formed by the axis O1 and the outer circumferential surface 55c is defined as $\theta 2$. For example, the angle $\theta 2$ is 1° or less and is equal to or less than the angle $\theta 1$.

[0048]

For example, when the upper vertical pipe connecting portion 53 is attached to the joint body 26, the upper main body 28 presses radially inward against the blade support portion 55, and the blade support portion 55 deforms as indicated by a solid line. The upper main body 28 and the blade support portion 55 pressing against each other in the radial direction constitute a vibration reducing portion (fixing portion) 124. The vibration reducing portion as used herein means a configuration that reduces vibration of the swirl blade as compared with bonding between the joint body and the vertical pipe connecting portion of the blade unit in Patent Document 1.

The vibration reducing portion 124 is provided on the upper main body 28 (the joint body 26) and the blade support portion 55 and fixes the upper main body 28 and the blade support portion 55 to each other by an interference fit in the radial direction. The interference fit as used in the present description means a fit having an allowance provided for tight fastening. The vibration reducing portion 124 reduces vibration of the blade support portion 55.

[0049]

A configuration of the sealing member 62 is not limited. The sealing member 62 is formed in a tubular shape and is disposed radially inward of the upper vertical pipe connecting portion 53 coaxially with the axis O1. The sealing member 62 is engaged with the protruding portion 54 from above the protruding portion 54.

The sealing member 62 is made of synthetic rubber or the like.

The retaining member is formed in an annular shape and is disposed coaxially with the axis O1. The retaining member is fitted to the large-diameter portion of the upper vertical pipe connecting portion 53.

The blade unit 121 need not include the sealing member 62 and the retaining

member.

[0050]

A lower end portion of the first vertical pipe 10 is disposed inside each of the sealing member 62, the retaining member, and the upper vertical pipe connecting portion 53 of the blade unit 121. The lower end portion of the first vertical pipe 10 is engaged with the protruding portion 54 of the unit main body 122 from above the protruding portion 54 via the sealing member 62.

An upper end portion of the second vertical pipe is disposed inside a lower end portion of the lower joint body of the joint body 26.

A second end portion of the lateral pipe 20 opposite to a first end portion is disposed inside the lateral pipe connecting portion 47 of the collective joint 25.

[0051]

As described above, in the collective joint 120 according to the present embodiment, for example, drainage water flowing into the joint body 26 through the first vertical pipe 10 connected to the joint body 26 impinges on the swirl blade 56. Accordingly, the drainage water can be caused to flow downward through the joint body 26 while being swirled around the axis O1 by the swirl blade 56. The drainage water flows through the second vertical pipe and is treated by drainage treatment equipment.

At this time, the vibration reducing portion 124 provided on the upper main body 28 and the blade support portion 55 reduces vibration of the blade support portion 55. Because the vibration reducing portion 124 is provided on the blade support portion 55, which is closer to the swirl blade 56 than the vertical pipe connecting portion of Patent Document 1, vibration of the swirl blade 56, which is a principal source of noise, can be reduced more effectively, thereby reducing noise generated by the drainage water.

[0052]

The vibration reducing portion 124 is provided on the upper main body 28 and the blade support portion 55 and fixes the upper main body 28 and the blade support portion 55 to each other by an interference fit. Accordingly, the upper main body 28 and the blade support portion 55 can be fixed to each other by an interference fit using the vibration reducing portion 124 provided on the upper main body 28 and the blade support portion 55.

The vibration reducing portion 124 is provided on the upper main body 28 and the blade support portion 55 and fixes the upper main body 28 and the blade support portion 55 to each other by an interference fit in the radial direction. Therefore, the upper main body 28 and the blade support portion 55 can be fixed to each other by the interference fit in the radial direction using the vibration reducing portion 124.

[0053]

The configuration of the collective joint 120 according to the present embodiment can be modified in various ways as described below.

As in a collective joint 120A according to a first modification shown in FIG. 2, the respective configurations of the collective joint 120 according to the first embodiment may include a blade unit 131 instead of the blade unit 121.

In the first modification, a recessed portion 28d recessed radially outward is formed in the inner circumferential surface of the upper main body 28 of the joint body 26. The recessed portion 28d is formed in a range of the upper main body 28 in the up-down direction that substantially corresponds to the blade support portion 55. The recessed portion 28d is formed only in a portion of the upper main body 28 in the circumferential direction.

In the first modification and the subsequent modifications, the inner circumferential surface 28c of the upper main body 28 and the outer circumferential

surface 55c of the blade support portion 55 extend along the axis O1 (are not inclined relative to the axis O1).

[0054]

The blade unit 131 includes a unit main body 132 instead of the unit main body 122 in the respective configurations of the blade unit 121.

The unit main body 132 includes a projecting portion 134 in addition to the respective configurations of the unit main body 122. The projecting portion 134 is provided on the outer circumferential surface of the blade support portion 55. In this example, the projecting portion 134 is provided over substantially the entire length of the blade support portion 55 in the up-down direction.

A radial length of the projecting portion 134 in the natural state is equal to or less than a radial length (depth) of the recessed portion 28d. A length of the projecting portion 134 in the up-down direction in the natural state is slightly greater than a length of the recessed portion 28d in the up-down direction.

[0055]

Accordingly, when the projecting portion 134 is pressed into the recessed portion 28d, the projecting portion 134 presses, from below, against an upper end of an opening peripheral edge portion of the recessed portion 28d in the upper main body 28. The upper end of the opening peripheral edge portion of the recessed portion 28d in the upper main body 28 and the projecting portion 134, which press against each other in the up-down direction (the axis O1 direction), constitute a vibration reducing portion 136. The projecting portion 134 also presses, from above, against a lower end of the opening peripheral edge portion of the recessed portion 28d in the upper main body 28. The lower end of the opening peripheral edge portion of the recessed portion 28d in the upper main body 28 and the projecting portion 134, which press against each other in the up-

down direction (the axis O1 direction), constitute a vibration reducing portion 137.

The vibration reducing portions 136 and 137 fix the upper main body 28 (the joint body 26) and the blade support portion 55 to each other by an interference fit in the up-down direction (the axis O1 direction).

[0056]

As described above, in the collective joint 120A according to the first modification, the vibration reducing portions 136 and 137 fix the upper main body 28 and the blade support portion 55 to each other by an interference fit in the up-down direction. Accordingly, the upper main body 28 and the blade support portion 55 can be fixed to each other by the interference fit in the up-down direction using the vibration reducing portions 136 and 137. Therefore, noise generated by the drainage water can be reduced.

The recessed portion 28d and the projecting portion 134 formed only in portions in the circumferential direction enable the unit main body 132 to be positioned relative to the joint body 26 in the circumferential direction.

A recessed portion may be formed in the outer circumferential surface of the blade support portion 55, and a projecting portion corresponding to the recessed portion may be formed on the upper main body 28.

[0057]

As in a collective joint 120B according to a second modification shown in FIG. 3, the respective configurations of the collective joint 120 according to the first embodiment may include a unit main body 52A of a blade unit 51A instead of the unit main body 122 of the blade unit 121 and the vibration reducing portion 124.

The unit main body 52A (the blade unit 51A) has a second blade support portion (reinforcing plate) 139 in the respective configurations of the unit main body 122.

In this modification, the swirl blade 56 is disposed at a lower end (an end in the axis O1 direction) in a predetermined range of the blade support portion 55 in the circumferential direction.

The second blade support portion 139 is formed in a curved flat plate shape and is formed in an arc shape as viewed in the up-down direction. The second blade support portion 139 is disposed on a side opposite to the blade support portion 55 in the axis O1 direction (below the blade support portion 55) across the swirl blade 56. The swirl blade 56 is disposed at an upper end of the second blade support portion 139.

[0058]

A lower end of the second blade support portion 139 is in contact, from above, with an upper end of the surface 29a of the engaging portion 29.

An upper surface of the engaging portion 29 may be formed so as to extend along a horizontal plane. This configuration may facilitate contact of the lower end of the second blade support portion 139 with the upper surface of the engaging portion 29.

[0059]

In the second modification, two vertical ribs 30 provided on the upper main body 28 (the joint body 26) are disposed so as to sandwich the blade support portion 55 and the second blade support portion 139 in the circumferential direction. In the second modification, a length of the blade support portion 55 and the second blade support portion 139 in the circumferential direction in the natural state is slightly greater than a length between the two vertical ribs 30 in the circumferential direction. Accordingly, when the blade support portion 55 and the second blade support portion 139 are disposed between the two vertical ribs 30, the blade support portion 55 and the second blade support portion 139 press against the two vertical ribs 30 from inside the two vertical ribs 30. The two vertical ribs 30 and the blade support portions 55 and 139, which press

against each other in the circumferential direction, constitute a vibration reducing portion (fixing portion) 141.

[0060]

Here, of the two vertical ribs 30 arranged in the circumferential direction, the vertical rib 30 disposed on the first side D1 is also referred to as a vertical rib 30A, and the vertical rib 30 disposed on the second side D2 is also referred to as a vertical rib 30B.

The blade support portion 55 presses against the vertical rib 30A from the second side D2 relative to the vertical rib 30A. The second blade support portion 139 presses against the vertical rib 30B from the first side D1 relative to the vertical rib 30B.

The vibration reducing portion 141 fixes the upper main body 28 (the joint body 26) and the blade support portions 55 and 139 to each other by an interference fit in the circumferential direction via the two vertical ribs 30.

[0061]

As described above, in the collective joint 120B according to the second modification, the vibration reducing portion 141 fixes the upper main body 28 and the blade support portions 55 and 139 to each other by an interference fit in the circumferential direction. Therefore, the upper main body 28 and the blade support portions 55 and 139 can be fixed to each other by the interference fit in the circumferential direction using the vibration reducing portion 141. Accordingly, noise generated by the drainage water can be reduced.

The blade support portion may be constituted by the entirety of the blade support portion 55 and the second blade support portion 139.

[0062]

A collective joint 120C according to a third modification shown in FIG. 4 includes a bonded portion 146 in addition to the respective configurations of the

collective joint 120A according to the first modification. The swirl blade 56 is not shown in FIG. 4.

In the third modification, the recessed portion 28d is not formed in the upper main body 28. The projecting portion 134 is formed only on a lower end portion of the outer circumferential surface of the blade support portion 55.

[0063]

The bonded portion 146 is disposed on a portion of the outer circumferential surface of the blade support portion 55 that is located above the projecting portion 134. A known adhesive for bonding a vinyl chloride resin or the like can be used for the bonded portion 146. The bonded portion 146 fixes the upper main body 28 (the joint body 26) and the blade support portion 55 to each other by bonding.

Because a thickness (a radial length) of the blade support portion 55 and the projecting portion 134 as a whole is greater than a thickness of the blade support portion 55, the projecting portion 134 presses against the upper main body 28 from a radially inner side of the upper main body 28. The upper main body 28 and the projecting portion 134 pressing against each other in the radial direction constitute a vibration reducing portion 147. The vibration reducing portion 147 fixes the upper main body 28 and the blade support portion 55 to each other by an interference fit in the radial direction.

The collective joint 120C according to the third modification includes the bonded portion 146 and the vibration reducing portion 147 that fix the upper main body 28 and the blade support portion 55 to each other.

[0064]

In a collective joint 120D according to a fourth modification shown in FIG. 5, a total length of the blade support portion 55 and the second blade support portion 139 in

the circumferential direction is shorter than that in the collective joint 120B according to the second modification, and a cutout 139a is formed in the second blade support portion 139.

The cutout 139a penetrates the second blade support portion 139 in the radial direction and opens downward. A bottom (upper end) of the cutout 139a presses against the vertical rib 30B from above the vertical rib 30B, and the cutout 139a and the vertical rib 30B are fixed to each other by an interference fit in the up-down direction (the axis O1 direction). A bottom portion of the cutout 139a and the vertical rib 30B constitute a vibration reducing portion 148.

The blade support portion 55 is spaced apart from the vertical rib 30A toward the second side D2.

[0065]

As indicated by a two-dot chain line L1 in FIG. 5, the blade support portion 55 may press against the vertical rib 30A from the second side D2 relative to the vertical rib 30A.

As indicated by a two-dot chain line L2, the second blade support portion 139 may be cut out upward from an end of the bottom of the cutout 139a on the second side D2. Even with this configuration, the second blade support portion 139 and the vertical rib 30B can constitute a vibration reducing portion.

[0066]

(Second Embodiment)

Next, a second embodiment of the present invention will be described with reference to FIGS. 6 and 7. Portions identical to those of the preceding embodiment are denoted by identical reference signs, descriptions of the portions are omitted, and only differences will be described.

As shown in FIG. 6, a unit main body 152 of a blade unit 151 included in a collective joint 150 according to the present embodiment includes the upper vertical pipe connecting portion 53, the protruding portion 54 (not shown), the blade support portion 55, the swirl blade 56, and two vibration reducing portions 153 and 154.

The vibration reducing portions 153 and 154 are formed in curved flat plate shapes and are formed in arc shapes as viewed in the up-down direction.

[0067]

The vibration reducing portion 153 protrudes from an end of the blade support portion 55 on the first side D1 (the circumferential direction) toward the first side D1 (in the circumferential direction so as to be spaced apart from the blade support portion 55). The vibration reducing portion 154 protrudes from an end of the blade support portion 55 on the second side D2 (the circumferential direction) toward the second side D2 (in the circumferential direction so as to be spaced apart from the blade support portion 55). The vibration reducing portions 153 and 154 are provided on the blade support portion 55.

In the present embodiment, lengths of the vibration reducing portions 153 and 154 in the circumferential direction gradually increase toward the upper side. The vibration reducing portions 153 and 154 are connected to the upper vertical pipe connecting portion 53. The vibration reducing portions 153 and 154 reinforce the blade support portion 55.

[0068]

As described above, in the collective joint 150 according to the present embodiment, because the vibration reducing portions 153 and 154 that reinforce the blade support portion 55 are provided on the blade support portion 55, which is closer to the swirl blade 56 than the vertical pipe connecting portion of Patent Document 1,

vibration of the blade support portion 55 supporting the swirl blade 56, which is a principal source of noise, can be further suppressed, thereby reducing noise generated by the drainage water.

[0069]

The vibration reducing portion 153 protrudes from the end of the blade support portion 55 on the first side D1 toward the first side D1 and is connected to the upper vertical pipe connecting portion 53. Therefore, the upper vertical pipe connecting portion 53 can be attached to the joint body 26 together with the blade support portion 55 and the swirl blade 56. The blade support portion 55 can be reinforced by the vibration reducing portion 153 without obstructing the drainage water flowing through the joint body 26.

The unit main body 152 includes the two vibration reducing portions 153 and 154. Accordingly, the blade support portion 55 can be reinforced more efficiently by the two vibration reducing portions 153 and 154.

[0070]

The unit main body 152 need not include the vibration reducing portion 153 or the vibration reducing portion 154.

The vibration reducing portion may protrude from the blade support portion 55 in the radial direction.

[0071]

A unit main body 152A of a blade unit 151A included in a collective joint 150A according to a first modification shown in FIG. 7 includes a vibration reducing portion 161 instead of the vibration reducing portion 153 in the respective configurations of the unit main body 152.

The vibration reducing portion 161 protrudes from the end of the blade support

portion 55 on the first side D1 toward the first side D1. When the vibration reducing portion 161 is viewed in the radial direction from a position facing the vibration reducing portion 161, an outer edge of the vibration reducing portion 161 is formed in an arc shape.

[0072]

The collective joint 150A according to the first modification configured as described above can suppress concentration of stress caused by, for example, when an external force caused by drainage water acts on the swirl blade 56, the external force in the vibration reducing portion 161 connected to each of the blade support portion 55 and the upper vertical pipe connecting portion 53.

[0073]

(Third Embodiment)

Next, a third embodiment of the present invention will be described with reference to FIGS. 8 to 16. Portions identical to those of the preceding embodiments are denoted by identical reference signs, descriptions of the portions are omitted, and only differences will be described.

As shown in FIGS. 8 to 11, a collective joint 165 according to the present embodiment includes a unit main body 167 of a blade unit 166, a bonded portion (vibration reducing portion) 81, and a second bonded portion (second vibration reducing portion) 175 instead of the unit main body 52A of the blade unit 51A in the respective configurations of the collective joint 120B according to the second modification of the first embodiment.

The unit main body 167 includes reinforcing ribs (second reinforcing portions, reinforcing portions) 168A and 168B in addition to the respective configurations of the unit main body 52A. The shape of each second reinforcing portion is not limited to a

rib shape.

[0074]

The reinforcing ribs 168A and 168B are respectively provided on the inner circumferential surface of the second blade support portion 139 and protrude radially inward from the second blade support portion 139. The reinforcing ribs 168A and 168B extend along the up-down direction. The reinforcing ribs 168A and 168B are disposed at an interval from each other in the circumferential direction, and the reinforcing rib 168A is disposed on the first side D1 relative to the reinforcing rib 168B.

The reinforcing rib 168A is formed in a plate shape having a thickness direction of the reinforcing rib 168A (itself) extending along the circumferential direction. The reinforcing rib 168B is formed in a plate shape having a thickness direction of the reinforcing rib 168B extending along the circumferential direction.

[0075]

As shown in FIG. 11, in the present embodiment, a surface 168aA of the reinforcing rib 168A facing radially inward is inclined so as to gradually move away from the axis O1 toward the lower side. The surface 168aA is flat.

The reinforcing ribs 168A and 168B are connected to each of the swirl blade 56 and the second blade support portion 139. That is, upper end portions of the reinforcing ribs 168A and 168B are continuous with the swirl blade 56.

[0076]

A surface 55e at a connecting portion between the protruding portion 54 and the blade support portion 55, the surface 55e facing in a direction between radially inward and downward, is recessed in a direction between radially outward and upward.

A surface 55f at a connecting portion between the upper vertical pipe connecting portion 53 and the blade support portion 55, the surface 55f being disposed at an end on

the first side D1 and facing in a direction between the first side D1 and downward, is recessed in a direction between the second side D2 and upward. The surface 55f and the surface 55e are smoothly connected to each other by a three-dimensional curved surface.

A surface 55g at the connecting portion between the upper vertical pipe connecting portion 53 and the blade support portion 55, the surface 55g being disposed at an end on the second side D2 and facing in a direction between the second side D2 and downward, is recessed in a direction between the first side D1 and upward. The surface 55g and the surface 55e are smoothly connected to each other by a three-dimensional curved surface.

[0077]

As shown in FIG. 8, the bonded portion 81 fixes the joint body 26 and the blade support portion 55 to each other by bonding. The second bonded portion 175 fixes the joint body 26 and the second blade support portion 139 to each other by bonding. A known adhesive for bonding a vinyl chloride resin or the like can be used for the bonded portions 81 and 175.

The blade support portions 55 and 139 and the joint body 26 may be fixed to each other by at least one of bonding, fitting, and interference fitting.

The reinforcing rib 168B and the vertical rib 30B constitute a vibration reducing portion 169 by pressing against each other in the up-down direction.

[0078]

As described above, in the collective joint 165 according to the present embodiment, in addition to the blade support portion 55, the second blade support portion 139 fixed to the joint body 26 by bonding enables the swirl blade 56, which is a principal source of noise, to be fixed to the joint body 26 more reliably.

[0079]

The unit main body 167 includes the reinforcing ribs 168A and 168B. Therefore, the reinforcing ribs 168A and 168B enable the swirl blade 56 and the second blade support portion 139 to be connected to each other more reliably.

The reinforcing rib 168A is formed in a plate shape having a thickness direction of the reinforcing rib 168A extending along the circumferential direction. Accordingly, for example, when a volume of the reinforcing rib 168A is constant, deformation of the swirl blade 56 in the up-down direction relative to the second blade support portion 139 can be efficiently suppressed.

[0080]

The collective joint 165 may include, instead of the bonded portion 81, the vibration reducing portion 124 that fixes the joint body 26 and the blade support portion 55 to each other by an interference fit in the radial direction.

The collective joint 165 may include, instead of the second bonded portion 175, a second vibration reducing portion that fixes the joint body 26 and the second blade support portion 139 to each other by an interference fit in the radial direction. The second vibration reducing portion may have any structure that fixes the joint body 26 and the second blade support portion 139 to each other by at least one of bonding, fitting, and interference fitting.

The unit main body 167 need not include the reinforcing rib 168A.

[0081]

As indicated by a line L5 in FIG. 10, a length by which the swirl blade 56 protrudes radially inward may be reduced, and a length of the swirl blade 56 in the circumferential direction may be increased.

In this case, the length of the blade support portion 55 in the circumferential

direction is preferably increased in accordance with the swirl blade 56. Furthermore, a lower end of the vertical rib 30 is preferably disposed above the swirl blade 56 so that the swirl blade 56 does not contact the vertical rib 30.

[0082]

As in a collective joint 165A according to a first modification shown in FIGS. 12 and 13, a connecting portion between the inner circumferential surface of the blade support portion 55 and the upper surface of the swirl blade 56 may have a curved surface 55i recessed in a direction between radially outward and downward. The collective joint 165A does not include the second blade support portion 139 or the reinforcing ribs 168A and 168B in the respective configurations of the collective joint 165.

As described above, a unit main body 167A may include the curved surface 55i instead of the reinforcing ribs 168A and 168B to suppress vibration of the swirl blade 56 and the blade support portions 55 and 139.

[0083]

As in a collective joint 165B according to a second modification shown in FIGS. 14 and 15, a connecting portion between the inner circumferential surface of the second blade support portion 139 and a lower surface of the swirl blade 56 may have a curved surface 56c recessed in a direction between radially outward and upward. The collective joint 165B does not include the reinforcing ribs 168A and 168B in the respective configurations of the collective joint 165.

As described above, a unit main body 167B may include the curved surface 56c instead of the reinforcing ribs 168A and 168B to suppress vibration of the swirl blade 56 and the blade support portions 55 and 139.

[0084]

As in a collective joint 165C according to a third modification shown in FIG. 16,

the surface 168aA of the reinforcing rib 168A facing radially inward may be a curved surface recessed in a direction between radially outward and upward.

Similarly to the surface 168aA, a surface 168aB of the reinforcing rib 168B facing radially inward may be a curved surface recessed in a direction between radially outward and upward.

[0085]

The first to third embodiments of the present invention have been described above in detail with reference to the drawings; however, specific configurations are not limited to the embodiments and include modifications, combinations, omissions, and the like of the configurations within a scope not departing from the gist of the present invention. Needless to say, the respective configurations shown in the embodiments can be appropriately combined and used.

For example, in the first to third embodiments, the joint body 26 need not include the engaging portion 29, the vertical rib 30, or the lateral rib 31.

[0086]

The unit main body 122 need not include the upper vertical pipe connecting portion 53 or the protruding portion 54.

Although the joint body 26 has been described as being constituted by three members, namely, the upper joint body 27, the connecting pipe 37, and the lower joint body, the joint body may be constituted by one member, two members, or four or more members.

[0087]

For example, the joint body 26 may be constituted by two members, namely, the upper joint body 27 and a lower joint body 42, without providing the connecting pipe 37. In this case, a lower end of the upper joint body 27 is formed as a socket or a spigot, and

an upper end of the lower joint body 42 is formed as a spigot or a socket so that the lower end of the upper joint body 27 and the upper end of the lower joint body 42 can be directly connected to each other. In this case, a sheet-shaped fire-resistant material containing a thermally expandable material such as thermally expandable graphite may be provided at a position below the lateral pipe connecting portion 47 of the upper joint body 27 or on an outer surface of a lower main body 43 or a connecting portion 44 of the lower joint body 42. A width of the sheet-shaped fire-resistant material in a pipe axial direction of the joint body 26 is set to 100 mm or more, preferably 140 mm or more, and most preferably 160 mm or more.

[0088]

In order to suppress drainage noise generated when drainage water impinges on the swirl blade 56 provided on the upper main body 28 and to suppress vibration of the upper main body 28 and the swirl blade 56, a vibration damping material (not shown) is preferably provided on the upper main body 28 and the swirl blade 56.

Examples of the vibration damping material include rubber such as butyl rubber and an elastomer. The vibration damping material may be molded into a sheet shape so as to be wound around the outer circumferential surface of the upper main body 28 or may be in a putty form.

The vibration damping material may be provided on the outer circumferential surface of the upper main body 28, the lower surface of the swirl blade 56, a support-portion-side bonding surface 55a of the blade support portion 55, an inner circumferential surface 55b of the blade support portion 55, or the like.

[0089]

(Fourth Embodiment)

(Floor Structure)

As shown in FIGS. 17 to 19, a floor structure 201 is used, for example, in a building 400 having multiple floors. The floor structure 201 is used, for example, at a portion of each floor of the building 400 to which a lateral pipe P3 is connected. The floor structure 201 includes, for example, a floor slab (floor) S and a collective joint 210.

[0090]

(Floor Slab)

The floor slab S is a floor that separates an upper floor F1 above the floor slab S from a lower floor F2 below the floor slab S.

The upper floor F1 as used herein means one floor (story) of the building 400 that includes the floor slab S and extends to a position above the floor slab S. The lower floor F2 means one floor of the building 400 that includes the floor slab S and extends to a position below the floor slab S.

[0091]

The floor slab S includes a wooden floor in addition to an ordinary slab floor. A thickness T of the floor slab S can be arbitrarily selected from, for example, 75 mm, 100 mm, 150 mm, and the like, but is preferably 150 mm or more. Hereinafter, the thickness T of the floor slab S may be referred to as a “slab thickness T”.

The floor slab S has a through-hole H. The through-hole H penetrates from the upper floor F1 to the lower floor F2. The collective joint 210 is disposed in a state of being inserted into the through-hole H. A hole diameter of the through-hole H is preferably, for example, 210 mm or more and 300 mm or less.

[0092]

In the fourth embodiment, a first vertical pipe (vertical pipe) P1 on the upper floor F1 is provided above the through-hole H formed in the floor slab S, and a second vertical pipe (vertical pipe) P2 on the lower floor F2 is provided below the through-hole

H. A lateral pipe P3 is provided along the upper floor F1. A collective joint 210 inserted into the through-hole H is installed in the floor slab S. A space between an outer surface of the collective joint 210 and an inner surface of the through-hole H is filled with a filling material M.

[0093]

(Collective Joint)

The collective joint 210 is used in drainage piping 500 (piping structure). The drainage piping 500 is provided in the building 400. Here, for example, a discharge outlet of a toilet on each floor (both not shown) is disposed at a relatively high position with respect to a surface of the floor slab S. Accordingly, the lateral pipe P3 needs to be disposed at a relatively high position with respect to the surface of the floor slab S in accordance with the discharge outlet of the toilet. For this purpose, with the collective joint 210 disposed in the through-hole H, the collective joint 210 is installed in the floor slab S by an installation method in which a lateral pipe connecting portion 221 (described below) to which the lateral pipe P3 is connected is raised a predetermined distance above the floor slab S. This installation method may hereinafter be referred to as "raised-branch installation".

[0094]

In this state, a height H1 from the surface of the floor slab S to a lower end 221a of an outer surface of the lateral pipe connecting portion 221 described below is preferably 140 mm. Hereinafter, the height H1 from the floor slab S to the lower end 221a of the outer surface of the lateral pipe connecting portion 221 may be referred to as a "branch underside height H1". The lower end 221a of the outer surface of the lateral pipe connecting portion 221 may be referred to as an "outer-surface lower end 221a".

[0095]

Although the fourth embodiment mainly describes an example in which the collective joint 210 is installed in the floor slab S by raised-branch installation, the collective joint 210 may be installed in the floor slab S by ordinary installation. In the case of ordinary installation, the collective joint 210 is installed with the outer-surface lower end 221a of the lateral pipe connecting portion 221 positioned close to the floor slab S. This installation method may hereinafter be referred to as "ordinary installation".

The collective joint 210 includes, for example, a joint body 211, a fire-resistant material 212, an upper acoustic insulation cover 213, a lower acoustic insulation cover (acoustic insulation cover, first acoustic insulation cover) 214, and a fixing tape 215.

[0096]

In the fourth embodiment, a joint in which the joint body 211 is provided with the fire-resistant material 212, the upper acoustic insulation cover 213, the lower acoustic insulation cover 214, and the fixing tape 215 is described as an example of the collective joint 210, but the collective joint 210 is not limited to this example. As another example, for example, the collective joint 210 need not include the upper acoustic insulation cover 213 or the lower acoustic insulation cover 214. In this case, with the collective joint 210 accommodated in the through-hole H of the floor slab S, a space between the inner surface of the through-hole H and an outer surface of the collective joint 210 (specifically, a vertical pipe connecting portion 220 described below) is filled with the filling material M. In this state, a portion of a tapered portion 293 described below is embedded in the filling material M, and the tapered portion 93 is in contact with the filling material M.

As described below, a fire-resistant pipe 360 may be provided instead of the fire-resistant material 212.

[0097]

(Joint Body)

The joint body 211 includes the vertical pipe connecting portion 220 connectable to the first vertical pipe P1 and the second vertical pipe P2, and the lateral pipe connecting portion 221 projecting from a side surface of the vertical pipe connecting portion 220 and connectable to the lateral pipe P3. The joint body 211 is a resin joint component.

An overall length of the joint body 211 is 700 mm. An effective length of the joint body 211 is 625 mm. A length from a lower end of the lateral pipe connecting portion 221 to an upper end of the joint body 211 is 232 mm. A length from the lower end of the lateral pipe connecting portion 221 to a projection 222 of a lower connecting pipe 233 (described below) is 378 mm. A length from the projection 222 of the lower connecting pipe 233 to a lower end of the lower connecting pipe 233 is 90 mm. An inner diameter of the vertical pipe connecting portion 220 in the joint body 211 is 140 mm. An outer diameter (that is, a maximum outer diameter) of the vertical pipe connecting portion 220 is 180 mm or more and 195 mm or less. The maximum outer diameter of the vertical pipe connecting portion 220 will be described in detail below. However, dimensions such as the various lengths and angles, including dimensions described below, are not limited to the exemplified dimensions.

[0098]

(Vertical Pipe Connecting Portion)

The vertical pipe connecting portion 220 includes an upper connecting pipe 230 connectable to the first vertical pipe P1, a blade unit 231 connected to the upper connecting pipe 230, an intermediate pipe 232 connected to the upper connecting pipe 230, and a lower connecting pipe 233 connected to the intermediate pipe 232 and

connectable to the second vertical pipe P2.

The vertical pipe connecting portion 220 is formed in a tubular shape around an axis O11. In the following description, along the axis O11 of the vertical pipe connecting portion 220, a side toward the upper connecting pipe 230 and a side toward the lower connecting pipe 233 are appropriately referred to as an upper side and a lower side, respectively.

[0099]

(Lateral Pipe Connecting Portion)

As shown in FIGS. 19 and 20, the lateral pipe connecting portion 221 is disposed above the floor slab S. The lateral pipe connecting portion 221 extends in a tubular shape from a circumferential wall of the upper connecting pipe 230 in the vertical pipe connecting portion 220 radially outward in a direction orthogonal to the axis O11. The lateral pipe connecting portion 221 has a bushing stopper 224. The bushing stopper 224 is annularly provided on an inner surface of the lateral pipe connecting portion 221. The bushing stopper 224 is in contact with a distal end of a lateral bushing 225 described below.

[0100]

Three lateral pipe connecting portions 221 are disposed in the circumferential direction of the vertical pipe connecting portion 220. Two of the three lateral pipe connecting portions 221 are individually disposed at positions radially sandwiching the axis O11. The remaining lateral pipe connecting portion 221 extends in a direction that, among radial directions orthogonal to the axis O11, forms an angle of 90° in plan view with each direction in which the two lateral pipe connecting portions 221 extend.

The lateral pipe connecting portion 221 has an opening 226 that opens in an inner surface of the vertical pipe connecting portion 220. In the present embodiment,

the opening 226 is an opening of the bushing stopper 224 as viewed from the axis O11 inside the upper connecting pipe 230, but the opening 226 is not limited to this configuration. For example, when the lateral pipe connecting portion 221 does not have the bushing stopper 224, the opening 226 may be an opening formed by an end of the lateral pipe connecting portion 221 that opens into the vertical pipe connecting portion 220. The opening 226 is opened, for example, in a circular shape centered on an axis O12 of the lateral pipe connecting portion 221.

[0101]

The lateral bushing (bushing) 225, a lateral packing 227, and a lateral ring 228 are provided at a distal end portion of the lateral pipe connecting portion 221 to which the lateral pipe P3 is connected. The number and extending directions of the lateral pipe connecting portions 221 are not limited to this configuration and may be arbitrarily changed. For example, the number of lateral pipe connecting portions 221 need not be two or more and may be one or zero.

[0102]

(Upper Connecting Pipe)

Returning to FIGS. 17 to 19, the upper connecting pipe 230 has an upper connecting portion 235 connectable to the first vertical pipe P1 and a lower connecting portion (lower end) 236 connectable to the intermediate pipe 232. The lower connecting portion 236 is located near and below the lateral pipe connecting portion 221 in the upper connecting pipe 230. Drainage water from the lateral pipe connecting portion 221 merges at the lower connecting portion 236. Hereinafter, the lower connecting portion 236 may be referred to as a “lateral-pipe merging portion 236”. The lateral-pipe merging portion 236 is a main-body merging portion that is located near and below the lateral pipe connecting portion 221 in the upper connecting pipe 230 and at

which drainage water from the lateral pipe connecting portion 221 merges.

[0103]

(Blade Unit)

As shown in FIGS. 18 and 20, the blade unit 231 is fitted to an upper end portion of the upper connecting pipe 230 in the vertical pipe connecting portion 220. The blade unit 231 includes a unit main body 240, a sealing member 241, and a retaining member 242.

[0104]

As shown in FIGS. 20 to 22, the unit main body 240 includes an upper vertical pipe connecting portion 245, a blade support portion 246, a plurality of reinforcing ribs 247, and a first swirl blade (swirl blade) 248.

The upper vertical pipe connecting portion 245 is fitted to the upper end portion of the upper connecting pipe 230 in the vertical pipe connecting portion 220 (see FIG. 18). The upper vertical pipe connecting portion 245 has a projecting portion 245a. The projecting portion 245a protrudes radially outward from an outer surface of the upper vertical pipe connecting portion 245. The projecting portion 245a engages with a recessed portion 237 of the upper connecting pipe 230 (see FIG. 18), thereby enabling the unit main body 240 (specifically, the first swirl blade 248) to be positioned relative to the upper connecting pipe 230 in the circumferential direction.

[0105]

The blade support portion 246 extends downward from a portion in the circumferential direction of a lower end portion of the upper vertical pipe connecting portion 245. That is, the upper vertical pipe connecting portion 245 is connected to an upper end portion of the blade support portion 246.

The blade support portion 246 is formed in a curved flat plate shape and is

formed in an arc shape as viewed in the up-down direction. The blade support portion 246 extends in the up-down direction. That is, a length of the blade support portion 246 in the circumferential direction is substantially constant regardless of a position in the up-down direction. The plurality of reinforcing ribs 247 are provided on an outer surface 246a of the blade support portion 246 that faces an inner surface of the upper connecting pipe 230.

[0106]

On the outer surface 246a of the blade support portion 246, the plurality of reinforcing ribs 247 extend in the up-down direction along the axis O11 from the lower end portion of the upper vertical pipe connecting portion 245 to a lower end portion of the blade support portion 246. The plurality of reinforcing ribs 247 protrude from the outer surface 246a of the blade support portion 246 to the inner surface of the upper connecting pipe 230. The plurality of reinforcing ribs 247 are in contact with the inner surface of the upper connecting pipe 230. By bringing the plurality of reinforcing ribs 247 into contact with the inner surface of the upper connecting pipe 230, vibration of the blade support portion 246 and the first swirl blade 248 can be damped by the plurality of reinforcing ribs 247. The plurality of reinforcing ribs 247 constitute a vibration suppressing portion (vibration reducing portion) 249. That is, the vibration suppressing portion 249 is in contact with the inner surface of the upper connecting pipe 230 and has a vibration suppressing function for the blade support portion 246 and the first swirl blade 248.

[0107]

The plurality of reinforcing ribs 247 are disposed at intervals in the circumferential direction of the upper connecting pipe 230. Spaces 250 partitioned by the plurality of reinforcing ribs 247 are formed between the outer surface 246a of the

blade support portion 246 and the inner surface of the upper connecting pipe 230. In other words, each space 250 is formed by being surrounded by the upper connecting pipe 230, the blade support portion 246, and the plurality of reinforcing ribs 247.

[0108]

As shown in FIGS. 21 to 24, a lower end portion 246b of the blade support portion 246 gradually extends farther downward toward a first side X1 (a first side in the circumferential direction) in the circumferential direction. The first swirl blade 248 is provided on an inner surface (a surface facing radially inward) of the lower end portion 246b of the blade support portion 246. An upper surface 248a of the first swirl blade 248 protrudes radially inward from the blade support portion 246 at an inclination angle θ11 of 116°. The upper surface 248a of the first swirl blade 248 is inclined at an inclination angle θ12 of 45° so as to gradually extend downward toward the first side X1 in the circumferential direction. The inclination angle θ12 is an angle at which the upper surface 248a is inclined from one side portion 246c of the blade support portion 246 toward another side portion 246d relative to a plane orthogonal to the axis O11.

[0109]

Contact of the first swirl blade 248 with drainage water in the upper connecting pipe 230 of the vertical pipe connecting portion 220 can make the drainage water likely to stagnate locally in the vicinity of the first swirl blade 248. Accordingly, an advantageous effect of improving drainage capacity in the upper connecting pipe 230 is markedly achieved.

The upper vertical pipe connecting portion 245, the blade support portion 246, the plurality of reinforcing ribs 247, and the first swirl blade 248 included in the unit main body 240 are integrally made of a vinyl chloride resin or the like.

[0110]

As shown in FIGS. 20, 25, and 26, the upper connecting pipe 230 includes a plurality of vertical ribs (backflow prevention ribs) 252 on an inner surface thereof. The plurality of vertical ribs 252 are provided on the inner surface of the upper connecting pipe 230 and arranged in the circumferential direction of the upper connecting pipe 230. Specifically, the plurality of vertical ribs 252 are disposed between the lateral pipe connecting portions 221 adjacent to each other in the circumferential direction and between the lateral pipe connecting portion 221 and the blade support portion 246 adjacent to each other in the circumferential direction. That is, four vertical ribs 252 are disposed at intervals in the circumferential direction. The plurality of vertical ribs 252 are disposed in the up-down direction along the axis O11. Of the plurality of vertical ribs 252, a vertical rib 252A is disposed below the first swirl blade 248 (see FIG. 18). A height of the vertical rib 252A is reduced to avoid the first swirl blade 248. The vertical rib 252A supports the first swirl blade 248 (see FIG. 18) from below. The vertical ribs 252 restrict drainage water from flowing back into the lateral pipe connecting portions 221.

[0111]

Lower ends 252a of the plurality of vertical ribs 252 are located at the same height in an axis O11 direction. The lower ends 252a of the plurality of vertical ribs 252 are located, for example, within a first allowable range from a height equal to or above a lower end 226a of the opening 226 in the lateral pipe connecting portion 221 to a height 25 mm or less above the lower end 226a of the opening 226. The lower end 226a of the opening 226 is a position of the lowermost end of the opening 226 in the axis O11 direction.

[0112]

Here, the lateral bushing 225 has an opening 229. The opening 229 is an

opening formed by an end of the lateral bushing 225 that opens into the vertical pipe connecting portion 220. The opening 229 can also be regarded as an opening of the lateral bushing 225 as viewed from inside the upper connecting pipe 230. An opening diameter (inner diameter) of the opening 229 of the lateral bushing 225 varies among a variety of sizes in accordance with a diameter of the lateral pipe P3 (see FIG. 17). However, the opening 229 is offset downward relative to the lateral pipe connecting portion 221. Here, an axis of the opening 229 is defined as the axis O12 of the lateral bushing 225. In this case, the lower ends 252a of the vertical ribs 252 may be located within a second allowable range from a height equal to or above the lower end 226a of the opening 226 to a height equal to or below the axis O12 of the lateral bushing 225. The lower ends 252a of the vertical ribs 252 may be located within both the first allowable range and the second allowable range, or may be located within only either one of the first allowable range and the second allowable range. Furthermore, with respect to the second allowable range, the lower limit may be a lower end 229a of the opening 229 in the lateral bushing 225 instead of the lower end 226a of the opening 226 in the lateral pipe connecting portion 221.

[0113]

(Intermediate Pipe)

As shown in FIGS. 17, 18, 27, and 28, the intermediate pipe 232 is connected to the lateral-pipe merging portion 236 of the upper connecting pipe 230. The intermediate pipe 232 is produced, for example, by injection-molding a resin composition. A second swirl blade may be provided on an inner surface of the intermediate pipe 232.

The intermediate pipe 232 includes, for example, a straight pipe portion 260, a first connecting port 261, and a second connecting port 262. In the fourth embodiment,

the first connecting port 261 is a “socket 261”. The second connecting port 262 is a “spigot 262”.

[0114]

In the fourth embodiment, the first connecting port 261 is described as the “socket 261”, and the second connecting port 262 is described as the “spigot 262”; however, the first connecting port 261 and the second connecting port 262 are not limited to this configuration. As another example, the first connecting port 261 may be a “spigot”, and the second connecting port 262 may be a “spigot”. Alternatively, the first connecting port 261 may be a “socket”, and the second connecting port 262 may be a “socket”. Furthermore, the first connecting port 261 may be a “spigot”, and the second connecting port 262 may be a “socket”.

[0115]

The straight pipe portion 260 is provided between the socket 261 and the spigot 262 in the axis O11 direction. The socket 261 is provided coaxially at an upper end portion of the straight pipe portion 260. The socket 261 is connected to the lateral-pipe merging portion 236 of the upper connecting pipe 230 by being fitted to the lateral-pipe merging portion 236. Accordingly, an outer surface of a connecting part between the socket 261 and the lateral-pipe merging portion 236 of the upper connecting pipe 230 is the outer surface of the socket 261.

The spigot 262 is provided coaxially at a lower end portion of the straight pipe portion 260. Inner diameters of the straight pipe portion 260 and the spigot 262 are preferably greater than an inner diameter of the first vertical pipe P1. The spigot 262 is connected to a socket 291 of the lower connecting pipe 233 described below by being fitted to the socket 291. Accordingly, an outer surface of a connecting part between the spigot 262 and the socket 291 of the lower connecting pipe 233 is the outer surface of the

socket 291.

[0116]

As shown in FIGS. 27 and 28, the straight pipe portion 260 is formed in a circular cross-sectional shape. An outer diameter of the straight pipe portion 260 is equal to the outer diameter of the upper connecting pipe 230. An inner diameter of the straight pipe portion 260 is equal to the inner diameter of the upper connecting pipe 230. The straight pipe portion 260 has a thick-walled portion 265. The thick-walled portion 265 is integrally molded with the straight pipe portion 260. The thick-walled portion 265 is a protruding portion that protrudes radially outward from a side surface of the straight pipe portion 260. Hereinafter, the thick-walled portion 265 may be referred to as a “protruding portion 265”.

[0117]

The protruding portion 265 includes a plurality of first ribs 265a and a plurality of second ribs 265b. The plurality of first ribs 265a are provided at intervals in the axis O11 direction on the side surface of the straight pipe portion 260. The plurality of first ribs 265a are formed in annular shapes by extending in the circumferential direction along the side surface of the straight pipe portion 260. The plurality of second ribs 265b are provided at intervals in the circumferential direction on the side surface of the straight pipe portion 260. The plurality of second ribs 265b are formed in linear shapes by extending in the axis O11 direction along the side surface of the straight pipe portion 260.

[0118]

The plurality of first ribs 265a and the plurality of second ribs 265b are provided over the entire side surface of the straight pipe portion 260. The plurality of first ribs 265a and the plurality of second ribs 265b are disposed so as to be orthogonal to each other. Outer surfaces of the plurality of first ribs 265a and outer surfaces of the plurality

of second ribs 265b are formed flush with each other. The outer surfaces of the plurality of first ribs 265a and the outer surfaces of the plurality of second ribs 265b form an "outer surface of the straight pipe portion 260". The outer surface of the straight pipe portion 260 forms the same outer surface as the outer surface of the socket 261 in the intermediate pipe 232 and the outer surface of the socket 291 (described below) in the lower connecting pipe 233.

[0119]

Although the fourth embodiment describes an example in which both the plurality of first ribs 265a and the plurality of second ribs 265b are provided as the protruding portion 265, the protruding portion 265 is not limited to this configuration. As another example, either one of the plurality of first ribs 265a and the plurality of second ribs 265b may serve as the protruding portion 265.

[0120]

Here, the intermediate pipe 232 has a first recessed portion 267 and a second recessed portion 268. The first recessed portion 267 is formed at an upper end of the socket 261. The first recessed portion 267 is fitted to a projecting portion 238 of the upper connecting pipe 230 (see FIG. 19), thereby enabling the intermediate pipe 232 to be positioned relative to the upper connecting pipe 230 in the circumferential direction. The second recessed portion 268 is formed in the lowermost first rib 265a among the plurality of first ribs 265a. The second recessed portion 268 is fitted to a projecting portion 295 of the lower connecting pipe 233 (see FIG. 31), thereby enabling the lower connecting pipe 233 to be positioned relative to the intermediate pipe 232 in the circumferential direction.

Here, as shown in FIG. 18, the first swirl blade 248 is positioned relative to the upper connecting pipe 230 in the circumferential direction. Accordingly, by positioning

the intermediate pipe 232 relative to the upper connecting pipe 230 in the circumferential direction and positioning the lower connecting pipe 233 relative to the intermediate pipe 232 in the circumferential direction, a third swirl blade 300 (described below) of the lower connecting pipe 233 can be positioned relative to the first swirl blade 248 in the circumferential direction.

[0121]

(Modification 1 of Intermediate Pipe)

As shown in FIG. 29, the intermediate pipe 232 according to the fourth embodiment may be replaced with an intermediate pipe 272. The intermediate pipe 272 is obtained by replacing the straight pipe portion 260 according to the fourth embodiment with a straight pipe portion 273. The straight pipe portion 273 is formed in a circular cross-sectional shape. The straight pipe portion 273 has a thick-walled portion 274 having a constant wall thickness over the entire circumference. An outer surface over the entire circumference of the straight pipe portion 273 forms the same outer surface as the outer surface of the socket 261 in the intermediate pipe 272 and the outer surface of the socket 291 (described below) in the lower connecting pipe 233.

[0122]

(Modification 2 of Intermediate Pipe)

As shown in FIG. 30, the intermediate pipe 272 according to Modification 1 may be replaced with an intermediate pipe 282. The intermediate pipe 282 is obtained by replacing the straight pipe portion 273 according to Modification 1 with a straight pipe portion 283 and replacing the spigot 262 according to Modification 1 with a socket 285. An outer surface over the entire circumference of the straight pipe portion 283 forms the same outer surface as the outer surface of the socket 261 in the intermediate pipe 282 and the outer surface of the socket 285 in the intermediate pipe 282.

The straight pipe portion 283 also has a plurality of groove portions 286 in an inner surface thereof. The plurality of groove portions 286 are provided at intervals in the circumferential direction. The plurality of groove portions 286 are recessed radially outward from the inner surface of the straight pipe portion 283 and extend in the axis O11 direction. Accordingly, a wall thickness of the straight pipe portion 283 can be reduced at intervals in the circumferential direction.

[0123]

Here, ribs 287 are formed on the inner surface of the straight pipe portion 283 between the plurality of groove portions 286 in the circumferential direction. The plurality of ribs 287 protrude radially inward and extend in the axis O11 direction. Accordingly, when the socket 261 of the intermediate pipe 282 is fitted to the lateral-pipe merging portion 236 of the upper connecting pipe 230 (see FIG. 18), upper ends of the plurality of ribs 287 abut against the lateral-pipe merging portion 236 and serve as stoppers. When the socket 285 of the intermediate pipe 282 is fitted to a spigot (not shown) of the lower connecting pipe 233, lower ends of the plurality of ribs 287 also abut against the spigot of the lower connecting pipe 233 and serve as stoppers.

[0124]

(Lower Connecting Pipe)

As shown in FIGS. 17 to 19 and FIG. 31, the lower connecting pipe 233 is formed of a pipe body having a diameter reduced on a lower side relative to an upper side. The lower connecting pipe 233 is disposed below the intermediate pipe 232. The lower connecting pipe 233 includes a socket (upper end) 291 that is located at an upper end portion of the lower connecting pipe 233 and connected to the spigot 262 of the intermediate pipe 232, a coupling pipe portion 292 provided at a lower end portion of the socket 291, a downwardly narrowing tapered portion 293 provided at a lower end portion

of the coupling pipe portion 292, and a lower pipe portion 294 provided at a lower end portion of the tapered portion 293 and to which the second vertical pipe P2 is connected. The lower connecting pipe 233 is integrally formed, for example, by injection molding a synthetic resin material.

[0125]

The lower pipe portion 294 connects the second vertical pipe P2 below the tapered portion 293. An outer diameter of the lower pipe portion 294 is a minimum outer diameter of the vertical pipe connecting portion 220 below the tapered portion 293. The minimum outer diameter is 110 mm or more and 120 mm or less.

The tapered portion 293 is inclined so as to decrease in diameter downward from the lower end portion of the coupling pipe portion 292 to the lower pipe portion 294. An inclination angle θ13 of the tapered portion 293 is 80° or more and 85° or less. Here, the slab thickness T of the floor slab S is greater than an ordinary slab thickness and is formed to be 150 mm or more. For example, with the collective joint 210 installed in the floor slab S by raised-branch installation, at least an upper half portion of the tapered portion 293 is preferably disposed in the through-hole H of the floor slab S.

[0126]

An inner diameter of the socket 291 is greater than the spigot 262 of the intermediate pipe 232. The spigot 262 of the intermediate pipe 232 is fitted inside the socket 291. An outer diameter of the coupling pipe portion 292 is smaller than an outer diameter of the socket 291. The outer diameter of the socket 291 is the maximum outer diameter of the vertical pipe connecting portion 220. The maximum outer diameter of the vertical pipe connecting portion 220 is 180 mm or more and 195 mm or less.

[0127]

Because the outer diameter of the coupling pipe portion 292 is smaller than the

outer diameter of the socket 291, a circumferential stepped portion is formed at a boundary portion between the socket 291 and the coupling pipe portion 292. A first rib 296 and a second rib 297 are provided on a side surface of the coupling pipe portion 292, similarly to the protruding portion 265 of the intermediate pipe 232. Outer surfaces of the first rib 296 and the second rib 297 form an outer surface of the coupling pipe portion 292. Accordingly, the outer surface of the coupling pipe portion 292 is formed as the same outer surface as the outer surface of the socket 291, the outer surface of the straight pipe portion 260 in the intermediate pipe 232, and the outer surface of the socket 261 in the intermediate pipe 232.

[0128]

As shown in FIGS. 17, 19, and 32, an outer diameter at an upper end of the tapered portion 293 is equal to the outer diameter of the coupling pipe portion 292. An outer diameter at the lower end portion of the tapered portion 293 is smaller than an outer diameter at an upper end portion of the tapered portion 293. The third swirl blade 300 is provided on an inner surface of an intermediate part of the tapered portion 293 in the up-down direction. The third swirl blade 300 gradually extends toward the first side X1 in the circumferential direction from the upper side toward the lower side. More specifically, a surface 300a of the third swirl blade 300 facing the first side X1 gradually extends toward the first side X1 from the upper side toward the lower side. A surface 300b of the third swirl blade 300 facing a second side X2 in the circumferential direction gradually extends toward the first side X1 from the upper side toward the lower side.

[0129]

As shown in FIGS. 32 to 34, the third swirl blade 300 is inclined downward from an upper end portion 300c toward a lower end portion 300d at an inclination angle $\theta 14$ of 68°. The inclination angle $\theta 14$ is an angle at which the third swirl blade 300 is

inclined from the upper end portion 300c toward the lower end portion 300d relative to a plane orthogonal to the axis O11. An overall length of the third swirl blade 300 is 150 mm. The overall length is a length from the upper end portion 300c to the lower end portion 300d.

The third swirl blade 300 protrudes, for example, from an outer side toward an inner side of the tapered portion 293 at an inclination angle θ15 of 30° relative to the radial direction. A width (a dimension in the circumferential direction) of the third swirl blade 300 is 36 mm. The width of the third swirl blade 300 is a width from an inner edge 300e to an outer edge 300f of the third swirl blade 300 as viewed in the radial direction from the axis O11.

The third swirl blade 300 changes and swirls a flow of drainage water flowing through the lower connecting pipe 233.

[0130]

The outer diameter of the lower pipe portion 294 is smaller than the outer diameter of the socket 261 in the intermediate pipe 232. The second vertical pipe P2 on the lower floor F2 is connected to the lower connecting pipe 233 by being fitted, from below, around the outside of the lower pipe portion 294. Although the fourth embodiment describes an example in which the lower pipe portion 294 serves as a spigot for the second vertical pipe P2, the lower pipe portion 294 may serve as a socket for the second vertical pipe P2.

[0131]

(Fire-Resistant Material)

As shown in FIGS. 17 to 19, the fire-resistant material 212 is provided on the outer surface of the vertical pipe connecting portion 220. The fire-resistant material 212 is covered with the lower acoustic insulation cover 214 described below. That is, the

fire-resistant material 212 is provided between the vertical pipe connecting portion 220 and the lower acoustic insulation cover 214. The fire-resistant material 212 is provided, for example, at a position avoiding the first swirl blade 248, the plurality of vertical ribs 252, and the third swirl blade 300 in the axis O11 direction.

[0132]

A height H2 of the fire-resistant material 212 is preferably greater than 150 mm and equal to or less than 300 mm in the axis O11 direction. In the fourth embodiment, as an example, the height H2 of the fire-resistant material 212 is 210 mm, and a thickness of the fire-resistant material 212 is 2 mm. The height H2 of the fire-resistant material 212 is preferably greater than a height of the intermediate pipe 232. For example, with the collective joint 210 installed in the floor slab S by raised-branch installation, at least a lower half portion of the fire-resistant material 212 is preferably disposed in the through-hole H of the floor slab S.

[0133]

Examples of the fire-resistant material 212 include a fire-resistant sheet 310 made of resin containing thermally expandable graphite. The fire-resistant sheet 310 has thermal expandability that causes the fire-resistant sheet 310 to expand upon heating and form a fire-resistant heat-insulating layer. The fire-resistant sheet 310 is not particularly limited as long as a volumetric expansion ratio after heating for 30 minutes under a heating condition of 50 kW/m^2 is 3 to 100 times, but is preferably made of a resin binder and an inorganic filling material. Specifically, the fire-resistant sheet 310 is formed, for example, from commercially available Fi-Block (registered trademark) manufactured by Sekisui Chemical Co., Ltd.

[0134]

The fire-resistant sheet 310 is disposed, for example, on the outer surface of the

socket 261 in the intermediate pipe 232, the outer surface of the straight pipe portion 260 in the intermediate pipe 232, the outer surface of the socket 291 in the lower connecting pipe 233, and the outer surface of the coupling pipe portion 292 in the lower connecting pipe 233. By attaching the fire-resistant sheet 310 to the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233, the height H2 of the fire-resistant material 212 can be set to 210 mm. An upper end 212a of the fire-resistant material 212 is preferably located 15 mm below the lower end of the outer surface of the lateral pipe connecting portion 221.

A thermal expansion ratio of the fire-resistant material 212 is preferably 1.3 times or more and 100 times or less.

[0135]

Here, reasons for setting the height H2 of the fire-resistant material 212 to 210 mm and setting the thermal expansion ratio of the fire-resistant material 212 to 1.3 times or more and 100 times or less will be described with reference to FIGS. 35 to 40. FIGS. 35 to 40 show examples in which the collective joint 210 is installed in the floor slab S by raised-branch installation and ordinary installation when the slab thickness T of the floor slab S is 150 mm, 100 mm, and 75 mm.

[0136]

First, a case in which the slab thickness T of the floor slab S is 150 mm will be described with reference to FIGS. 35 and 36.

As shown in FIG. 35, the collective joint 210 is installed at the branch underside height H1 by raised-branch installation in the floor slab S having the slab thickness T of 150 mm. In this case, by setting the height H2 of the fire-resistant material 212 to 210 mm, an 85 mm range of the fire-resistant material 212 can be embedded in the through-

hole H.

[0137]

When the slab thickness T of the floor slab S is 150 mm, at least the upper half portion of the tapered portion 293 can be embedded in the through-hole H of the floor slab S. Furthermore, an inclination angle θ3 of the tapered portion 293 is set to 80° or more and 85° or less. Accordingly, the tapered portion 293 can suppress falling-off of residue of the fire-resistant material 212 generated by a flame on the lower floor F2 of the floor slab S. Suppression of falling-off of the residue will be described in detail below.

[0138]

As shown in FIG. 36, the collective joint 210 may also be installed by ordinary installation in the floor slab S having the slab thickness T of 150 mm. In this case, by setting the height H2 of the fire-resistant material 212 to 210 mm, a 135 mm range of the fire-resistant material 212 can be embedded in the through-hole H. Accordingly, a large embedded range of the fire-resistant material 212 can be ensured. As a result, when a flame occurs on the lower floor F2 of the floor slab S, thermal expansion of the fire-resistant material 212 can appropriately close the through-hole H.

[0139]

As shown in FIGS. 35 and 36, when the slab thickness T is 150 mm, setting the height H2 of the fire-resistant material 212 to 210 mm can ensure fire resistance provided by the fire-resistant material 212 when a flame occurs on the lower floor F2 of the floor slab S.

[0140]

Next, a case in which the slab thickness T of the floor slab S is 100 mm will be described with reference to FIGS. 37 and 38.

As shown in FIG. 37, the collective joint 210 may be installed at the branch underside height H1 by raised-branch installation in the floor slab S having the slab thickness T of 100 mm. By setting the height H2 of the fire-resistant material 212 to 210 mm, an 85 mm range of the fire-resistant material 212 can be embedded in the through-hole H. In this case, by setting the thermal expansion ratio of the fire-resistant material 212 to 1.3 times or more and 100 times or less, thermal expansion of the fire-resistant material 212 can appropriately close the through-hole H.

[0141]

As shown in FIG. 38, the collective joint 210 may also be installed by ordinary installation in the floor slab S having the slab thickness T of 100 mm. By setting the height H2 of the fire-resistant material 212 to 210 mm, an 85 mm range of the fire-resistant material 212 can be embedded in the through-hole H. In this case, by setting the thermal expansion ratio of the fire-resistant material 212 to 1.3 times or more and 100 times or less, thermal expansion of the fire-resistant material 212 can appropriately close the through-hole H.

[0142]

Subsequently, a case in which the slab thickness T of the floor slab S is 75 mm will be described with reference to FIGS. 39 and 40.

As shown in FIG. 39, the collective joint 210 may be installed at the branch underside height H1 by raised-branch installation in the floor slab S having the slab thickness T of 75 mm. By setting the height H2 of the fire-resistant material 212 to 210 mm, a 75 mm range of the fire-resistant material 212 can be embedded in the through-hole H. In this case, by setting the thermal expansion ratio of the fire-resistant material 212 to 1.3 times or more and 100 times or less, thermal expansion of the fire-resistant material 212 can appropriately close the through-hole H.

[0143]

As shown in FIG. 40, the collective joint 210 may also be installed by ordinary installation in the floor slab S having the slab thickness T of 75 mm. By setting the height H2 of the fire-resistant material 12 to 210 mm, a 60 mm range of the fire-resistant material 212 can be embedded in the through-hole H. In this case, by setting the thermal expansion ratio of the fire-resistant material 212 to 1.3 times or more and 100 times or less, thermal expansion of the fire-resistant material 212 can appropriately close the through-hole H.

[0144]

As shown in FIGS. 38 and 40, when the slab thickness T is 75 mm or 100 mm, the height H2 of the fire-resistant material 212 is preferably set to 210 mm, and the thermal expansion ratio of the fire-resistant material 212 is preferably set to 1.3 times or more and 100 times or less. Accordingly, when a flame occurs on the lower floor F2 of the floor slab S, fire resistance provided by the fire-resistant material 212 can be ensured. As a result, by setting the height H2 of the fire-resistant material 212 to 210 mm and setting the thermal expansion ratio of the fire-resistant material 212 to 1.3 times or more and 100 times or less, the thickness of the floor slab S can also be reduced to less than 100 mm.

[0145]

Although the fourth embodiment describes an example in which the fire-resistant material 212 covers a range from the intermediate pipe 232 to the lower connecting pipe 233 in the joint body 211, the fire-resistant material 212 is not limited to this configuration. As another example, the fire-resistant material 212 may cover a range from the upper connecting pipe 230 to the intermediate pipe 232 in the joint body 211. The fire-resistant material 212 may also cover a range from the intermediate pipe

232 to the lower connecting pipe 233 in the joint body 11.

[0146]

As shown in FIGS. 17 and 41, the fire-resistant material 212 may include a plurality of fire-resistant sheets 312. A width of each fire-resistant sheet 312 is formed, for example, to be narrower in the axis O11 direction than a width from the socket 261 of the intermediate pipe 232 to the coupling pipe portion 292 of the lower connecting pipe 233. The plurality of fire-resistant sheets 312 are disposed in a state of being wound in the circumferential direction around the outer surfaces of the socket 61 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

Adjacent fire-resistant sheets 312 among the plurality of fire-resistant sheets 312 are overlapped or butted against each other in the axis O11 direction of the vertical pipe connecting portion 220. Accordingly, the fire-resistant material 212 formed from the plurality of fire-resistant sheets 312 can cover the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

[0147]

Here, the plurality of second ribs 265b are provided at intervals in the axis O11 direction on the outer surface of the straight pipe portion 260 in the intermediate pipe 232. The plurality of second ribs 265b extend in the axis O11 direction along the outer surface of the straight pipe portion 260. The outer surfaces of the plurality of second ribs 265b are formed flush with the outer surface of the socket 261 in the intermediate pipe 232 and the outer surface of the socket 91 in the lower connecting pipe 233. The

plurality of fire-resistant sheets 314 are disposed on the outer surfaces of the plurality of second ribs 265b. Accordingly, the plurality of fire-resistant sheets 314 can be appropriately disposed on the outer surface of the intermediate pipe 232 while suppressing the occurrence of wrinkles.

[0148]

Next, an installation method for the collective joint 210 in which the plurality of fire-resistant sheets 312 are installed will be described.

First, the plurality of fire-resistant sheets 312 are wound in the circumferential direction around the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233. At this time, adjacent fire-resistant sheets 312 are overlapped or butted against each other in the axis O11 direction. Accordingly, the plurality of fire-resistant sheets 312 can be continuously disposed on the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

That is, the fire-resistant material 212 can be formed to cover the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233. This completes the installation method for the collective joint 210 in which the fire-resistant material 212 is formed from the plurality of fire-resistant sheets 312.

[0149]

Here, the plurality of fire-resistant sheets 312 may be disposed on the

intermediate pipe 232 before installation work for connecting the upper connecting pipe 230, the intermediate pipe 232, and the lower connecting pipe 233 of the vertical pipe connecting portion 220. Here, a seam (not shown) at which both ends are joined is formed in each fire-resistant sheet 312 wound around the intermediate pipe 232. The seam can be used for positioning when the vertical pipe connecting portion 220 is assembled.

Specifically, for example, the seam between both ends of one fire-resistant sheet 312 serves as a positioning portion (not shown). Based on the positioning portion, the upper connecting pipe 230 and the lower connecting pipe 233 to be connected to the intermediate pipe 232 are positioned in the circumferential direction. Accordingly, the third swirl blade 300 of the lower connecting pipe 233 can be positioned in the circumferential direction relative to the first swirl blade 248 of the upper connecting pipe 230.

[0150]

(Modification 1 of Fire-Resistant Material)

As shown in FIGS. 17 and 42, the plurality of fire-resistant sheets 310 according to the fourth embodiment may be replaced with a plurality of fire-resistant sheets 314. A length of each fire-resistant sheet 314 is set, for example, to a length from the socket 261 of the intermediate pipe 232 to the coupling pipe portion 292 of the lower connecting pipe 233. A width of each fire-resistant sheet 314 is formed, for example, to be narrower than a circumferential length of the socket 61 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233. The plurality of fire-resistant sheets 314 are disposed along the axis O11 on the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of

the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

[0151]

Adjacent fire-resistant sheets 310 among the plurality of fire-resistant sheets 314 are overlapped or butted against each other in the circumferential direction of the vertical pipe connecting portion 220. Accordingly, the fire-resistant material 212 formed from the plurality of fire-resistant sheets 314 can cover the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

[0152]

Here, the plurality of first ribs 265a are provided at intervals in the axis O11 direction on the outer surface of the straight pipe portion 260 in the intermediate pipe 232. The plurality of first ribs 265a are formed in annular shapes by extending in the circumferential direction along the outer surface of the straight pipe portion 260. The outer surfaces of the plurality of first ribs 265a are formed flush with the outer surface of the socket 261 in the intermediate pipe 232 and the outer surface of the socket 291 in the lower connecting pipe 233. The plurality of fire-resistant sheets 314 are disposed on the outer surfaces of the plurality of first ribs 265a. Accordingly, the plurality of fire-resistant sheets 314 can be appropriately disposed on the outer surface of the intermediate pipe 232 while suppressing the occurrence of wrinkles.

[0153]

Next, an installation method for the collective joint 210 in which the plurality of fire-resistant sheets 314 according to Modification 1 are installed will be described.

First, the plurality of fire-resistant sheets 314 are disposed along the axis O11 of

the vertical pipe connecting portion 220 on the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233. At this time, adjacent fire-resistant sheets 314 are overlapped or butted against each other in the circumferential direction of the vertical pipe connecting portion 220. Accordingly, the plurality of fire-resistant sheets 314 can be continuously disposed on the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233. That is, the fire-resistant material 212 can be formed to cover the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233. This completes the installation method for the collective joint 210 in which the fire-resistant material 212 is formed from the plurality of fire-resistant sheets 314.

[0154]

Here, the plurality of fire-resistant sheets 314 may be disposed on the intermediate pipe 232 before installation work for connecting the upper connecting pipe 230, the intermediate pipe 232, and the lower connecting pipe 233 of the vertical pipe connecting portion 220. Here, seams (not shown) are formed between the fire-resistant sheets 314 disposed on the intermediate pipe 232 by overlapping or butting adjacent fire-resistant sheets 314 against each other. At least one of the seams can be used for positioning when the vertical pipe connecting portion 220 is assembled.

Specifically, for example, at least one of the seams between adjacent fire-resistant sheets serves as a positioning portion (not shown). Based on the positioning

portion, the upper connecting pipe 230 and the lower connecting pipe 233 to be connected to the intermediate pipe 232 are positioned in the circumferential direction. Accordingly, the third swirl blade 300 of the lower connecting pipe 233 can be positioned in the circumferential direction relative to the first swirl blade 248 of the upper connecting pipe 230.

[0155]

(Upper Acoustic Insulation Cover)

As shown in FIGS. 17 to 19, the upper acoustic insulation cover 213 is disposed so as to surround an outer surface of the upper connecting pipe 230 of the joint body 211. Specifically, the upper acoustic insulation cover 13 includes an acoustic absorption sheet 320 wound around the upper connecting pipe 230 from a radially outer side to cover the upper connecting pipe 230, and an acoustic insulation sheet 321 covering the acoustic absorption sheet 320. The acoustic absorption sheet 320 and the acoustic insulation sheet 321 each have flexibility.

[0156]

The acoustic absorption sheet 320 is made of, for example, an acoustic absorption material such as needle felt. The acoustic absorption sheet 320 has, for example, an areal density of 1.0 kg/m^2 and a thickness of 10 mm. Three first fitting openings (not shown) into which the lateral pipe connecting portions 221 are fitted are formed in the acoustic absorption sheet 320. Each first fitting opening not shown is formed, for example, in an elliptical shape in plan view. When the lateral pipe connecting portion 221 is inserted through the first fitting opening, the first fitting opening is widened in the lateral direction and assumes a perfect circular shape.

[0157]

The acoustic insulation sheet 321 is made of, for example, an olefin-based

acoustic insulation material. The acoustic insulation sheet 321 has, for example, an areal density of 3.44 kg/m^2 and a thickness of 2 mm. Second fitting openings (not shown) into which the lateral pipe connecting portions 21 are fitted are formed in the acoustic insulation sheet 321. Three second fitting openings not shown are disposed at intervals from each other in the lateral direction.

Each second fitting opening is formed in an elliptical shape in front view. When the lateral pipe connecting portion 221 is inserted through the second fitting opening, the second fitting opening is widened in the lateral direction and assumes a perfect circular shape.

[0158]

When the acoustic insulation sheet 321 is wound around a radially outer side of the acoustic absorption sheet 320, the lateral pipe connecting portions 221 are inserted into and fitted into the second fitting openings while the acoustic insulation sheet 321 is elastically deformed so as to widen the second fitting openings not shown. Accordingly, inner peripheral edge portions of the second fitting openings not shown are in close contact with the outer surfaces of the lateral pipe connecting portions 221 due to an elastic restoring force of the acoustic insulation sheet 321.

[0159]

Both lateral end portions of the acoustic insulation sheet 321 are connected to each other at a portion of a side surface of the upper connecting pipe 230 from which no lateral pipe connecting portion 221 projects. The acoustic absorption sheet 320 and the acoustic insulation sheet 321 wound around the upper connecting pipe 230 are each formed in an annular shape.

[0160]

The upper acoustic insulation cover 213 is provided so as to surround the outer

surface of the upper connecting pipe 230 in a state in which the acoustic absorption sheet 320 is wound around the upper connecting pipe 230 and is covered with the acoustic insulation sheet 321. In this state, a lower end 213a of the upper acoustic insulation cover 213 can be disposed, for example, on the socket 261 of the intermediate pipe 232. The lower end 213a of the upper acoustic insulation cover 213 can also be disposed above the floor slab S (on the upper floor) when the collective joint 210 is installed by raised-branch installation.

[0161]

(Lower Acoustic Insulation Cover)

The lower acoustic insulation cover 214 is provided below the upper acoustic insulation cover 213 in the axis O11 direction. The lower acoustic insulation cover 214 is provided so as to cover a portion of the joint body 211 extending from the upper end 212a of the fire-resistant material 212, through the tapered portion 293, to the lower pipe portion 294. That is, the lower acoustic insulation cover 214 integrally covers the intermediate pipe 232 and the lower connecting pipe 233. Although the fourth embodiment describes an example in which the lower acoustic insulation cover 214 integrally covers the intermediate pipe 232 and the lower connecting pipe 233, the lower acoustic insulation cover 214 is not limited to this configuration. As another example, the lower acoustic insulation cover 214 may be integrally provided below the lateral pipe connecting portion 221 so as to indirectly cover the upper connecting pipe 230 via the intermediate pipe 232. An upper end 214a of the lower acoustic insulation cover 214 is disposed, for example, on the socket 261 of the intermediate pipe 232. The upper end 214a of the lower acoustic insulation cover 214 is butted, for example, against the lower end 13a of the upper acoustic insulation cover 213.

[0162]

The lower acoustic insulation cover 214 has a two-layer structure in which an inner layer 200a made of an acoustic absorption material such as rock wool and an outer layer 200b made of an acoustic insulation material such as ethylene propylene diene rubber (EPDM) are combined. Specifically, the inner layer 200a is made of, for example, fibers such as needle felt. The inner layer 200a has, for example, an areal density of 1.0 kg/m^2 and a thickness of 5 mm. The outer layer 200b is made of a resin containing an olefin-based rubber component. The outer layer 200b has, for example, an areal density of 4.8 kg/m^2 and a thickness of 3 mm. The outer layer 200b is integrally molded, for example, by injection molding.

[0163]

That is, the lower acoustic insulation cover 214 is integrally formed in a tubular shape without being divided in the axis O11 direction. The lower acoustic insulation cover 214 is fitted, for example, over a portion extending from the upper end 212a of the fire-resistant material 212 to a lower end of the tapered portion 293. The lower acoustic insulation cover 214 covers the outer surface of the fire-resistant material 212 and the outer surface of the tapered portion 293. Accordingly, the lower acoustic insulation cover 214 includes an inclined portion 330 covering the tapered portion 293 and a straight portion 331 integrally formed at an upper end of the inclined portion 330.

[0164]

The inclined portion 330 is inclined along the tapered portion 293 so as to decrease in diameter downward. Here, the inclination angle θ13 of the tapered portion 293 is 80° or more and 85° or less. Accordingly, with the inclined portion 330 inclined along the tapered portion 293, an inclination angle θ16 of the inclined portion 330 is 70° or more and 89° or less. The inclined portion 330 is in contact with the filling material M.

The straight portion 331 is formed with the same diameter from the upper end of the inclined portion 330 to the upper end of the lower acoustic insulation cover 214. An outer diameter of the straight portion 331 is a maximum outer diameter of the lower acoustic insulation cover 214. The maximum outer diameter of the lower acoustic insulation cover 214 is a maximum outer diameter of the collective joint 210. The maximum outer diameter of the collective joint 210 is 180 mm or more and 195 mm or less.

The inner layer 200a may have a two-layer structure including a combination of a fire-resistant material such as fiber-containing mortar and an outer layer made of an acoustic insulation sheet.

[0165]

The outer layer 200b of the lower acoustic insulation cover 214 may have irregularities on an outer surface thereof. The reason why the outer surface of the outer layer 200b has irregularities will be described in detail below.

The collective joint 210 may include a fiber mortar layer (not shown) covering the lower acoustic insulation cover 214. The reason why the collective joint 210 includes the fiber mortar layer covering the lower acoustic insulation cover 214 will be described in detail below.

[0166]

Although the fourth embodiment describes an example including the upper acoustic insulation cover 213 and the lower acoustic insulation cover 214, only the lower acoustic insulation cover 214 may be included, only the upper acoustic insulation cover 213 may be included, or neither acoustic insulation cover may be included.

[0167]

(Fixing Tape)

The fixing tape 215 is wound, from a radially outer side, around the lower end 213a of the upper acoustic insulation cover 213 and the upper end 214a of the lower acoustic insulation cover 214 and is adhered to the respective outer surfaces. The fixing tape 215 is disposed on the outer surface of the lower end 213a of the upper acoustic insulation cover 213 and the outer surface of the upper end 214a of the lower acoustic insulation cover 214. The outer surface of the upper acoustic insulation cover 213 and the outer surface of the lower acoustic insulation cover 214 are outermost surfaces at a maximum outer diameter of the lateral-pipe merging portion 236. That is, the fixing tape 15 is located on the outermost surface of the lateral-pipe merging portion 236.

The lower end 213a of the upper acoustic insulation cover 213 and the upper end 214a of the lower acoustic insulation cover 214 are butted against each other on the socket 261 of the intermediate pipe 232. Accordingly, the lower end 213a of the upper acoustic insulation cover 213 and the upper end 214a of the lower acoustic insulation cover 214 are fixed to the outer surface of the socket 261 of the intermediate pipe 232 with the fixing tape 215.

[0168]

The fixing tape 215 is made of, for example, a material such as a butyl rubber sheet provided with a polyolefin-based film. The fixing tape 215 can waterproof an adhered portion.

The upper acoustic insulation cover 213 and the lower acoustic insulation cover 214 are fixed with the fixing tape 215 so as to cover the vertical pipe connecting portion 220. Accordingly, the joint body 211 has excellent acoustic insulation properties. For example, even when drainage water passes through the joint body 211, the joint body 211 has a structure that makes drainage noise unlikely to leak outside.

[0169]

Here, the lower end 213a of the upper acoustic insulation cover 213 and the upper end 214a of the lower acoustic insulation cover 214 are fixed to the socket 261 of the intermediate pipe 232 with the fixing tape 215. Accordingly, an upper end of the fixing tape can be disposed, for example, at an uppermost position of the lateral-pipe merging portion 236.

The uppermost position of the lateral-pipe merging portion 236 is the highest position of the vertical pipe connecting portion 220 below the lateral pipe connecting portion 221. More specifically, the uppermost position of the lateral-pipe merging portion 236 is a position corresponding to the outer-surface lower end 221a of the lateral pipe connecting portion 221 in the lateral-pipe merging portion 236. Accordingly, for example, the fixing tape 215 can be disposed at a height equal to or greater than 1/2 of the slab thickness T of the floor slab S. Alternatively, when the collective joint 210 is installed by raised-branch installation, the fixing tape 215 can be disposed above the floor slab S (that is, at a position higher than the floor slab S).

[0170]

Although the fourth embodiment describes an example including the upper acoustic insulation cover 213 and the lower acoustic insulation cover 214, the configuration is not limited to this example. As another example, the fixing tape 215 may also be applied when the collective joint 210 includes only the lower acoustic insulation cover 214. Specifically, with the fixing tape 215 adhered (positioned) to the upper end 214a of the lower acoustic insulation cover 214, an upper end of the fixing tape 215 is wound, from outside, around and adhered to the outer surface of the socket 261 of the intermediate pipe 232. The upper end 214a of the lower acoustic insulation cover 214 is fixed to the outer surface of the socket 261 of the intermediate pipe 232 with the fixing tape 215.

[0171]

In this case, the fixing tape 215 is disposed on the outer surface of the lower acoustic insulation cover 214 and the outer surface of the socket 261 of the intermediate pipe 232. The outer surface of the lower acoustic insulation cover 214 and the outer surface of the socket 261 of the intermediate pipe 232 are outermost surfaces at the maximum outer diameter of the lateral-pipe merging portion 236. In this state, the upper end of the fixing tape 215 can be disposed, for example, at the uppermost position of the lateral-pipe merging portion 236. The upper end of the fixing tape 215 is located, for example, on the outermost surface of the lateral-pipe merging portion 236.

The reason for disposing the upper end of the fixing tape 215 at the uppermost position of the lateral-pipe merging portion 36 will be described in detail below.

[0172]

(Installation of Collective Joint)

As shown in FIG. 17, the collective joint 210 is installed in the floor slab S by raised-branch installation in which the lateral pipe connecting portion 221 is raised a predetermined distance above the surface of the floor slab S. Hereinafter, a process of installing the collective joint 210 in the floor slab S by raised-branch installation will be described with reference to FIG. 17.

[0173]

As shown in FIGS. 17 and 18, the fire-resistant material 212 is attached to the vertical pipe connecting portion 220 of the joint body 211. Next, the upper acoustic insulation cover 213 and the lower acoustic insulation cover 214 are attached to the vertical pipe connecting portion 220. The lower end 213a of the attached upper acoustic insulation cover 213 and the upper end 214a of the attached lower acoustic insulation cover 214 are fixed with the fixing tape 215. Assembly of the collective joint 210 is

completed by attaching the fire-resistant material 212, the upper acoustic insulation cover 213, the lower acoustic insulation cover 214, and the fixing tape to the vertical pipe connecting portion 220.

[0174]

The collective joint 210 is inserted into the through-hole H of the floor slab S. The collective joint 210 is installed with the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, the coupling pipe portion 292 of the lower connecting pipe 233, and at least an upper half portion of the tapered portion 293 of the lower connecting pipe 233 disposed in the through-hole H of the floor slab S. With the collective joint 210 disposed in the through-hole H, an upper end portion of the second vertical pipe P2 on the lower floor F2 (for example, commercially available ESLON (registered trademark) Fire-Resistant VP Pipe manufactured by Sekisui Chemical Co., Ltd. can be used) is fitted to and connected to the lower pipe portion 294 of the lower connecting pipe 233.

In this state, for example, at least a lower half portion of the fire-resistant material 212 and the inclined portion 330 of the lower acoustic insulation cover 214 are accommodated inside the through-hole H.

[0175]

Next, a lower end portion of the first vertical pipe P1 on the upper floor F1 is fitted to the upper vertical pipe connecting portion 245 and the sealing member 241 of the blade unit 231, thereby connecting the first vertical pipe P1 to the vertical pipe connecting portion 220.

By connecting the upper end portion of the second vertical pipe P2 to the lower pipe portion 294 of the lower connecting pipe 233 and connecting the lower end portion of the first vertical pipe P1 to the vertical pipe connecting portion 220, the lateral pipe

connecting portion 221 is disposed in a state of being raised above the floor slab S by the branch underside height H1. The branch underside height H1 is preferably 140 mm.

[0176]

Next, a space between the inner surface of the through-hole H and the outer surface of the collective joint 210 (specifically, the lower acoustic insulation cover 214) is filled with the filling material M, such as mortar or rock wool. In this state, the inclined portion 330 of the lower acoustic insulation cover 214 is embedded in the filling material M. At least the lower half portion of the fire-resistant material 212 is also embedded in the filling material M. Furthermore, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, the coupling pipe portion 292 of the lower connecting pipe 233, and at least the upper half portion of the tapered portion 293 of the lower connecting pipe 233 are embedded in the filling material M. Mortar having excellent residue retention properties is preferably used as the filling material M.

[0177]

With the through-hole H filled with the filling material M, an end portion of the lateral pipe P3 is inserted into the lateral bushing 225 of the lateral pipe connecting portion 221, thereby connecting the lateral pipe P3 to the lateral pipe connecting portion 221. Accordingly, for example, the lateral pipe P3 can be disposed at a height corresponding to a discharge outlet of a toilet. This completes the process of installing the collective joint 210 in the floor slab S by raised-branch installation.

[0178]

Advantageous effects of the floor structure 201, the collective joint 210, and the installation method for the collective joint 210 according to the fourth embodiment described above will be described with reference to FIGS. 17 to 42.

[0179]

That is, the hole diameter of the through-hole H in the floor slab S is set to 210 mm or more and 300 mm or less. Accordingly, the hole diameter of the through-hole H can be adapted to the maximum outer diameter of the collective joint 210 (for example, the lower acoustic insulation cover 214 or the vertical pipe connecting portion 220). This configuration facilitates installation of the collective joint 210 in the floor slab S.

[0180]

The inclination angle θ13 of the tapered portion 293 in the vertical pipe connecting portion 220 is also set to 80° or more and 85° or less. The inclination angle θ16 of the inclined portion 330 of the lower acoustic insulation cover 214 covering the tapered portion 293 is also set to 70° or more and 89° or less. By setting the inclination angle θ16 of the inclined portion 330 to 70° or more and 89° or less, the tapered shape (inclined shape) of the inclined portion 330 is transferred to the filling material M, and the inner surface of the filling material M also assumes a tapered shape (inclined shape). Accordingly, for example, falling-off of residue of the fire-resistant material 212 generated by a flame on the lower floor F2 can be suppressed by the taper formed by the inner surface of the filling material M. As a result, the residue can be retained in the through-hole H, and fire-resistant performance provided by the collective joint 210 can be exhibited.

[0181]

Furthermore, the inclination angle θ13 of the tapered portion 293 is set to 80° or more and 85° or less. Accordingly, when the lower acoustic insulation cover 214 is not provided, the tapered shape of the tapered portion 293 is transferred to the filling material M, and the inner surface of the filling material M also assumes a tapered shape. For example, falling-off of residue of the fire-resistant material 212 generated by a flame on

the lower floor F2 can be suppressed by the taper formed by the inner surface of the filling material M. As a result, the residue can be retained in the through-hole H, and fire-resistant performance provided by the collective joint 210 can be exhibited.

[0182]

Here, when the inclination angle θ13 of the tapered portion 293 is excessively small, for example, drainage water may undergo a hydraulic jump inside the collective joint 210, thereby reducing drainage performance. Therefore, by setting the inclination angle θ13 of the tapered portion 293 to 80° or more, an appropriate inclination angle θ13 of the tapered portion 293 is ensured. As a result, the flow of drainage water inside the collective joint 210 can be appropriately maintained, and drainage performance can be ensured.

[0183]

The lower acoustic insulation cover 214 is also configured as a two-layer structure combining the inner layer 200a and the outer layer 200b. The inner layer 200a is made of fibers having excellent acoustic absorption properties. The outer layer 200b is made of a resin containing a rubber component having excellent acoustic insulation properties. As a result, when drainage water passes through the inside of the collective joint 210, the lower acoustic insulation cover 214 can suppress water noise caused by the drainage water from leaking outside the collective joint.

[0184]

The lower acoustic insulation cover 214 is also configured as the two-layer structure including the inner layer 200a and the outer layer 200b. As a result, when a thickness of the filling material M with which the through-hole H of the floor slab S is filled decreases due to drying, formation of a gap between the filling material M and the lower acoustic insulation cover 214 can be suppressed. The inner layer 200a and the

outer layer 200b may contain expanded graphite. As a result, formation of a gap between the filling material M and the lower acoustic insulation cover 214 can be suppressed more appropriately.

[0185]

Furthermore, irregularities may be formed on the outer surface of the outer layer 200b of the lower acoustic insulation cover 214. By forming irregularities on the outer surface of the outer layer 200b, adhesion of the filling material M to the outer surface of the outer layer 200b can be increased. As a result. Formation of a gap between the filling material M and the lower acoustic insulation cover 214 can be suppressed.

[0186]

The collective joint 210 may also include a fiber mortar layer (not shown) covering the lower acoustic insulation cover 214. By providing the fiber mortar layer on the lower acoustic insulation cover 214, the fiber mortar layer can be disposed in the through-hole H. Accordingly, fire-resistant performance can be improved by the fiber mortar layer. Furthermore, adhesion of the filling material M to an outer surface of the mortar layer can be increased. As a result. Formation of a gap between the filling material M and the mortar layer can be suppressed.

Here, providing the fiber mortar layer on the collective joint 210 increases a weight of the collective joint 210. Therefore, in consideration of ease of installation of the collective joint 210, a thickness of the fiber mortar layer is preferably set to 10 mm or less.

Although the fourth embodiment describes an example in which the entire lower acoustic insulation cover 14 is covered with the fiber mortar layer, the fiber mortar layer may be provided on a portion of the lower acoustic insulation cover 214 corresponding to the through-hole H.

[0187]

Furthermore, the slab thickness T of the floor slab S is set to 150 mm or more. Accordingly, for example, at least the upper half portion of the tapered portion 293 can be disposed in the through-hole H of the floor slab S. As a result, for example, at least the upper half portion of the tapered portion 293 can be disposed in the through-hole H. In this state, by setting the inclination angle θ13 of the tapered portion 293 to 80° or more and 85° or less, the tapered shape of the tapered portion 293 is transferred to the filling material M, and the inner surface of the filling material M also assumes a tapered shape. Accordingly, for example, falling-off of residue of the fire-resistant material 212 generated by a flame on the lower floor F2 can be suppressed by an inclination formed by the inner surface of the filling material M.

[0188]

The inclined portion 330 of the lower acoustic insulation cover 114 covering the tapered portion 193 can also be disposed in the through-hole H. In this state, by setting the inclination angle θ16 of the inclined portion 330 to 70° or more and 89° or less, the tapered shape of the inclined portion 330 is transferred to the filling material M, and the inner surface of the filling material M also assumes a tapered shape. Accordingly, for example, falling-off of residue of the fire-resistant material 212 generated by a flame on the lower floor F2 can be suppressed by an inclination formed by the inner surface of the filling material M.

[0189]

Furthermore, the thermal expansion ratio of the fire-resistant material 212 may be set to 1.3 times or more and 100 times or less. At least the lower half portion of the fire-resistant material 212 is also disposed, for example, in the through-hole H of the floor slab S. Accordingly, thermal expansion of the fire-resistant material 212 can

suppress formation of a gap in the through-hole H. As a result, the through-hole H can be appropriately closed with the fire-resistant material 212.

[0190]

The slab thickness T of the floor slab S may also be less than 100 mm. In this state, the thermal expansion ratio of the fire-resistant material 212 can be set to 1.3 times or more and 100 times or less. Accordingly, thermal expansion of the fire-resistant material can suppress formation of a gap in the through-hole H when the slab thickness T is less than 100 mm. As a result, the through-hole H can be appropriately closed with the fire-resistant material 212 while the slab thickness T of the floor slab S is reduced to less than 100 mm.

[0191]

Here, for example, by installing the collective joint 210 by raised-branch installation, the lateral pipe connecting portion 221 is disposed in a state of being raised above the floor slab S by the branch underside height H1. The fire-resistant material 212 also has a height H2 greater than 150 mm (for example, 210 mm). Accordingly, with the lateral pipe connecting portion 221 raised by the branch underside height H1, for example, at least the lower half portion of the fire-resistant material 212 can be disposed in the through-hole H. As a result, when a fire occurs on the lower floor F2 of the floor slab S and the floor slab S and an area surrounding the through-hole H are heated by flames or smoke, the fire-resistant material 212 can be expanded. Therefore, the through-hole H can be closed by the expanded fire-resistant material 212. As a result, flames and smoke on the lower floor F2 can be prevented from spreading to the upper floor F1, and fire-resistant performance of the fire-resistant material 212 can be exhibited.

[0192]

The fire-resistant sheet 310 is also used as the fire-resistant material 212. Accordingly, for example, the height H2 of the fire-resistant material 212 can be arbitrarily selected. As a result, for example, the height H2 of the fire-resistant material 212 can be appropriately adapted to a height required at an installation site.

[0193]

Furthermore, the height H2 of the fire-resistant material 212 is preferably greater than the height of the intermediate pipe 232. By setting the height H2 of the fire-resistant material 212 to be greater than the height of the intermediate pipe 232, a large amount of the fire-resistant material 212 disposed in the through-hole H can be ensured. Accordingly, when a fire occurs on the lower floor F2 of the floor slab S, the fire-resistant material 212 can be expanded to appropriately close the through-hole H. As a result, the fire-resistant material 212 can prevent flames and smoke on the lower floor F2 from spreading to the upper floor F1.

[0194]

The lower end 213a of the upper acoustic insulation cover 213 and the upper end 214a of the lower acoustic insulation cover 214 are also fixed to the outer surface of the socket 261 of the intermediate pipe 232 with the fixing tape 215, and the fixing tape 215 is disposed on the upper end 214a of the lower acoustic insulation cover 214. Furthermore, the upper end of the fixing tape 215 can be disposed at the uppermost position of the lateral-pipe merging portion 236. Accordingly, for example, the fixing tape 215 can be disposed at a height equal to or greater than 1/2 of the slab thickness T of the floor slab S. Alternatively, when the collective joint 210 is installed by raised-branch installation, the fixing tape 215 can be disposed above the floor slab S (that is, at a position higher than the floor slab S).

As a result, for example, the floor slab S can suppress damage to the fixing tape

215 caused by a flame on the lower floor F2. Therefore, smoke on the lower floor F2 can be suppressed from spreading to the upper floor F1, and fire-resistant performance provided by the collective joint 210 can be exhibited.

[0195]

Here, the lateral pipe connecting portion 221 is provided on the upper connecting pipe 230 of the vertical pipe connecting portion 220. The lateral pipe connecting portion 221 is disposed above the floor slab S. Accordingly, the upper acoustic insulation cover 213 covering the upper connecting pipe 230 can be disposed above the floor slab S, for example, when the collective joint is installed by raised-branch installation. Accordingly, the fixing tape 215 can be disposed above the floor slab S. As a result, for example, the floor slab S can suppress damage to the fixing tape 215 caused by a flame on the lower floor F2.

[0196]

The collective joint 210 is also disposed in the through-hole H of the floor slab S. As a result, by disposing the fixing tape 215 on the upper end 214a of the lower acoustic insulation cover 214, for example, the floor slab S can suppress damage to the fixing tape 215 caused by a flame on the lower floor F2.

[0197]

Furthermore, the fixing tape 215 is disposed at a height equal to or greater than 1/2 of the slab thickness T of the floor slab S. As a result, for example, the floor slab S can suppress damage to the fixing tape 215 caused by a flame on the lower floor F2.

[0198]

The fixing tape 215 is also disposed above an upper surface of the floor slab S. As a result, for example, the floor slab S can suppress damage to the fixing tape 215 caused by a flame on the lower floor F2.

[0199]

The lower ends 252a of the vertical ribs 252 are disposed within the first allowable range extending from the lower end 226a of the opening 226 in the lateral pipe connecting portion 221 as a lowermost position to a height 25 mm or less above the lower end 226a. Accordingly, the vertical ribs 252 can be prevented from obstructing inflow of drainage water from the opening 226 of the lateral pipe connecting portion 221 into the vertical pipe connecting portion 220. As a result, drainage performance from the opening 226 of the lateral pipe connecting portion 221 to the vertical pipe connecting portion 220 can be improved.

[0200]

Here, for example, the first swirl blade 248 is provided on the inner surface of the vertical pipe connecting portion 220. Accordingly, drainage water rebounding from the first swirl blade 248 may enter the lateral pipe connecting portion 221 and flow backward. Therefore, the lower ends 252a of the vertical ribs 252 are restricted to the first allowable range and are not positioned above the first allowable range. As a result, for example, drainage water rebounding from the first swirl blade 248 inside the vertical pipe connecting portion 220 can be suppressed from entering the lateral pipe connecting portion 221 through the opening 226 and flowing backward.

[0201]

The lower ends 252a of the vertical ribs 252 may also be located within the second allowable range from a height equal to or above the lower end 226a of the opening 226 to a height equal to or below the axis O12 of the lateral bushing 225. In general, a water level in the lateral pipe P3 inserted into the lateral bushing 225 is equal to or below the axis O12. Accordingly, the vertical ribs 252 can be prevented from obstructing inflow of drainage water from the opening 226 of the lateral pipe connecting

portion 221 into the vertical pipe connecting portion 220. As a result, drainage performance from the opening 226 of the lateral pipe connecting portion 221 into the vertical pipe connecting portion 220 can be improved.

Disposition of the lower ends 252a of the vertical ribs 252 within the second allowable range can also suppress, for example, drainage water rebounding from the first swirl blade 248 inside the vertical pipe connecting portion 220 from entering the lateral pipe connecting portion 221 through the opening 226 and flowing backward.

[0202]

Here, when the vertical pipe connecting portion 220 is injection-molded, a first mold is opened upward from the lower ends 252a of the plurality of vertical ribs 252, and a second mold is opened downward from the lower ends 252a of the plurality of vertical ribs 252. Accordingly, a first draft angle extending upward from the lower ends 252a of the plurality of vertical ribs 252 and a second draft angle extending downward from the lower ends 252a of the plurality of vertical ribs 252 are formed on the inner surface of the upper connecting pipe 230. Therefore, the inner surface of the vertical pipe connecting portion 220 has a minimum inner diameter at the lower ends 252a of the plurality of vertical ribs 252.

[0203]

The plurality of fire-resistant sheets 312 and 314 serving as the fire-resistant material 212 are also disposed (attached) on the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233. As a result, the outer surfaces can be covered with the fire-resistant material 212 formed from the plurality of fire-resistant sheets 312 and 314.

By forming the fire-resistant material 12 from the plurality of fire-resistant

sheets 312 and 314, widths of the fire-resistant sheets 312 and 314 can be reduced as compared with one fire-resistant sheet. As a result, the occurrence of wrinkles can be suppressed in the fire-resistant material 212 covering the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

[0204]

Here, for example, when adjacent fire-resistant sheets 312 and 314 are disposed at intervals, radially inward recessed portions are formed between the adjacent fire-resistant sheets 312 and 314. The outer surface of the fire-resistant material 212 is covered with the lower acoustic insulation cover 214. Accordingly, the lower acoustic insulation cover 214 may be recessed radially inward at the recessed portions between the adjacent fire-resistant sheets 312 and 314, thereby reducing acoustic insulation performance.

[0205]

Therefore, among the plurality of fire-resistant sheets 312 and 314, the adjacent fire-resistant sheets 312 and 314 are overlapped or butted against each other. Accordingly, the occurrence of irregularities on the outer surface of the fire-resistant material 212 formed from the plurality of fire-resistant sheets 312 and 314 can be suppressed. As a result, radially inward recessing of the lower acoustic insulation cover 214 can be suppressed, and acoustic insulation performance can be ensured.

[0206]

Furthermore, the plurality of fire-resistant sheets 312 are disposed in the circumferential direction on the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the

lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

Here, the joint body 211 is rotatable about the axis O11 when the plurality of fire-resistant sheets 312 are disposed. As a result, for example, by rotating the joint body 211, the plurality of fire-resistant sheets 312 can be appropriately wound around and disposed on the outer surfaces of the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

[0207]

As with the plurality of fire-resistant sheets 314 according to Modification 1, the plurality of fire-resistant sheets 314 may also be disposed in the axis O11 direction on the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233. As a result, for example, with the joint body 211 fixed, the plurality of fire-resistant sheets 314 can be appropriately disposed on the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

[0208]

Furthermore, in the installation method for the collective joint 210, the plurality of fire-resistant sheets 312 and 314 are disposed on the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the

lower connecting pipe 233. At this time, the adjacent fire-resistant sheets 312 and 314 are overlapped or butted against each other. As a result, the plurality of fire-resistant sheets 312 and 314 form the fire-resistant material 212 covering the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

[0209]

By forming the fire-resistant material 212 from the plurality of fire-resistant sheets 312 and 314, a width of the fire-resistant sheet 310 can be reduced as compared with a case in which the fire-resistant material 212 is formed from one fire-resistant sheet. As a result, the occurrence of wrinkles can be suppressed in the fire-resistant material 212 covering the outer surfaces of the socket 261 of the intermediate pipe 232, the straight pipe portion 260 of the intermediate pipe 232, the socket 291 of the lower connecting pipe 233, and the coupling pipe portion 292 of the lower connecting pipe 233.

[0210]

In the installation method for the collective joint 210, by winding the plurality of fire-resistant sheets 312 in the circumferential direction, a seam between both ends of one fire-resistant sheet 312 can serve as a positioning portion (not shown). Accordingly, the upper connecting pipe 230 and the lower connecting pipe 233 to be connected to the intermediate pipe 232 can be positioned in the circumferential direction based on the positioning portion. As a result, the third swirl blade 300 of the lower connecting pipe 233 can be positioned in the circumferential direction relative to the first swirl blade 248 of the upper connecting pipe 230. Therefore, installation work for connecting the upper connecting pipe 230, the intermediate pipe 232, and the lower connecting pipe 233 of the vertical pipe connecting portion 220 can be facilitated.

[0211]

Furthermore, by overlapping or butting the plurality of fire-resistant sheets 314 according to Modification 1 against each other in the circumferential direction, at least one of the seams between the adjacent fire-resistant sheets 314 can serve as a positioning portion (not shown). Accordingly, the upper connecting pipe 230 and the lower connecting pipe 233 to be connected to the intermediate pipe 232 can be positioned in the circumferential direction based on the positioning portion. As a result, the third swirl blade 300 of the lower connecting pipe 233 can be positioned in the circumferential direction relative to the first swirl blade 248 of the upper connecting pipe 230. Therefore, installation work for connecting the upper connecting pipe 230, the intermediate pipe 232, and the lower connecting pipe 233 of the vertical pipe connecting portion 220 can be facilitated.

[0212]

The thick-walled portions 265 and 274 are also provided on the straight pipe portions 260 and 273 of the intermediate pipes 232 and 272. Furthermore, the outer surfaces of the straight pipe portions 260 and 273 form the same outer surfaces as the outer surfaces of the sockets 261 of the intermediate pipes 232 and 272, the outer surface of the socket 291 of the lower connecting pipe 233, and the outer surface of the coupling pipe portion 292 of the lower connecting pipe 233. Accordingly, the fire-resistant sheets 310, 312, and 314 forming the fire-resistant material 212 can be attached flatly, using the thick-walled portions 265 and 274, to the outer surfaces of the intermediate pipes 232 and 272, the outer surface of the socket 291 of the lower connecting pipe 233, and the outer surface of the coupling pipe portion 292 of the lower connecting pipe 233. As a result, the occurrence of wrinkles can be suppressed in the fire-resistant material 212 covering the outer surfaces of the intermediate pipes 232 and 272, the outer surface

of the socket 291 of the lower connecting pipe 233, and the outer surface of the coupling pipe portion 292 of the lower connecting pipe 233.

[0213]

The thick-walled portion 265 of the intermediate pipe 232 is also formed as the protruding portion 265 protruding radially outward from the side surface of the straight pipe portion 260. Accordingly, thick-walled regions of the straight pipe portion 260 can be reduced. As a result, when the intermediate pipe 232 is injection-molded, the occurrence of sink marks and the like in the straight pipe portion 260 can be suppressed, thereby improving injection moldability of the intermediate pipe 232.

[0214]

Furthermore, at least one of the first rib 265a extending in the circumferential direction and the second rib 265b extending in the axis O11 direction is provided as the protruding portion 265. Accordingly, ribs can be provided over the entire side surface of the straight pipe portion 260. As a result, the occurrence of wrinkles can be appropriately suppressed in the fire-resistant material 212 covering the outer surface of the intermediate pipe 232, the outer surface of the socket 291 of the lower connecting pipe 233, and the outer surface of the coupling pipe portion 292 of the lower connecting pipe 233.

[0215]

As in the intermediate pipe 272 according to Modification 1, the entire circumference of the straight pipe portion 273 of the intermediate pipe 272 may have a constant wall thickness provided by the thick-walled portion 274. Accordingly, the outer surface over the entire circumference of the straight pipe portion 273 can form the same outer surface as the outer surface of the socket 261 of the intermediate pipe 272, the outer surface of the socket 291 of the lower connecting pipe 233, and the outer surface of

the coupling pipe portion 292 of the lower connecting pipe 233. As a result, the occurrence of wrinkles can be appropriately suppressed in the fire-resistant material 212 covering the outer surface of the intermediate pipe 272, the outer surface of the socket 291 of the lower connecting pipe 233, and the outer surface of the coupling pipe portion 292 of the lower connecting pipe 233.

[0216]

Furthermore, as in the intermediate pipe 282 according to Modification 2, the groove portions 286 are provided in the inner surface of the straight pipe portion 283 of the intermediate pipe 282. Accordingly, thick-walled regions of the straight pipe portion 283 can be reduced at intervals in the circumferential direction. As a result, when the intermediate pipe 282 is injection-molded, the occurrence of sink marks and the like in the straight pipe portion 283 can be suppressed, thereby improving injection moldability of the intermediate pipe 282.

[0217]

Next, fifth to seventh embodiments will be described with reference to FIGS. 43 to 49. In the fifth to seventh embodiments, members identical or similar to those of the floor structure according to the fourth embodiment are denoted by identical reference signs, and detailed descriptions of the members are omitted.

[0218]

(Fifth Embodiment)

As shown in 43, the fifth embodiment is obtained by replacing the blade unit 231 according to the fourth embodiment with a blade unit 350. Similarly to the blade unit 231 according to the fourth embodiment, the blade unit 350 according to the fifth embodiment is fitted to the upper end portion of the upper connecting pipe 230 in the vertical pipe connecting portion 220. The blade unit 350 includes a unit main body 351,

the sealing member 241, and the retaining member 242. The unit main body 351 includes the upper vertical pipe connecting portion 245, a blade support portion 352, a first swirl blade 353, and a plurality of reinforcing ribs 354. The blade support portion 352, the first swirl blade 353, and the plurality of reinforcing ribs 354 are disposed inside the upper connecting pipe 230 in the vertical pipe connecting portion 220. The upper vertical pipe connecting portion 245, the blade support portion 352, the first swirl blade 353, and the plurality of reinforcing ribs 354 included in the unit main body 351 are integrally made of a vinyl chloride resin or the like.

[0219]

As shown in FIGS. 43 to 47, the upper vertical pipe connecting portion 245 has the projecting portion 245a. The projecting portion 245a protrudes radially outward from the outer surface of the upper vertical pipe connecting portion 245. The projecting portion 245a engages with the recessed portion 237 of the upper connecting pipe 230, thereby enabling the unit main body 240 (specifically, the first swirl blade 248) to be positioned relative to the upper connecting pipe 230 in the circumferential direction.

The blade support portion 352 extends downward from a portion in the circumferential direction of the lower end portion of the upper vertical pipe connecting portion 245. The blade support portion 352 is formed in a curved flat plate shape and is formed in an arc shape as viewed in the up-down direction. The blade support portion 352 extends in the up-down direction. That is, a length of the blade support portion 352 in the circumferential direction is substantially constant regardless of a position in the up-down direction.

[0220]

The first swirl blade 353 is provided on an inner surface (a surface facing radially inward) of the blade support portion 352. An upper surface 353a of the first

swirl blade 353 protrudes radially inward from the blade support portion 352 at an inclination angle θ17 of 90°. The upper surface 353a of the first swirl blade 353 is inclined at an inclination angle θ18 of 55° so as to gradually extend downward toward the first side X1 in the circumferential direction. The inclination angle θ18 is an angle at which the upper surface 353a is inclined from one side portion 352a of the blade support portion 352 toward another side portion 352b relative to a plane orthogonal to the axis O11.

[0221]

As shown in FIG. 43, contact of the first swirl blade 353 with drainage water in the upper connecting pipe 230 of the vertical pipe connecting portion 220 can make the drainage water likely to stagnate locally in the vicinity of the first swirl blade 353. Accordingly, an advantageous effect of improving drainage capacity in the upper connecting pipe 230 is markedly achieved.

[0222]

As shown in FIGS. 44 and 45, the plurality of reinforcing ribs 354 are provided on a lower surface 353b of the first swirl blade 353. On the lower surface 353b of the first swirl blade 353, the plurality of reinforcing ribs 354 extend from the blade support portion 352 to an outer edge 353c of the first swirl blade 353. The plurality of reinforcing ribs 354 can damp vibration of the blade support portion 352 and the first swirl blade 353. The plurality of reinforcing ribs 354 constitute a vibration suppressing portion 356. That is, the vibration suppressing portion 356 has a vibration suppressing function for the blade support portion 352 and the first swirl blade 353.

[0223]

(Sixth Embodiment)

As shown in FIG. 48, in the sixth embodiment, thermally expandable graphite is

contained in a portion of the vertical pipe connecting portion 220, and the portion of the vertical pipe connecting portion 220 is configured as a fire-resistant pipe 360. Specifically, the sixth embodiment is obtained, for example, by replacing the fire-resistant material 212 and the intermediate pipe 232 according to the fourth embodiment with the fire-resistant pipe 360. Although the sixth embodiment describes an intermediate pipe as an example of the portion of the vertical pipe connecting portion 220, the portion of the vertical pipe connecting portion 220 is not limited to the intermediate pipe.

[0224]

The fire-resistant pipe 360 also serves as an intermediate pipe connected between the upper connecting pipe 230 and the lower connecting pipe 233 in the axis O11 direction. That is, the intermediate pipe constitutes the fire-resistant pipe 360. The fire-resistant pipe 360 has, for example, the same shape as the intermediate pipe 232 according to the fourth embodiment. That is, the fire-resistant pipe 360 is produced, for example, by injection-molding a resin composition. The fire-resistant pipe 360 includes, for example, a straight pipe portion 361, a socket 362, and a spigot 363. A height of the fire-resistant pipe 360 is preferably greater than 150 mm and equal to or less than 300 mm.

[0225]

The fire-resistant pipe 360 contains thermally expandable graphite. Furthermore, for example, a single-layer structure made of a resin composition containing thermally expandable graphite at a proportion of 1 to 20 parts by weight relative to 100 parts by weight of a polyvinyl chloride-based resin is employed for the fire-resistant pipe 360. Alternatively, a three-layer structure may be employed that includes a thermally expandable fire-resistant layer made of a resin composition

containing thermally expandable graphite at a proportion of 1 to 20 parts by weight relative to 100 parts by weight of a polyvinyl chloride-based resin, and coating layers made of a polyvinyl chloride-based resin composition containing no thermally expandable graphite and covering inner and outer surfaces of the thermally expandable fire-resistant layer.

[0226]

According to the fire-resistant pipe 360 of the sixth embodiment described above, the intermediate pipe constituting a portion of the vertical pipe connecting portion 220 is formed as the fire-resistant pipe 360. That is, the intermediate pipe also serves as the fire-resistant pipe 360. The height of the fire-resistant pipe 360 is also ensured to be greater than 150 mm. Accordingly, with the lateral pipe connecting portion 221 raised above the floor slab S by raised-branch installation, a large amount of the fire-resistant pipe 360 disposed in the through-hole H can be ensured.

As a result, when a fire occurs on the lower floor F2 of the floor slab S and the floor slab S and an area surrounding the through-hole H are heated by flames or smoke, the fire-resistant pipe 360 can be expanded. Therefore, the through-hole H can be closed by the expanded fire-resistant pipe 360. As a result, flames and smoke on the lower floor F2 can be prevented from spreading to the upper floor F1, and fire-resistant performance of the fire-resistant pipe 360 can be exhibited.

[0227]

In addition, by using the intermediate pipe constituting a portion of the vertical pipe connecting portion 220 also as a fire-resistant pipe 160, there is no need to attach a fire-resistant material to the outer surface of the joint body 11. As a result, the outer diameter of the collective joint 210 can be reduced.

[0228]

The intermediate pipe constituting the fire-resistant pipe 360 also has, for example, the same shape as the intermediate pipe 232 according to the fourth embodiment. Accordingly, the fire-resistant pipe 360 is provided at a position avoiding the first swirl blade 248, the plurality of vertical ribs 252, and the third swirl blade 300. As a result, when the fire-resistant pipe 360 thermally expands, the first swirl blade 248, the vertical ribs 252, and the third swirl blade 300 can be prevented from obstructing the thermal expansion.

[0229]

(Seventh Embodiment)

As shown in FIG. 49, in the seventh embodiment, the socket 291 of the lower connecting pipe 233 is connected to the lower connecting portion (lateral-pipe merging portion) 236 of the upper connecting pipe 230 in the vertical pipe connecting portion 220 by being fitted thereto, and a fire-resistant material 380 is provided on the lower connecting pipe 233. In the present embodiment, no intermediate pipe is provided. The fire-resistant material 380 is the same as the fire-resistant material 212 according to the fourth embodiment. The fire-resistant material 380 is disposed and attached, for example, on the outer surface of the coupling pipe portion 292 of the lower connecting pipe 233. A height of the fire-resistant material 380 is preferably greater than 150 mm.

[0230]

Although the seventh embodiment describes an example in which the fire-resistant material 380 is disposed on the outer surface of the coupling pipe portion 292 of the lower connecting pipe 233, the fire-resistant material 380 is not limited to this configuration. As another example, the fire-resistant material 380 may be continuously disposed on both the lower connecting portion 236 of the upper connecting pipe 230 and the lower connecting pipe 233.

[0231]

The technical scope of the present invention is not limited to the embodiments described above, and various modifications can be made without departing from the gist of the present invention.

[0232]

Although the embodiments described above describe an example in which the height H2 of the fire-resistant material 212 is greater than 150 mm and equal to or less than 300 mm, the height H2 of the fire-resistant material 12 is not limited to being greater than 150 mm and equal to or less than 300 mm.

Although the embodiments described above describe a preferred example in which the height H2 of the fire-resistant material 212 is greater than the height of the intermediate pipe 232, the height H2 is not limited to this example.

Although the embodiments described above describe an example in which the fixing tape 215 is disposed at a height equal to or greater than 1/2 of the slab thickness T of the floor slab S, the disposition of the fixing tape 215 is not limited to this example.

Although the embodiments described above describe an example in which the fixing tape 215 is disposed above the upper surface of the floor slab S, the disposition of the fixing tape 215 is not limited to this example.

[0233]

Although the embodiments described above describe an example in which the lower ends 252a of the plurality of vertical ribs 252 are disposed within the first allowable range from a height equal to or above the lower end 226a of the opening 226 in the lateral pipe connecting portion 221 to a height 25 mm or less above the lower end 226a of the opening 226, the disposition of the lower ends 252a is not limited to this example.

Although the embodiments described above describe an example in which the lower ends 252a of the vertical ribs 252 are disposed within the second allowable range from a height equal to or above the lower end 226a of the opening 226 in the lateral pipe connecting portion 221 to a height equal to or below the axis O12 of the lateral bushing 225, the disposition of the lower ends 252a is not limited to this example.

Although the embodiments described above describe an example in which the lower ends 252a of the plurality of vertical ribs 252 are disposed at the same height in the axis O11 direction, the disposition of the lower ends 252a is not limited to this example.

[0234]

Although the embodiments described above describe an example in which the thick-walled portions 265 and 274 are provided on the straight pipe portions 260 and 273 of the intermediate pipes 232 and 272, and the outer surfaces of the straight pipe portions 260 and 273 form the same outer surfaces as the socket 261 of the intermediate pipe 232 and the socket 291 of the lower connecting pipe 233, the configuration is not limited to this example. The thick-walled portions 265 and 274 need not be provided on the straight pipe portions 260 and 273 of the intermediate pipes 232 and 272.

Although the embodiments described above describe, as examples of the thick-walled portion (protruding portion) 265 of the straight pipe portion 260, the first rib 265a extending in the circumferential direction and the second rib 265b extending in the axial direction, extending directions of the first rib 265a and the second rib 265b can be arbitrarily selected.

[0235]

In addition, the constituent elements according to the present embodiment may be appropriately replaced with known constituent elements without departing from the gist of the present invention.

[0236]

(Eighth Embodiment)

Next, an eighth embodiment of the present invention will be described with reference to FIG. 50. Portions identical to those of the preceding embodiments are denoted by identical reference signs, descriptions of the portions are omitted, and only differences will be described.

As shown in FIG. 50, drainage piping 500 including, for example, the collective joint 210 according to the fourth embodiment is provided in a building 410.

The collective joint 210 is supported by a support fitting 420 below the through-hole H in the floor slab S.

A second through-hole H10 is formed in the floor slab S in addition to the through-hole H.

[0237]

A pipe space S15 is formed between two walls S10 and S11 extending downward from the floor slab S. The collective joint 210 is disposed in the pipe space S15.

Through-holes S10a and S11a are formed in the walls S10 and S11, respectively. The wall S10 is disposed and disposed, along a horizontal plane, at a position between the through-hole H and the second through-hole H10. For example, the walls S10 and S11 are made of concrete.

[0238]

A lower end portion of the first vertical pipe P1 is connected to the vertical pipe connecting portion 220 of the collective joint 210. The first vertical pipe P1 extends through the through-hole H to the upper floor F1. A space between the outer surface of the first vertical pipe P1 and an opening peripheral edge portion of the through-hole H in

the floor slab S is filled with the filling material M. A first end portion of the lateral pipe P3 and a first end portion of a lateral pipe P3A are connected to the plurality of lateral pipe connecting portions 221 of the collective joint 210.

The lateral pipe P3 extends along a horizontal plane. The lateral pipe P3 passes through the through-hole S11a in the wall S11. A space between the outer surface of the lateral pipe P3 and an opening peripheral edge portion of the through-hole S11a in the wall S11 is filled with the filling material M.

[0239]

For example, the lateral pipe P3A includes a first pipe P3B and a second pipe P3C.

A first end portion of the first pipe P3B is connected to the lateral pipe connecting portion 221 of the collective joint 210. The first pipe P3B extends along a horizontal plane. The first pipe P3B passes through the through-hole S10a in the wall S10. A space between an outer surface of the first pipe P3B and an opening peripheral edge portion of the through-hole S10a in the wall S10 is filled with the filling material M.

A first end portion of the second pipe P3C is connected to a second end portion of the first pipe P3B. The second pipe P3C extends upward from the first pipe P3B and passes through the second through-hole H10 in the floor slab S. A space between an outer surface of the second pipe P3C and an opening peripheral edge portion of the second through-hole H10 in the floor slab S is filled with the filling material M. The second pipe P3C protrudes above the floor slab S (to the upper floor F1). A drainage fixture 425, such as a bathtub, is connected to a second end portion of the second pipe P3C.

[0240]

An upper end portion of the second vertical pipe P2 is connected to the lower connecting pipe 233 of the collective joint 210. A space between an outer surface of the second vertical pipe P2 and the walls S10 and S11 is filled with the filling material M.

The first vertical pipe P1, the second vertical pipe P2, the lateral pipe P3, and the lateral pipe P3A can be made of a vinyl chloride resin, a polyethylene resin, a polypropylene resin, or the like.

[0241]

As described above, in the present embodiment, the lateral pipe P3 and the first pipe P3B of the lateral pipe P3A are disposed below the floor slab S.

The collective joint provided in the building 410 may be any of the collective joints according to the first to seventh embodiments.

[0242]

(Supplementary Notes)

(1) Aspect 1 of the present disclosure is a collective joint including: a joint body that is disposed such that an axis of the joint body extends along an up-down direction; a blade unit that has a blade support portion disposed on an inner circumferential surface of the joint body and a swirl blade protruding radially inward from the blade support portion; and a vibration reducing portion that is provided on at least the blade support portion and reduces vibration of the blade support portion.

[0243]

(2) Aspect 2 of the present disclosure may be the collective joint according to (1), in which the vibration reducing portion is provided on the joint body and the blade support portion and fixes the joint body and the blade support portion to each other by an interference fit.

(3) Aspect 3 of the present disclosure may be the collective joint according to

(2), in which the vibration reducing portion fixes the joint body and the blade support portion to each other by the interference fit in a radial direction.

[0244]

(4) Aspect 4 of the present disclosure may be the collective joint according to (2), in which the vibration reducing portion fixes the joint body and the blade support portion to each other by the interference fit in an axial direction.

(5) Aspect 5 of the present disclosure may be the collective joint according to (1), in which the vibration reducing portion is provided on the blade support portion and reinforces the blade support portion.

[0245]

(6) Aspect 6 of the present disclosure may be the collective joint according to (5), in which the blade unit has a main-body connecting portion connected to an end portion of the blade support portion and attachable to the joint body, and the vibration reducing portion protrudes in a circumferential direction from an end of the blade support portion in the circumferential direction so as to be spaced apart from the blade support portion and is connected to the main-body connecting portion.

[0246]

(7) Aspect 7 of the present disclosure may be the collective joint according to (6), including two vibration reducing portions, in which the two vibration reducing portions respectively protrude in the circumferential direction from ends of the blade support portion in the circumferential direction.

(8) Aspect 8 of the present disclosure may be the collective joint according to (6), in which, when the vibration reducing portion is viewed in a radial direction from a position facing the vibration reducing portion, an outer edge of the vibration reducing portion is formed in an arc shape.

INDUSTRIAL APPLICABILITY

[0247]

The collective joint can reduce noise generated by liquid. Accordingly, the collective joint has significant industrial applicability.

REFERENCE SIGNS LIST

[0248]

26 Joint body

53 Upper vertical pipe connecting portion (main-body connecting portion)

55 Blade support portion

56 Swirl blade

81 Bonded portion (vibration reducing portion)

120, 120A, 120B, 120C, 120D, 150, 150A, 165, 165A, 165B, 165C Collective joint

51A, 121, 151, 151A, 166 Blade unit

124, 141, 147, 148, 153, 154 Vibration reducing portion

139 Second blade support portion

168A, 168B Reinforcing rib (second reinforcing portion, reinforcing portion)

175 Second bonded portion (second vibration reducing portion)

O1 Axis

CLAIMS

[Claim 1] A collective joint comprising:

a joint body that is disposed such that an axis of the joint body extends along an up-down direction;

a blade unit that has a blade support portion disposed on an inner circumferential surface of the joint body and a swirl blade protruding radially inward from the blade support portion; and

a vibration reducing portion that is provided on at least the blade support portion and reduces vibration of the blade support portion.

[Claim 2] The collective joint according to claim 1, wherein the vibration reducing portion is provided on the joint body and the blade support portion and fixes the joint body and the blade support portion to each other by an interference fit.

[Claim 3] The collective joint according to claim 2, wherein the vibration reducing portion fixes the joint body and the blade support portion to each other by the interference fit in a radial direction.

[Claim 4] The collective joint according to claim 2, wherein the vibration reducing portion fixes the joint body and the blade support portion to each other by the interference fit in an axial direction.

[Claim 5] The collective joint according to claim 2, wherein

the swirl blade is disposed at an end of the blade support portion in an axial direction,

the blade unit has a second blade support portion disposed on a side opposite to the blade support portion in the axial direction across the swirl blade, and

the collective joint comprises a second vibration reducing portion that fixes the joint body and the second blade support portion to each other by at least one of bonding,

fitting, and interference fitting.

[Claim 6] The collective joint according to claim 5, comprising a second reinforcing portion that is connected to each of the swirl blade and the second blade support portion.

[Claim 7] The collective joint according to claim 6, wherein the second reinforcing portion is formed in a plate shape having a thickness direction extending along a circumferential direction.

[Claim 8] The collective joint according to claim 1, wherein the vibration reducing portion is provided on the blade support portion and reinforces the blade support portion.

[Claim 9] The collective joint according to claim 8, wherein

the blade unit has a main-body connecting portion connected to an end portion of the blade support portion and attachable to the joint body, and

the vibration reducing portion protrudes in a circumferential direction from an end of the blade support portion in the circumferential direction so as to be spaced apart from the blade support portion and is connected to the main-body connecting portion.

[Claim 10] The collective joint according to claim 9, comprising two vibration reducing portions,

wherein the two vibration reducing portions respectively protrude in the circumferential direction from ends of the blade support portion in the circumferential direction.

[Claim 11] The collective joint according to claim 9, wherein, when the vibration reducing portion is viewed in a radial direction from a position facing the vibration reducing portion, an outer edge of the vibration reducing portion is formed in an arc shape.