

DESCRIPTION

TITLE OF INVENTION:

COLLECTIVE JOINT

5 TECHNICAL FIELD

[0001]

The present invention relates to a manifold joint.

Priorities are claimed on Japanese Patent Application Nos. 2023-103561 and 2023-103588, filed June 23, 2023; Japanese Patent Application Nos. 2023-170575 and 10 2023-170641, filed September 29, 2023; and Japanese Patent Application Nos. 2024-030620 and 2024-029890, filed February 29, 2024, the contents of which are incorporated herein by reference.

BACKGROUND ART

[0002]

15 Manifold joints for connecting a vertical pipe and a horizontal pipe and allowing drainage or the like to flow inside the joint are known (see, for example, Patent Documents 1 and 2).

The manifold joints in Patent Documents 1 and 2 include a joint body, a horizontal pipe connection portion, a vertical pipe connection portion, and a first swirl vane.

20 [0003]

The joint body has a tubular shape, and is arranged such that its axis extends vertically.

The horizontal pipe connection portion is provided on an outer peripheral surface of the joint body. A horizontal pipe extending along a horizontal plane is connected to 25 the horizontal pipe connection portion. The vertical pipe connection portions are

provided at upper and lower ends of the joint body. Vertical pipes extending along the vertical direction are connected to the vertical pipe connection portions.

A first swirl vane is provided on an inner peripheral surface of the joint body. The first swirl vane is arranged such that at least part of the vane overlaps the opening of
5 the horizontal pipe connection portion in the axial direction.

The joint body and the first swirl vane are each formed of synthetic resin and fitted together.

[0004]

In the manifold joint configured as above, for example, drainage flows into the
10 joint body through the vertical pipe and the horizontal pipe. The drainage strikes the first swirl vane and flows downward inside the joint body while swirling around the axis.

Citation List

Patent Document

[0005]

15 Patent Document 1: Japanese Unexamined Patent Application Publication No. 2011-236676

Patent Document 2: Japanese Unexamined Patent Application Publication No. 2011-006893

SUMMARY OF INVENTION

20 Technical Problem

[0006]

To reduce noise generated when drainage flows through a manifold joint, integrally forming the joint body and the first swirl vane has been studied.

However, when the joint body and the first swirl vane are integrally formed by
25 injection molding, undercut portions requiring a slider in the mold tend to be formed in the

manifold joint during its manufacturing. As a result, manufacture of the manifold joint may prove difficult.

[0007]

The present invention has been made in view of these problems and aims to
5 provide a manifold joint that can be easily manufactured by injection molding even when a swirl vane is provided on an inner peripheral surface of the joint body.

Solution to Problem

[0008]

Embodiments proposed by the present invention in order to solve the above-
10 mentioned problem are as enumerated below.

According to one aspect of the present invention, there is provided a manifold joint including: a joint body arranged such that its first axis is oriented along a vertical direction; a horizontal pipe connection portion provided on an outer peripheral surface of the joint body; and a swirl vane provided on an inner peripheral surface of the joint body
15 such that at least a part of the swirl vane overlaps an opening of the horizontal pipe connection portion in a direction of the first axis; wherein the inner peripheral surface includes a first inner surface that is inclined such that the first inner surface gradually approaches the first axis as going downward, and a second inner surface that is arranged below the swirl vane; and at least a portion of the joint body in which the swirl vane is
20 provided, the horizontal pipe connection portion, and the swirl vane are integrally formed.

Advantageous Effects of Invention

[0009]

The present invention can provide a manifold joint which can be easily manufactured by injection molding even when a swirl vane is provided on an inner
25 peripheral surface of the joint body.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

FIG. 1 is a front sectional view of the manifold joint according to the first embodiment of the present invention.

5 FIG. 2 is a perspective sectional view of the upper connection pipe of the manifold joint.

FIG. 3 is a front sectional view of the upper connection pipe.

FIG. 4 is a sectional view illustrating a method for manufacturing the upper connection pipe.

10 FIG. 5 is a side sectional view of the manifold joint in a first modification example of the first embodiment of the present invention.

FIG. 6 is a side view of the manifold joint according to the first embodiment.

FIG. 7 is a side sectional view of the manifold joint in a second modification example of the first embodiment of the present invention.

15 FIG. 8 is a side sectional view of the manifold joint in a third modification example of the first embodiment of the present invention.

FIG. 9 is a front sectional view of the manifold joint according to the second embodiment of the present invention.

20 FIG. 10 is a front sectional view of a manifold joint in which a reinforcing rib is provided on the swirl vane.

FIG. 11 is a view taken in the direction of arrow A in Fig. 10.

FIG. 12 is a bottom view illustrating a modification example of the arrangement of the reinforcing rib.

25 FIG. 13A is a sectional view illustrating an example of the shape of the reinforcing rib.

FIG. 13B is a sectional view illustrating another example of the shape of the reinforcing rib.

FIG. 13C is a sectional view illustrating still another example of the shape of the reinforcing rib.

5 FIG. 14 is a front sectional view of the upper connection pipe included in the manifold joint in a fourth modification example of the first embodiment of the present invention.

FIG. 15 is a perspective sectional view of the upper connection pipe shown in Fig. 14.

10 FIG. 16 is a side view of the upper connection pipe shown in FIG. 14, viewed from the back.

FIG. 17 is a front sectional view of the upper connection pipe included in the manifold joint in a fifth modification example of the first embodiment of the present invention.

15 FIG. 18 is a perspective sectional view of the upper connection pipe shown in Fig. 17.

FIG. 19 is a side view of the upper connection pipe shown in FIG. 17, viewed from the back.

20 FIG. 20 is a front sectional view of the upper connection pipe included in the manifold joint in a sixth modification example of the first embodiment of the present invention.

FIG. 21 is a front sectional view of a manifold joint unit using an upper manifold joint of the third embodiment of the present invention.

FIG. 22 is a perspective sectional view of the upper part of the manifold joint unit.

25 FIG. 23 is a side sectional view of the upper part of the manifold joint unit.

FIG. 24 is a plan view of the manifold joint unit.

FIG. 25 is a front sectional view of a first ridge portion of the manifold joint unit.

FIG. 26 is a front sectional view of a second ridge portion of the manifold joint unit.

5 FIG. 27 is a sectional view of a core forming the first ridge portion, illustrating a method for manufacturing an upper manifold joint.

FIG. 28 is a sectional view of a core forming the second ridge portion, illustrating a method for manufacturing an upper manifold joint.

FIG. 29 is a plan view of an upper manifold joint in a first modification example
10 of the third embodiment of the present invention.

FIG. 30 is a side sectional view of the upper manifold joint.

FIG. 31 is a plan view of an upper manifold joint in the fourth embodiment of the present invention.

FIG. 32 is a side sectional view of the upper manifold joint.

15 FIG. 33 is a sectional view illustrating a method for manufacturing the upper connection pipe.

FIG. 34 is a front sectional view of a manifold joint unit in which a reinforcing rib is provided on the swirl vane.

FIG. 35 is a view taken in the direction of arrow A in Fig. 34.

20 FIG. 36 is a bottom view illustrating a modification example of the arrangement of the reinforcing rib.

FIG. 37A is a sectional view illustrating an example of the shape of the reinforcing rib.

FIG. 37B is a sectional view illustrating another example of the shape of the
25 reinforcing rib.

FIG. 37C is a sectional view illustrating still another example of the shape of the reinforcing rib.

FIG. 38 is a front sectional view of a manifold joint unit using an upper manifold joint of a second modification example of the third embodiment of the present invention.

5 DESCRIPTION OF EMBODIMENTS

[0011]

(First Embodiment)

An embodiment of the manifold joint of the present invention will be described below with reference to FIGs 1 to 8. In the present specification, for convenience of
10 explanation, positional relationships in the vertical direction are described for parts or portions of the manifold joint assuming that the axis 1 extends vertically; however, the joint of the present invention is not limited to use in such an orientation.

As shown in FIG. 1, a piping structure 1 includes vertical pipes 10, 15, a horizontal pipe 20, and a manifold joint 25 according to the present embodiment. In FIG. 1, the
15 vertical pipes 10, 15 and the horizontal pipe 20 are shown by two-dot chain lines.

The vertical pipes 10, 15 and the horizontal pipe 20 are formed of a synthetic resin such as PVC.

The vertical pipes 10 and 15 extend along the vertical direction, with the vertical pipe 10 positioned above the vertical pipe 15.

20 The upper end of the vertical pipe 10 is connected to the lower end of an upper-floor manifold joint 25. The lower end of the vertical pipe 15 is connected to the upper end of a lower-floor manifold joint 25 or to base joint (not shown).

The horizontal pipe 20 is arranged along a horizontal plane with an appropriate slope for drainage. A drainage fixture is connected to a first end of the horizontal pipe
25 20.

The manifold joint 25 is installed in a through-hole formed in a floor slab that separates the upper and lower floors.

[0012]

As shown in FIGs. 1 to 3, the manifold joint 25 includes an upper connection pipe 26, a lower connection pipe 36, and a vertical pipe connection portion 46. In FIG. 2, mutually different hatchings are used to distinguish inner surfaces 27b1, 27b2, 27b3, and 27b4 described later. These inner surfaces 27b1, 27b2, 27b3, and 27b4 are formed by respective cores 101, 102, and 103 described later.

The upper and lower connection pipes 26 and 36 are tubular, and the vertical pipe connection portion 46 is cylindrical. The center axes of the upper connection pipe 26, the lower connection pipe 36, and the vertical pipe connection portion 46 are coaxial with a common axis, which is hereinafter referred to as the first axis O1. A direction along the first axis O1 is referred to as the axial direction. A direction perpendicular to the first axis O1 is referred to as the radial direction, and a direction around the axis O1 is referred to as the circumferential direction.

[0013]

As shown in FIGs. 1 to 3, the upper connection pipe 26 includes an upper joint body 27, a horizontal pipe connection portion 28, a locking portion 29, a first swirl vane 30, and vertical ribs 31 and 32.

The upper joint body 27 has a cylindrical shape and is arranged on the first axis O1. An outer peripheral surface 27a of the upper joint body 27 is curved around the first axis O1.

In the present specification, the term “swirl vane” refers to a blade-like structure that imparts a swirling flow to drainage on its downstream side. The vane itself does not rotate. The swirl vane only needs to guide the flow in a specific direction by its upper

surface 30a, and it is not essential that a swirling flow actually occur downstream.

The horizontal pipe connection portion 28 is cylindrical and is provided on the outer peripheral surface 27a of the upper joint body 27 (joint body 51 described later) at its intermediate portion in the direction of the first axis O1. The internal space of the horizontal pipe connection portion 28 communicates with the internal space of the upper joint body 27.

[0014]

The locking portion 29 is annular and is provided on the inner peripheral surface 27b of the upper joint body 27 at its intermediate portion in the direction of the first axis O1. The locking portion 29 is provided below the opening 28a of the horizontal pipe connection portion 28.

The locking portion 29 protrudes from an inner peripheral surface 27b of the upper joint body 27 toward a radial inner side. The locking portion 29 is formed over an entire circumference of the upper joint body 27. The radially inner surface 29a of the locking portion 29 is inclined such that it gradually approaches the first axis O1 from an upper position toward a lower position. The inclination angle of the surface 29a is not particularly limited, but for ease of manufacture of the manifold joint 25 and suitable generation of swirling flow, an angle of 0.3 to 45° relative to the first axis O1 is preferable, and 0.5 to 30° is more preferable. The inclination angle in this context refers to an angle formed between the first axis O1 and a line connecting an upper end and a lower end of the surface 29a when the surface 29a is viewed in a section (longitudinal section) that passes through and is parallel to the first axis O1.

The lower portion of the upper connection pipe 26 below the locking portion 29 serves as a socket into which an intermediate pipe (not shown) is inserted. When the connection portion 38 of the lower connection pipe 36 is a spigot, it may be inserted into

this socket. Alternatively, the lower portion of the upper connection pipe 26 may be a spigot while the connection portion 38 of the lower connection pipe 36 being a socket, and the lower portion of the upper connection pipe 26 may be inserted into the connection portion 38 of the lower connection pipe 36.

5 [0015]

The first swirl vane 30 is formed in a curved plate-like shape. The first swirl vane 30 is provided on an inner peripheral surface 27b of the upper joint body 27.

The first swirl vane 30 is arranged so as to extend over the entire range of an opening 28a of the horizontal pipe connection portion 28 in the direction of the first axis
10 O1. Here, the term “opening 28a” refers to an opening at a radially inner end of the horizontal pipe connection portion 28.

The first swirl vane 30 only needs to be arranged so that at least a portion thereof overlaps the opening 28a of the horizontal pipe connection portion 28 in the direction of the first axis O1. Here, the expression “the first swirl vane 30 overlaps at least a portion
15 of the opening 28a of the horizontal pipe connection portion 28 in the direction of the first axis O1” means that a position in the direction of the first axis O1 of at least a portion of the first swirl vane 30 overlaps a position in the direction of the first axis O1 of at least a portion of the opening 28a of the horizontal pipe connection portion 28. In other words, the expression “the first swirl vane 30 overlaps at least a portion of the opening 28a of the
20 horizontal pipe connection portion 28 in the direction of the first axis O1” means that, when the opening 28a is viewed from the front (along the second axis O2), at least a portion of the first swirl vane 30 overlaps the opening 28a. The first swirl vane 30 has an upper surface 30a and a lower surface 30b. The upper surface 30a of the first swirl vane 30 is inclined such that the upper surface 30a gradually descends toward a first side D1 in the
25 circumferential direction (hereinafter, simply “first side D1”). Here, the inclination angle

of the upper surface 30a is not particularly limited; however, from the viewpoint of generating an appropriate swirling flow, an inclination angle of 10° to 50° with respect to the first axis O1 is preferable, and 15° to 45° is more preferable. The term “inclination angle” here refers to an angle formed between the first axis O1 and a line connecting an upper end and a lower end of the upper surface 30a when the first swirl vane 30 is viewed from a side. Viewing the first swirl vane 30 from a side means, for example, viewing a circumferential central portion of the first swirl vane 30 from a radial inner side (from the side of the first axis O1).

[0016]

Further, as shown in FIG. 10, it is preferable that the first swirl vane 30 is provided, on a lower surface 30b of the first swirl vane 30, with a protrusion or a plate-shaped reinforcing rib 41 for suppressing vibration of the first swirl vane 30. In particular, it is preferable that the reinforcing rib 41 is provided so as to connect the lower surface 30b of the first swirl vane 30 and a second inner surface 27b2 of the upper joint body 27, and it is preferable that the first swirl vane 30, the reinforcing rib 41, and the upper joint body 27 are integrally formed. When the reinforcing rib 41 is planar and plate-shaped, it is preferable that the plane of the reinforcing rib 41 is oriented in a direction parallel to the first axis O1 or in a direction parallel to a pipe axis (second axis O2) of the horizontal pipe connection portion 28. The reinforcing rib 41 may be composed of a plane parallel to the first axis O1 and a plane parallel to the pipe axis of the horizontal pipe connection portion 28.

[0017]

As shown in FIG. 10, when the plane of the reinforcing rib 41 is provided such that it is oriented in a direction parallel to the first axis O1, it is preferable that the reinforcing rib 41 has a draft angle by making its thickness smaller as it goes downward.

When the reinforcing rib 41 is plate-shaped, it is preferable that the reinforcing rib 41 is provided so as to be perpendicular to a pipe axis of the horizontal pipe connection portion 28 (see FIG. 11), or to be inclined toward the direction of the first axis O1, that is, to be provided in an orientation along a radial direction of the upper joint body 27 (see FIG. 12).

5 The number of reinforcing ribs 41 is not particularly limited, and one or a plurality may be provided. When a plurality of reinforcing ribs 41 are provided on the first swirl vane 30, it is preferable that the plurality of reinforcing ribs 41 are parallel to each other. For this reason, as shown in FIG. 12, when the reinforcing ribs 41 are inclined with respect to the pipe axis (second axis O2) of the horizontal pipe connection portion 28 so as to direct
10 toward the direction of the first axis O1, it is preferable that the inclination angles of the respective reinforcing ribs 41 are the same, and it is not necessary that all the reinforcing ribs 41 strictly direct toward the first axis O1. The inclination angle of the reinforcing rib 41 with respect to the pipe axis (second axis O2) of the horizontal pipe connection portion 28 is not particularly limited; however, an angle of 30° to 90° with respect to the pipe axis
15 of the horizontal pipe connection portion 28 is preferable, and 45° to 90° is more preferable. The “inclination angle” here refers to an angle formed between the reinforcing rib 41 and the second axis O2 when the reinforcing rib 41 is viewed from the direction of the first axis O1.

[0018]

20 The shape of the reinforcing rib 41 is not particularly limited as long as it is a shape that does not hinder inflow of drainage from the horizontal pipe 20. For example, the shape of the reinforcing rib 41 may be triangular as shown in FIG. 13A, may be rectangular as shown in FIG. 13B, or may be a shape having a cutout provided in a part thereof as shown in FIG. 13C.

25 [0019]

Further, the shape of the reinforcing rib 41 may be a shape such as that of the reinforcing rib 41 included in the upper connection pipe 26D provided in the manifold joint 25D according to the modification examples shown in FIGs. 14 to 16.

As shown in FIGs. 14 and 15, in this manifold joint 25D, two reinforcing ribs 41 are arranged with intervals in the circumferential direction. In the illustrated example, an amount of protrusion in the radial outward direction at upper ends of the two reinforcing ribs 41 is the same as an amount of radial protrusion of the first swirl vane 30. Also, lower ends of the two reinforcing ribs 41 are at the same position in the vertical direction.

Here, among the two reinforcing ribs 41, a reinforcing rib 41a located on the first side D1 in the circumferential direction is referred to as a first reinforcing rib 41a, and a reinforcing rib 41b located on the second side D2 (the opposite side of the first side D1) in the circumferential direction is referred to as a second reinforcing rib 41b.

In the illustrated example, the first reinforcing rib 41a is arranged at an end portion on the first side D1 of the first swirl vane 30. An amount of radial protrusion of the first reinforcing rib 41a decreases as going from above toward below. A radial inner edge 41a1 of the first reinforcing rib 41a forms a straight line. A change amount per unit length of the above-described protrusion amount of the first reinforcing rib 41a is the same regardless of the vertical position. A general shape of the first reinforcing rib 41a is, for example, a triangular shape as shown in FIG. 13A.

The second reinforcing rib 41b is arranged at a central portion in the circumferential direction of the first swirl vane 30. The second reinforcing rib 41b is closer to the horizontal pipe connection portion 28 than the first reinforcing rib 41a. An amount of radial protrusion of the second reinforcing rib 41b decreases as going from above toward below. A radial inner edge 41b1 of the second reinforcing rib 41b forms a curved line. The inner edge 41b1 is a curved line that protrudes toward a diagonal upper

direction on the radial outer side. A change amount per unit length of the above-described protrusion amount of the second reinforcing rib 41b becomes smaller as going toward below.

By the radial inner edge 41b1 of the second reinforcing rib 41b forming a curved
5 line as described above, the following effects (1) to (3) can be expected.

(1) Since the second reinforcing rib 41b is closer to the horizontal pipe connection
portion 28 than the first reinforcing rib 41a, drainage from the horizontal pipe 20 is more
likely to hit the second reinforcing rib 41b. Because the radial inner edge 41b1 of the
second reinforcing rib 41b is such a curved line as described above, the change amount per
10 unit length of the above-described protrusion amount of the second reinforcing rib 41b
becomes larger at an upper portion of the second reinforcing rib 41b. Therefore, drainage
from the horizontal pipe 20 is less likely to hit the second reinforcing rib 41b. As a result,
it is possible to suppress, for example, an influence on drainage performance or occurrence
of noise.

15 (2) Because the radial inner edge 41b1 of the second reinforcing rib 41b forms a
curved line as described above, an improvement in the strength of the second reinforcing
rib 41b can be expected, compared with, for example, the case where the inner edge 41b1
is a straight line. Accordingly, for example, it is possible to increase a reinforcing effect
on the swirl vane 30 by the second reinforcing rib 41b.

20 (3) Because the radial inner edge 41b1 of the second reinforcing rib 41b forms a
curved line, the lower end of the second reinforcing rib 41b does not become a sharp shape,
compared with, for example, the case where the inner edge 41b1 is a straight line. Here,
when the upper connection pipe 26D is injection-molded, if the lower end of the second
reinforcing rib 41b is a sharp shape, there is a possibility that unexpected damage may
25 occur to the metal mold when the mold is moved during injection molding. Therefore,

by preventing the lower end of the second reinforcing rib 41b from becoming a sharp shape, it is possible to suppress occurrence of such mold chipping.

[0020]

As shown in FIG. 16, in the manifold joint 25D according to this modification example, a recess 27c may be provided on an outer peripheral surface 27a of the upper joint body 27, as in the manifold joint 25A of the first modification example described later. The recess 27c is recessed toward a radial inner side. The recess 27c may be formed on at least a portion of a radial outer side of a second inner surface 27b2 (not illustrated in FIG. 16). That is, a recess 27c that is recessed toward a radial inner side is formed on the outer peripheral surface 27a of the upper joint body 27 corresponding to the second inner surface 27b2. Furthermore, a rib 27d may be provided on the recess 27c. The rib 27d may extend in a circumferential direction as shown in the illustrated example, or may extend in a vertical direction. A plurality of ribs 27d may be provided in the recess 27c, or only one rib 27d may be provided. By providing the rib 27d, it is possible to improve strength in the recess 27c. Further, when a cover (sound-insulating cover, sound-absorbing cover, fireproof material, etc.) is wrapped around the upper connection pipe 26D, it is possible to suppress the cover from sinking at the position of the recess 27c. The rib 27d and the recess 27c may be omitted.

[0021]

The reinforcing rib 41 may be omitted. In a case where the reinforcing rib 41 is not provided, for example, reinforcing projections 42 and 43 such as those in the respective modification examples shown in FIGs. 17 to 20 may be provided. Thus, a reinforcing portion 44 such as the reinforcing rib 41 or the reinforcing projections 42 and 43 may be provided, and the reinforcing portion 44 may also be entirely omitted.

[0022]

For example, in an upper connection pipe 26E included in a manifold joint 25E according to the modification examples shown in FIGs. 17 to 19, a reinforcing projection 42 bulges inward into an interior of the upper connection pipe 26E. As shown in FIGs. 17 and 18, the reinforcing projection 42 is provided integrally with the first swirl vane 30 in approximately a half-region located on the first side D1 from a circumferential center on a lower surface 30b of the first swirl vane 30. A surface of the reinforcing projection 42 includes: a first surface 42a facing a radial inner side; a second surface 42b facing the second side D2 in the circumferential direction; and a third surface 42c connecting the first surface 42a and the second surface 42b. The first surface 42a protrudes radially inward relative to the second inner surface 27b2. An amount of radial inward protrusion of the first surface 42a becomes smaller from an upper side toward a lower side. A circumferential size of the first surface 42a becomes larger from an upper side toward a lower side. A radial size of the second surface 42b becomes smaller from an upper side toward a lower side. The third surface 42c connects an edge on the second side D2 of the first surface 42a and a radial inner edge of the second surface 42b. The third surface 42c forms a curved shape that protrudes toward an interior of the upper connection pipe 26E in a cross-sectional view.

As shown in FIG. 19, in the manifold joint 25E of this modification example, a recess 27c may be provided on an outer peripheral surface 27a of the upper joint body 27. The recess 27c is recessed toward a radial inner side. The recess 27c may be formed on at least a portion of a radial outer side of the reinforcing projection 42. For example, the reinforcing projection 42 may be hollow, and the recess 27c may function as an internal space of the reinforcing projection 42.

[0023]

For example, in an upper connection pipe 26F included in a manifold joint 25F

according to the modification example shown in FIG. 20, a reinforcing projection 43 bulges inward into an interior of the upper connection pipe 26F. As shown in FIG. 20, the reinforcing projection 43 is provided over substantially the entire circumferential length on a lower surface 30b of the first swirl vane 30. A surface of the reinforcing projection 43 includes, in order from the second side D2 toward the first side D1, a first surface 43a, a second surface 43b, and a third surface 43c. The first surface 43a, the second surface 43b, and the third surface 43c are all concave curved surfaces. Centers of curvature of the first surface 43a, the second surface 43b, and the third surface 43c are, for example, located within an interior of the upper connection pipe 26F. Vertical sizes of the first surface 43a and the second surface 43b are the same, and a combined vertical size of the first surface 43a and the second surface 43b exceeds half of a vertical size of the first swirl vane 30. A part of the second side D2 of the first surface 43a may be arranged inside the horizontal pipe connection portion 28.

[0024]

As shown in FIGs. 1 to 3, the vertical ribs 31 and 32 are provided on an inner peripheral surface 27b of the upper joint body 27. The vertical ribs 31 and 32 protrude respectively from the inner peripheral surface 27b of the upper joint body 27 toward a radial inner side and extend along a vertical direction.

Upper ends of the vertical ribs 31 and 32 are arranged, in the direction of the first axis O1, within a range of the opening 28a of the horizontal pipe connection portion 28.

A lower end of the vertical rib 31 is arranged, in the direction of the first axis O1, at a position equal to a lower end of the locking portion 29. A lower end of the vertical rib 32 extends downward beyond the locking portion 29.

The vertical ribs 31 and 32 are arranged spaced from each other in a circumferential direction.

[0025]

As shown in FIGs. 2 and 3, an inner peripheral surface 27b of the upper joint body 27 (joint body 51 described later) has a first inner surface 27b1, a second inner surface 27b2, a third inner surface 27b3, and a fourth inner surface 27b4.

5 The first inner surface 27b1 is inclined such that, as going from above toward below, the first inner surface 27b1 gradually approaches the first axis O1. Here, the inclination angle of the first inner surface 27b1 is not particularly limited; however, from the viewpoints of ease of manufacture of the manifold joint 25 and promotion of generation of an appropriate swirling flow, an inclination angle of 0.3° to 5° with respect to the first
10 axis O1 is preferable, and 0.5° to 3° is more preferable. The inclination angle in this context refers to an angle formed between the first axis O1 and a line connecting an upper end and a lower end of the first inner surface 27b1 when the first inner surface 27b1 is viewed in a section (longitudinal section) that passes through and is parallel to the first axis O1. The same applies to the second inner surface 27b2 and the fourth inner surface 27b4.

15 The first inner surface 27b1 is formed at a position in the circumferential direction where it does not overlap the first swirl vane 30, and above the first swirl vane 30.

 The second inner surface 27b2 is arranged below the first swirl vane 30. In this example, the second inner surface 27b2 is parallel to the first axis O1 (see FIG. 3). Here, the inclination angle of the second inner surface 27b2 is not particularly limited; however,
20 from the viewpoints of ease of manufacture of the manifold joint 25 and promotion of generation of an appropriate swirling flow, an inclination angle of 0.3° to 5° with respect to the first axis O1 is preferable, and 0.5° to 3° is more preferable.

 The third inner surface 27b3 is inclined such that, when viewed from the direction of the first axis O1, the third inner surface 27b3 gradually increases its distance from the
25 second axis O2 of the horizontal pipe connection portion 28 as the third inner surface 27b3

approaches the horizontal pipe connection portion 28. Here, the inclination angle of the third inner surface 27b3 is not particularly limited; however, from the viewpoints of ease of manufacture of the manifold joint 25 and promotion of an appropriate swirling flow, an inclination angle of 0.3° to 5° with respect to the first axis O1 is preferable, and 0.5° to 3° is more preferable. The inclination angle in this context refers to an angle formed between the second axis O2 and a line connecting a radial outer end and a radial inner end of the third inner surface 27b3 when the third inner surface 27b3 is viewed in a section (cross section of the manifold joint 25 that is a longitudinal section of the horizontal pipe connection portion 28) that passes through and is parallel to the second axis O2.

The fourth inner surface 27b4 is formed so as to be continuous with the first inner surface 27b1 and the second inner surface 27b2, respectively. The fourth inner surface 27b4 is inclined such that, as going from below toward above, the fourth inner surface 27b4 gradually extends toward a radial outer side (away from the first axis O1). The fourth inner surface 27b4 may be parallel to the first axis O1. Here, the inclination angle of the fourth inner surface 27b4 is not particularly limited; however, from the viewpoints of ease of manufacture of the manifold joint 25 and promotion of generation of an appropriate swirling flow, an inclination angle of 0.3° to 15° with respect to the first axis O1 is preferable, and 0.5° to 10° is more preferable.

[0026]

The upper joint body 27, the horizontal pipe connection portion 28, the locking portion 29, the first swirl vane 30, and the vertical ribs 31 and 32 included in the upper connection pipe 26 are integrally formed of polyvinyl chloride resin or the like by injection molding.

That is, in the upper connection pipe 26, the first swirl vane 30 is formed integrally.

[0027]

As shown in FIG. 1, the lower connection pipe 36 includes a lower joint body 37, a connection portion 38, a second swirl vane 39, and a vertical pipe connection portion 40.

The upper joint body 27, lower joint body 37, and connection portion 38 together constitute the joint body 51. The first axis O1 is also the axis of the joint body 51. The upper joint body 27 is a portion of the joint body 51 where at least the first swirl vane 30 is provided.

[0028]

The lower joint body 37, the connecting portion 38, and the vertical pipe connection portion 40 are each formed in a tubular shape and are arranged coaxially with the first axis O1.

An inner diameter and an outer diameter of the lower joint body 37 gradually become smaller from an upper side toward a lower side.

The connecting portion 38 is fixed to an outer peripheral surface of an upper end portion of the lower joint body 37. The connecting portion 38 protrudes upward from the lower joint body 37. An intermediate pipe (not shown) connected to a lower end of the upper connection pipe 26 may be inserted into the connecting portion 38.

The second swirl vane 39 is formed in a curved plate shape. The second swirl vane 39 is provided on an inner peripheral surface of the lower joint body 37. An upper surface 39a of the second swirl vane 39 is inclined such that, as moving toward the first side D1, the upper surface 39a gradually inclines from an upper side toward a lower side. Here, the inclination angle of the upper surface 39a is not particularly limited; however, from the viewpoint of promoting generation of an appropriate swirling flow, 8° to 45° with respect to the first axis O1 is preferable, and 10° to 30° is more preferable. The "inclination angle" here refers to an angle formed between the first axis O1 and a line connecting an upper end and a lower end of the upper surface 39a when the second swirl

vane 39 is viewed from a side. Viewing the second swirl vane 39 from a side means, for example, viewing a circumferential central portion of the second swirl vane 39 from a radial inner side (from the first axis O1 side).

The vertical pipe connection portion 40 is fixed to an outer peripheral surface of
5 a lower end portion of the lower joint body 37. The vertical pipe connection portion 40 protrudes downward from the lower joint body 37.

[0029]

The lower joint body 37, the connecting portion 38, the second swirl vane 39, and the vertical pipe connection portion 40 included in the lower connection pipe 36 are
10 integrally formed of polyvinyl chloride resin or the like by injection molding.

The second swirl vane 39 may be separately injection-molded and installed inside the lower connection pipe 36 by adhesion or fitting, and the entire upper connection pipe 26 and lower connection pipe 36 may also be formed integrally by injection molding.

An upper end portion of the connecting portion 38 of the lower connection pipe
15 36 is fixed to a lower end portion of the upper joint body 27 of the upper connection pipe 26 by an adhesive or the like.

The joint body 51 configured as described above is arranged such that the first axis O1 extends along a vertical direction.

A soundproof cover may be wrapped around a radial outer side of the lower
20 connection pipe 36.

[0030]

The vertical pipe connection portion 46 has a main body 47, a locking portion 48, and a sealing member (not shown).

The main body 47 is formed in a tubular shape and is arranged on the first axis
25 O1. A lower portion of the main body 47 is fitted into the upper joint body 27 of the

upper connection pipe 26.

The locking portion 48 is formed in an annular shape and is fixed to a lower end portion of the main body 47. The locking portion 48 protrudes from the lower end portion of the main body 47 toward a radial inner side.

5 The sealing member is a packing or the like. The sealing member is arranged on a radial inner side of the main body 47.

The vertical pipe connection portion 46 may not include the sealing member. A swirl vane is not formed in the vertical pipe connection portion 46.

[0031]

10 The lower end portion of the vertical pipe 10 is arranged inside the main body 47 of the vertical pipe connection portion 46, and is locked to the locking portion 48 from above the locking portion 48. The sealing member watertightly seals between the main body 47 and the vertical pipe 10.

15 The upper end portion of the vertical pipe 15 is arranged inside the vertical pipe connection portion 40 of the lower connection pipe 36.

A second end portion of the horizontal pipe 20, which is opposite to the first end portion, is arranged inside the horizontal pipe connection portion 28 of the upper connection pipe 26.

[0032]

20 Next, a description will be given with respect to a method for manufacturing the upper connection pipe 26 of the manifold joint 25 configured as described above. The upper connection pipe 26 is manufactured by injection molding.

As shown in FIG. 4, the upper connection pipe 26 is manufactured by a mold 100 including a first core 101, a second core 102, a third core 103, and a cavity (not shown).

25 The first core 101 forms the first inner surface 27b1, the fourth inner surface 27b4,

the upper surface 30a of the first swirl vane 30, and the like of the upper connection pipe 26, and is pulled upward with respect to the upper connection pipe 26.

The second core 102 forms the second inner surface 27b2, the lower end portion of the lower surface 30b of the first swirl vane 30, and the like of the upper connection
5 pipe 26, and is pulled downward with respect to the upper connection pipe 26.

The third core 103 forms the third inner surface 27b3, the upper end portion of the lower surface 30b of the first swirl vane 30, and the like of the upper connection pipe 26, and is pulled outward in the radial direction with respect to the upper connection pipe 26.

10 [0033]

The lower surface 30b of the first swirl vane 30 may be formed only by the second core 102.

In addition, when a reinforcing rib for suppressing vibration of the first swirl vane 30 is provided on the lower surface of the first swirl vane 30, the reinforcing rib is formed
15 by the second core 102 or the third core 103. When the reinforcing rib is formed of a plane parallel to the first axis O1, it is formed together with the lower surface of the first swirl vane 30 by the second core 102, and when the reinforcing rib is formed of a plane parallel to the pipe axis of the horizontal pipe connection portion 28, it is formed together with the lower surface of the first swirl vane 30 by the third core 103. The reinforcing
20 rib may be formed by both the second core 102 and the third core 103.

[0034]

Further, as shown in FIG. 10, when the plane of the reinforcing rib 41 is provided so as to be oriented parallel to the first axis O1, it is preferable that the reinforcing rib 41 is formed by the second core 102.

25 [0035]

A molten synthetic resin is caused to flow into the space between the cavity and the cores 101, 102, and 103, and the mold 100 is cooled to solidify the molten synthetic resin. By withdrawing the cores 101, 102, and 103 from the cavity and appropriately separating the cavity, the upper connection pipe 26 is obtained.

5 [0036]

As described above, in the manifold joint 25 of the present embodiment, the upper joint body 27, the horizontal pipe connection portion 28, and the first swirl vane 30 are integrally formed and manufactured by injection molding. When the first swirl vane 30 includes a reinforcing rib 41, the reinforcing rib 41 is also integrally formed and
10 manufactured.

For example, wastewater discharged from drainage equipment flows into the interior of the joint body 51 through the horizontal pipe 20 connected to the horizontal pipe connection portion 28, and strikes the first swirl vane 30. This wastewater can be made to flow downward inside the joint body 51 while swirling around the first axis O1 by the
15 first swirl vane 30. This wastewater then flows through the vertical pipe 15 and is treated by wastewater treatment equipment.

Since the inner peripheral surface 27b of the upper joint body 27 (the joint body 51) includes the second inner surface 27b2, the second inner surface 27b2 can be formed by the second core 102 that is pulled downward with respect to the upper connection pipe
20 26.

[0037]

The inner peripheral surface 27b of the upper joint body 27 includes the first inner surface 27b1, which is inclined such that it gradually approaches the first axis O1 from above toward below. Therefore, the first inner surface 27b1 can be formed by the first
25 core 101, which is pulled upward with respect to the joint body 51, while suppressing

friction between the first inner surface 27b1 and the first core 101 during the pulling process.

As described above, even when the first swirl vane 30 is provided on the inner peripheral surface 27b of the upper joint body 27, it is possible to provide an upper
5 connection pipe 26 that can be easily manufactured by injection molding.

[0038]

The inner peripheral surface 27b has the third inner surface 27b3. Therefore, when the upper connection pipe 26 is manufactured by injection molding, the third inner surface 27b3 can be formed by the third core 103 that is pulled outward in the radial
10 direction with respect to the upper connection pipe 26.

The inner peripheral surface 27b has the fourth inner surface 27b4, and the fourth inner surface 27b4 is inclined such that it gradually moves outward in the radial direction (away from the first axis O1) from below toward above. Therefore, when the upper connection pipe 26 is manufactured by injection molding, the fourth inner surface 27b4
15 can be formed by the first core 101, which is pulled upward with respect to the upper connection pipe 26, while suppressing friction between the fourth inner surface 27b4 and the first core 101 during the pulling process.

[0039]

The upper connection pipe 26 (manifold joint 25) of the present embodiment can
20 have its configuration variously modified as described below.

As in the upper connection pipe 26A of the first modified example of the manifold joint 25A shown in FIGs. 5 and 6, a recess 27c may be provided in the outer peripheral surface 27a of the upper joint body 27. The recess 27c is recessed toward a radial inner side. The recess 27c may be formed in at least a part of the radial outer side of the second
25 inner surface 27b2.

In the first modified example of the manifold joint 25A, the distance between the bottom surface of the recess 27c and the second inner surface 27b2 becomes relatively short. Accordingly, the overall thickness of the manifold joint 25A can be made as uniform as possible, and the moldability of the manifold joint 25A can be improved.

5 [0040]

As in the upper connection pipe 26B of the second modified example of the manifold joint 25B shown in FIG. 7, the second inner surface 27b2A may be inclined such that it gradually moves outward in the radial direction from above toward below. In this case, when the upper connection pipe 26B is manufactured by injection molding, the
 10 second inner surface 27b2A can be formed by a second core that is pulled downward with respect to the upper connection pipe 26B, while suppressing friction between the second inner surface 27b2A and the second core during the pulling process. Although the inclination angle of the second inner surface 27b2A is not particularly limited, from the viewpoint of ease of manufacturing the manifold joint 25, 0.3 to 45° relative to the first
 15 axis O1 is preferable, and 0.5 to 15° is more preferable.

[0041]

In the upper connection pipe 26C included in the manifold joint 25C of the third modification example shown in FIG. 8, an upper surface 30aA of the first swirl vane 30A may be inclined such that the upper surface 30aA gradually inclines downward as it goes
 20 toward a radial inner side. It is preferable that an angle θ formed between the inner peripheral surface 27b of the upper joint body 27 and the upper surface 30aA (the first inner surface 27b1) is greater than 90° and equal to or less than 125°.

Such a configuration makes it possible to cause drainage that has struck the upper surface 30aA of the first swirl vane 30A to flow not only toward the first side D1, but also
 25 toward the side of the first axis O1. Accordingly, it is possible to dissipate the energy of

the drainage in a larger number of directions, and it is possible to improve the sound-insulating performance of the manifold joint 25C.

[0042]

As described above, the first swirl vane 30 may be provided with the reinforcing
5 rib 41. When the first swirl vane 30 is provided with the reinforcing rib 41, it is possible to suppress vibration of the first swirl vane 30 that occurs when drainage strikes the first swirl vane 30. Therefore, it is possible to suppress occurrence of noise caused by vibration of the first swirl vane 30 and reduce noise.

In addition, when the reinforcing rib 41 is provided in parallel with the first axis
10 O1, it is possible to provide a structure in which the second core 102 can be easily withdrawn even when the reinforcing rib 41 is formed. Moreover, when the reinforcing rib 41 has a draft angle, it becomes even easier to withdraw the second core 102. Accordingly, it is possible to easily manufacture the upper connection pipe 26 by injection molding.

15 [0043]

(Second Embodiment)

Next, a second embodiment of the present invention will be described with
reference to FIG. 9. In this description, the same reference numerals are given to the
same parts as those in the above embodiment and their explanation is omitted, and only
20 the differences will be described.

As shown in FIG. 9, a manifold joint 55 of the present embodiment includes an
upper connection pipe 56 instead of the upper connection pipe 26 in the respective
configurations of the manifold joint 25 of the first embodiment. The upper connection
pipe 56 has a shape obtained by rotating the upper connection pipe 26 by 180° about an
25 axis along a horizontal plane (inverting the upper and lower directions).

The upper connection pipe 56 has the upper joint body 27, the horizontal pipe connection portion 28, the locking portion 29, the first swirl vane 30, and the vertical ribs 31 and 32.

[0044]

5 When the upper connection pipe 56 is manufactured, the mold 100 described above is used.

 The first core 101 is pulled downward with respect to the upper connection pipe 56. The second core 102 is pulled upward with respect to the upper connection pipe 56. The third core 103 is pulled outward in the radial direction with respect to the upper
10 connection pipe 56.

 Also in the manifold joint 55 of the present embodiment, it is possible to achieve the same effects as those of the manifold joint 25 of the first embodiment.

[0045]

 Although the first and second embodiments of the present invention have been
15 described in detail above with reference to the drawings, specific configurations are not limited to these embodiments, and modifications, combinations, deletions, and the like of the configurations within a range not departing from the gist of the present invention are also included. Furthermore, it goes without saying that the respective configurations shown in the embodiments can be used in appropriate combinations.

20 For example, in the first and second embodiments, the inner peripheral surface 27b of the upper connection pipes 26 and 56 may not have the third inner surface 27b3 and the fourth inner surface 27b4.

 The first swirl vane 30 does not necessarily have to be arranged so as to overlap the opening 28a of the horizontal pipe connection portion 28 in the direction of the first
25 axis O1, and an upper end of the first swirl vane 30 may be positioned below a lower end

of the opening 28a of the horizontal pipe connection portion 28. In this case, since the recess 27c is arranged below the horizontal pipe connection portion 28 in the direction of the first axis O1, the recess 27c is located in the floor slab through-hole, and there is a possibility that the recess 27c cannot be filled with mortar at the time of construction of mortar for filling a gap between the manifold joint 25 and the floor slab through-hole.

Therefore, the recess 27c does not necessarily have to be provided, and the recess 27c may be filled with a filler such as a fireproof putty containing a heat-expandable fireproof material or a damping material having a vibration preventing effect so that no recess is present on the outer peripheral surface of the upper connection pipe 26, or the outer peripheral surface of the upper connection pipe 26 including the recess 27c may be covered in advance with a sound-insulating cover and then arranged in the floor slab through-hole.

[0046]

It is also possible that the manifold joint is configured only with the upper connection pipes 26 and 56.

The manifold joint 25 does not necessarily have to include the vertical ribs 31 and 32 and the vertical pipe connection portion 46. The same applies to the manifold joint 55.

[0047]

In addition, a member including a heat-expandable material (not shown) may be provided on an outer surface or an inner surface of a portion, among a lower portion of the upper connection pipe 26 and the lower connection pipe 36, that is located in the floor slab through-hole. For example, a heat-expandable sheet containing expandable graphite may be wound around an outer surface of the upper connection pipe 26 positioned below the horizontal pipe connection portion 28, an outer surface of the connecting portion 38 of the lower connection pipe 36 positioned above the lower connection pipe 36, or an outer

surface of the lower joint body 37 of the lower connection pipe 36. An intermediate pipe (not shown) connecting the upper connection pipe 26 and the lower connection pipe 36 may contain a heat-expandable material such as expandable graphite.

Further, an outer layer composed of a fiber mortar layer may be provided on an
5 outer peripheral surface of the upper connection pipe 26 or the lower connection pipe 36.

Further, in order to suppress drainage noise generated when drainage strikes the first swirl vane 30 provided in the upper connection pipe 26 and vibrations of the upper connection pipe 26, it is preferable that a damping material (not shown) is provided on an outer surface of the upper connection pipe 26.

10 Examples of the damping material include rubbers such as butyl rubber and elastomers, and the damping material may be molded into a sheet shape so as to be wound around the outer peripheral surface of the upper connection pipe 26, or may be in a putty form.

The damping material may be provided on a portion of the outer peripheral surface
15 of the upper connection pipe 26 on a lower side than the horizontal pipe connection portion 28, or on a side surface of the upper connection pipe 26 where the horizontal pipe connection portion 28 is not provided, for example, on the recess 27c.

[0048]

(Addendum 1)

20 The first and second embodiments described above can be understood, for example, as follows.

(1) According to a first aspect of the present invention, there is provided a manifold joint including: a joint body arranged such that its first axis is oriented along a vertical direction; a horizontal pipe connection portion provided on an outer peripheral surface of
25 the joint body; and a swirl vane provided on an inner peripheral surface of the joint body

such that at least a part of the swirl vane overlaps an opening of the horizontal pipe connection portion in a direction of the first axis; wherein the inner peripheral surface includes a first inner surface that is inclined such that the first inner surface gradually approaches the first axis as going downward, and a second inner surface that is arranged below the swirl vane; and at least a portion of the joint body in which the swirl vane is provided, the horizontal pipe connection portion, and the swirl vane are integrally formed.

[0049]

In this invention, for example, the manifold joint is manufactured by injection molding such that at least a portion of the joint body in which the swirl vane is provided, the horizontal pipe connection portion, and the swirl vane are integrally formed. For example, drainage that has flowed into the interior of the joint body through a horizontal pipe connected to the horizontal pipe connection portion strikes the swirl vane. This drainage can be made to flow downward inside the joint body while being caused to swirl around the first axis by the swirl vane.

Since the inner peripheral surface of the joint body has the second inner surface, the second inner surface can be formed by a core that is pulled downward with respect to the joint body.

Since the inner peripheral surface of the joint body has the first inner surface that is inclined such that it gradually approaches the axis as going downward, the first inner surface can be formed by a core that is pulled upward with respect to the joint body while suppressing friction between the first inner surface and the core during the pulling process.

As described above, even when the swirl vane is provided on the inner peripheral surface of the joint body, it is possible to provide a manifold joint that can be easily manufactured by injection molding.

[0050]

(2) According to a second aspect of the present invention, the manifold joint according to (1) may have a configuration in which the inner peripheral surface further includes a third inner surface that is inclined such that, as the third inner surface approaches the horizontal pipe connection portion, the third inner surface gradually moves away from a second axis of the horizontal pipe connection portion.

In this invention, when the manifold joint is manufactured by injection molding, the third inner surface can be formed by a core that is pulled outward in the radial direction with respect to the joint body.

[0051]

(3) According to a third aspect of the present invention, the manifold joint according to (1) or (2) may have a configuration in which the second inner surface is inclined such that, as going downward, the second inner surface gradually extends toward a radial outer side.

In this invention, when the manifold joint is manufactured by injection molding, the second inner surface can be formed by a core that is pulled downward with respect to the joint body while suppressing friction between the second inner surface and the core during the pulling process.

[0052]

(4) According to a fourth aspect of the present invention, the manifold joint according to any one of (1) to (3) may have a configuration in which the inner peripheral surface of the joint body further includes a fourth inner surface formed so as to be continuous with the first inner surface and the second inner surface, and the fourth inner surface is inclined such that, as going upward, the fourth inner surface gradually extends toward a radial outer side.

In this invention, when the manifold joint is manufactured by injection molding,

the fourth inner surface can be formed by a core that is pulled upward with respect to the joint body while suppressing friction between the fourth inner surface and the core during the pulling process.

[0053]

- 5 (5) According to a fifth aspect of the present invention, the manifold joint according to (3) may have a configuration in which a recess is provided in the outer peripheral surface, and the recess is formed on at least a portion of a radial outer side of the second inner surface.

In this invention, the distance between a bottom surface of the recess and the
10 second inner surface becomes relatively short. Accordingly, the overall thickness of the manifold joint can be made as uniform as possible, and the moldability of the manifold joint can be improved.

[0054]

(Third Embodiment)

- 15 Hereinbelow, a piping structure in which a third embodiment of the manifold joint according to the present invention is used will be described with reference to FIGs. 21 to 30.

As shown in FIG. 21, a piping structure 201 includes vertical pipes 210 and 215, a horizontal pipe 220, and a manifold joint unit 225. In FIG. 21, the vertical pipes 210,
20 215 and the horizontal pipe 220 are indicated by two-dot chain lines.

The vertical pipes 210, 215 and the horizontal pipe 220 are formed in a tubular shape with polyvinyl chloride resin or the like.

The vertical pipe 210 and the vertical pipe 215 extend along an upward-downward direction. The vertical pipe 210 is arranged above the vertical pipe 215.

- 25 The vertical pipe 215 has a pipe main body 216 and a socket 217. The socket

217 is formed in a tubular shape and arranged coaxially with the pipe main body 216. The socket 217 is provided on an outer peripheral surface of an upper end portion of the pipe main body 216 so as to protrude upward from the pipe main body 216.

[0055]

- 5 The upper end of the vertical pipe 210 is connected to another vertical pipe 210 which is connected to the lower end of a manifold joint unit 225 on an upper floor. A lower end portion of the pipe main body 216 of the vertical pipe 215 is connected to an upper end portion of a manifold joint unit 225 of a lower floor or to a leg joint (not shown).

 The horizontal pipe 220 is arranged along a horizontal plane with an appropriate
10 slope for drainage. A drainage fixture is connected to a first end of the horizontal pipe 220.

 The manifold joint 225 is installed in a through-hole formed in a floor slab that separates the upper and lower floors.

[0056]

- 15 The manifold joint unit 225 has an upper manifold joint (manifold joint) 226 and a lower manifold joint 241.

 Here, the upper manifold joint 226 and the lower manifold joint 241 are each formed in a tubular shape. Central axes of the upper manifold joint 226 and the lower manifold joint 241 are arranged coaxially with a common axis. Hereinafter, the common
20 axis is referred to as an axis O1 (first axis O1). A direction along the axis O1 is referred to as an axis O1 direction. A direction perpendicular to the axis O1 is referred to as a radial direction, and a direction circling around the axis O1 is referred to as a circumferential direction.

[0057]

- 25 As shown in FIGs. 21 to 24, the upper manifold joint 226 has an upper joint body

227, a locking portion 228, a vertical pipe connection portion 229, a horizontal pipe connection portion 230, a vane support portion 231, a first swirl vane (swirl vane) 232, a first ridge portion (ridge portion) 233, a second ridge portion 234, and a socket 235. The upper joint body 227 and the vane support portion 231 together constitute a joint body 237, and the locking portion 228, the vertical pipe connection portion 229, and the horizontal pipe connection portion 230 may be members separate from the upper joint body 227 and joined thereto with an adhesive or the like.

[0058]

The upper joint body 227 is formed in a cylindrical tubular shape. The upper joint body 227 is arranged on the axis O1.

The locking portion 228 is formed in an annular shape and is provided at an upper end portion of the upper joint body 227. The locking portion 228 protrudes from an inner peripheral surface of the upper joint body 227 toward a radial inner side. The locking portion 228 is formed over an entire circumference of the upper joint body 227.

The vertical pipe connection portion 229 is formed in a tubular shape and is arranged on the axis O1. The vertical pipe connection portion 229 extends upward from the upper joint body 227.

The horizontal pipe connection portion 230 is formed in a cylindrical shape. The horizontal pipe connection portion 230 is provided on an outer peripheral surface of an upper end portion of the upper joint body 227. A space inside the horizontal pipe connection portion 230 communicates with an opening 227a of the upper joint body 227.

[0059]

The vane support portion 231 is formed in a plate shape and is provided on an inner peripheral surface of the upper joint body 227 (see FIG. 23). The vane support portion 231 is arranged in an upper portion of the upper joint body 227. The vane support

portion 231 projects from the inner peripheral surface of the upper joint body 227 toward a radial inner side. That is, an overall thickness (radial length) of the upper joint body 227 and the vane support portion 231 is greatest in a portion where the vane support portion 231 is provided. The vane support portion 231 extends to an upper end of the upper joint
 5 body 227.

As shown in FIG. 23, a surface of the vane support portion 231 that faces a radial inner side is an inner surface portion 231a, which is a portion of an inner surface of the joint body 237 located above the first swirl vane 232 among inner surfaces of the joint body 237. The inner surface portion 231a is inclined such that, as going upward, the inner
 10 surface portion 231a gradually extends toward a radial outer side. The inner surface portion 231a can also be regarded as the first inner surface 27b1 that is inclined such that, as going downward, it gradually approaches the axis O1. A portion of the inner surface of the joint body 237 that is arranged below the first swirl vane 232 can also be regarded as the second inner surface 27b2. The vane support portion 231 can also be regarded as
 15 a part of the joint body 237, and can also be regarded as a portion of the joint body 237 located above the first swirl vane 232. The inclination angle of the inner surface portion 231a is not particularly limited; however, from the viewpoints of ease of manufacture of the manifold joint 25 and promotion of generation of an appropriate swirling flow, 0.3° to 5° with respect to the axis O1 is preferable, and 0.5° to 3° is more preferable. The
 20 inclination angle in this context refers to an angle formed between the axis O1 and a line connecting an upper end and a lower end of the inner surface portion 231a when the inner surface portion 231a is viewed in a section (longitudinal section) that passes through and is parallel to the axis O1.

The joint body 237 having the upper joint body 227 and the vane support portion
 25 231 is formed in a cylindrical tubular shape.

[0060]

A recess 227b may be provided on an outer peripheral surface of the upper joint body 227. The recess 227b is recessed toward a radial inner side. The recess 227b may be formed on at least a portion of a radial outer side of the vane support portion 231.

5 [0061]

As shown in FIGs. 21 to 24, the first swirl vane 232 is formed in a curved plate shape. The first swirl vane 232 is provided on an inner peripheral surface of a lower end portion of the vane support portion 231. The first swirl vane 232 is provided such that, in the direction of the axis O1, at least a part of the first swirl vane 232 overlaps the opening
10 227a. The first swirl vane 232 projects from the vane support portion 231 toward a radial inner side. The first swirl vane 232 has an upper surface 232a and a lower surface 232b. The upper surface 232a of the first swirl vane 232 is inclined such that, as going toward a first side D1 in the circumferential direction (hereinafter simply referred to as the first side D1), the upper surface 232a gradually inclines from an upper side toward a lower side.
15 Here, the inclination angle of the upper surface 232a is not particularly limited; however, from the viewpoint of generating an appropriate swirling flow, 10° to 50° with respect to the axis O1 is preferable, and 15° to 45° is more preferable. The term “inclination angle” here refers to an angle formed between the axis O1 and a line connecting an upper end and a lower end of the upper surface 232a when the first swirl vane 232 is viewed from a side.
20 Viewing the first swirl vane 232 from a side means, for example, viewing a circumferential central portion of the first swirl vane 232 from a radial inner side (from the axis O1 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 D2).

25 [0062]

The first ridge portion 233 and the second ridge portion 234 are provided so as to extend along the axis O1 in a region above the first swirl vane 232 on the inner peripheral surface of the vane support portion 231. The first ridge portion 233 and the second ridge portion 234 extend to a vicinity of the locking portion 228.

- 5 As shown in FIG. 24, when viewed along the direction of the axis O1, the first ridge portion 233 is arranged at a position corresponding to an end portion on the first side D1 of the first swirl vane 232.

Here, the expression “a position corresponding to the end portion on the first side D1 of the first swirl vane 232 when viewed along the direction of the axis O1” means a position that overlaps the end portion on the first side D1 of the first swirl vane 232 when viewed along the direction of the axis O1. The expression “a position corresponding to the end portion on the first side D1 of the first swirl vane 232 when viewed along the direction of the axis O1” may also mean a range which, when viewed along the direction of the axis O1, is located on both sides in the circumferential direction within a distance of three times the thickness of the first swirl vane 232 from the end on the first side D1 of the first swirl vane 232.

[0063]

As shown in FIG. 25, a first ridge outer surface (ridge outer surface) 233a of the first ridge portion 233 that faces the first side D1 is inclined such that, as going downward, the first ridge outer surface 233a gradually inclines toward the second side D2. A first ridge inner surface (ridge inner surface) 233b of the first ridge portion 233 that faces the second side D2 is inclined such that, as going upward, the first ridge inner surface 233b gradually inclines toward the first side D1.

That is, the first ridge inner surface 233b is inclined in the same direction as the first ridge outer surface 233a such that the first ridge portion 233 has substantially the same

thickness regardless of its position along the direction of the axis O1. The inclination angle of the first ridge outer surface 233a is not particularly limited; however, 0.3° to 5° with respect to the axis O1 is preferable, and 0.5° to 3° is more preferable. The inclination angle of the first ridge inner surface 233b is not particularly limited; however, 0.3° to 5° with respect to the axis O1 is preferable, and 0.5° to 3° is more preferable. The term “inclination angle” here refers to an angle formed between the axis O1 and a line connecting an upper end and a lower end of each of the first ridge outer surface 233a and the first ridge inner surface 233b when the first ridge portion 233 is viewed from a side. Viewing the first ridge portion 233 from a side means, for example, viewing a central portion of the first ridge portion 233 along the direction of the axis O1 (a central portion in the circumferential direction) from a radial inner side (from the axis O1 side).

[0064]

Further, as shown in FIGs. 25 and 34, it is preferable that a projection or a plate-shaped reinforcing rib 236 for suppressing vibration of the first swirl vane 232 is provided on the lower surface 232b of the first swirl vane 232 on a side opposite to the upper surface 232a of the first swirl vane 232. In particular, as shown in FIGs. 23 and 34, it is preferable that the reinforcing rib 236 is provided so as to connect the lower surface 232b of the first swirl vane 232 and an inner surface of the upper joint body 227, and it is preferable that the first swirl vane 232, the reinforcing rib 236, and the upper joint body 227 is integrally formed. When the reinforcing rib 236 is planar and plate-shaped, it is preferable that a plane of the reinforcing rib 236 is oriented in a direction parallel to the axis O1 or in a direction parallel to a pipe axis of the horizontal pipe connection portion 230, and the reinforcing rib 236 may be formed of a plane parallel to the axis O1 and a plane parallel to the pipe axis of the horizontal pipe connection portion 230.

[0065]

As shown in FIG. 34, when the reinforcing rib 236 is arranged such that its plate surface extends in a direction parallel to the axis O1, it is preferable that the reinforcing rib 236 have a draft angle by decreasing its thickness progressively toward the lower side. When the reinforcing rib 236 has a plate-like shape, it is preferably arranged so as to be perpendicular to the pipe axis of the horizontal pipe connection portion 230 (see FIG. 35), or inclined toward the direction of the axis O1, that is, oriented along the radial direction of the upper manifold joint 226 (see FIG. 36). The number of reinforcing ribs 236 is not particularly limited and may be one or more. When multiple reinforcing ribs 236 are provided on the first swirl vane 232, it is preferable that they be parallel to one another. Accordingly, as shown in FIG. 36, when the reinforcing rib 236 is inclined toward the axis O1 relative to the pipe axis of the horizontal pipe connection portion 230, the inclination angle is preferably identical across all ribs 236, and it is not necessary for all of the reinforcing ribs to be strictly directed toward the axis O1. No particular limitation is imposed on the inclination angle of the reinforcing rib 236, but an angle of 30 to 90° relative to the pipe axis of the horizontal pipe connection portion 230 is preferable, and an angle of 45 to 90° is more preferable. Here, the term “inclination angle” refers to the angle formed between the reinforcing rib 236 and the pipe axis of the horizontal pipe connection portion 230 when the reinforcing rib 236 is viewed along the axis O1.

[0066]

The shape of the reinforcing rib 236 is not particularly limited as long as it is a shape that does not hinder inflow of drainage from the horizontal pipe 220. For example, the shape of the reinforcing rib 236 may be triangular as shown in FIG. 37A, may be rectangular as shown in FIG. 37B, or may be a shape having a cutout provided in a part thereof as shown in FIG. 37C.

[0067]

The reinforcing rib 236 may be omitted.

[0068]

As shown in FIG. 24, when viewed along the direction of the axis O1, the second ridge portion 234 is arranged at a position corresponding to an end portion on the second side D2 of the first swirl vane 232. The meaning of “a position corresponding to the end portion on the second side D2 of the first swirl vane 232 when viewed along the direction of the axis O1” is the same as the meaning of “a position corresponding to the end portion on the first side D1 of the first swirl vane 232 when viewed along the direction of the axis O1.”

As shown in FIG. 26, a second ridge outer surface 234a of the second ridge portion 234 that faces the second side D2 is inclined such that, as going downward, the second ridge outer surface 234a gradually inclines toward the first side D1. A second ridge inner surface 234b of the second ridge portion 234 that faces the first side D1 is inclined such that, as going upward, the second ridge inner surface 234b gradually inclines toward the second side D2. The inclination angle of the second ridge outer surface 234a is not particularly limited; however, 0.3° to 5° with respect to the axis O1 is preferable, and 0.5° to 3° is more preferable. The inclination angle of the second ridge inner surface 234b is not particularly limited; however, 0.3° to 5° with respect to the axis O1 is preferable, and 0.5° to 3° is more preferable. The term “inclination angle” here refers to an angle formed between the axis O1 and a line connecting an upper end and a lower end of each of the second ridge outer surface 234a and the second ridge inner surface 234b when the second ridge portion 234 is viewed from a side. Viewing the second ridge portion 234 from a side means, for example, viewing a central portion of the second ridge portion 234 along the direction of the axis O1 (a central portion in the circumferential direction) from a radial inner side (from the axis O1 side).

[0069]

As shown in FIG. 21, the socket 235 is formed in a tubular shape and is arranged coaxially with the upper joint body 227. The socket 235 is provided on an outer peripheral surface of a lower end portion of the upper joint body 227 so as to protrude
5 downward from the upper joint body 227.

The joint body 237, the locking portion 228, the vertical pipe connection portion 229, the horizontal pipe connection portion 230, the first swirl vane 232, the first ridge portion 233, the second ridge portion 234, and the socket 235 included in the upper manifold joint 226 are integrally formed of polyvinyl chloride resin or the like by injection
10 molding.

The axis O1 is also an axis of the joint body 237. The joint body 237 is arranged such that the axis O1, which is the axis of the joint body 237, extends along an upward-downward direction.

The socket 235 may not be provided at the lower end of the upper joint body 227,
15 and the lower end of the upper joint body 227 may instead be formed as a spigot, and the spigot provided at the lower end of the upper joint body 227 may be inserted into a socket provided at an upper end of a lower joint body 242. Alternatively, an intermediate pipe for connecting the socket 235 at the lower end of the upper joint body 227 and the socket provided at the upper end of the lower joint body 242 may be provided. Further, an
20 intermediate joint having sockets at upper and lower ends thereof may be provided to connect the spigot at the lower end of the upper joint body 227 and the spigot at the upper end of the lower joint body 242.

[0070]

As shown in FIG. 21, the lower manifold joint 241 has a lower joint body 242, a
25 connecting portion 243, a second swirl vane 244, and a vertical pipe connection portion

245.

The lower joint body 242, the connecting portion 243, and the vertical pipe connection portion 245 are each formed in a tubular shape and are arranged coaxially with the axis O1.

- 5 An inner diameter and an outer diameter of the lower joint body 242 gradually become smaller from an upper side toward a lower side.

The connecting portion 243 is fixed to an upper end portion of the lower joint body 242. The connecting portion 243 protrudes upward from the lower joint body 242.

[0071]

- 10 The second swirl vane 244 is formed in a curved plate shape. The second swirl vane 244 is provided on inner peripheral surfaces of the lower joint body 242 and the connecting portion 243. An upper surface 244a of the second swirl vane 244 is inclined such that, as going toward the first side D1, the upper surface 244a gradually inclines from an upper side toward a lower side. Here, the inclination angle of the upper surface 244a
- 15 is not particularly limited; however, from the viewpoint of promoting generation of an appropriate swirling flow, 8° to 45° with respect to the axis O1 is preferable, and 10° to 30° is more preferable. The term “inclination angle” here refers to an angle formed between the axis O1 and a line connecting an upper end and a lower end of the upper surface 244a when the second swirl vane 244 is viewed from a side. Viewing the second
- 20 swirl vane 244 from a side means, for example, viewing a circumferential central portion of the second swirl vane 244 from a radial inner side (from the axis O1 side).

The vertical pipe connection portion 245 is fixed to a lower end portion of the lower joint body 242. The vertical pipe connection portion 245 protrudes downward from the lower joint body 242.

- 25 [0072]

The lower joint body 242, the connecting portion 243, the second swirl vane 244, and the vertical pipe connection portion 245 included in the lower manifold joint 241 are integrally formed of polyvinyl chloride resin or the like by injection molding. The second swirl vane 244 may be separately injection-molded and installed inside the lower manifold joint 241 by being bonded or fitted to the lower manifold joint 241.

An upper end portion of the connecting portion 243 of the lower manifold joint 241 is arranged inside the socket 235 of the upper manifold joint 226. The connecting portion 243 and the socket 235 are fixed to each other by an adhesive or the like.

[0073]

10 A lower end portion of the vertical pipe 210 is arranged inside the vertical pipe connection portion 229 of the upper manifold joint 226 and is locked to the locking portion 228 from above the locking portion 228.

A lower end portion of the vertical pipe connection portion 245 of the lower manifold joint 241 is arranged inside the socket 217 of the vertical pipe 215.

15 A second end portion of the horizontal pipe 220, which is opposite to the first end portion, is arranged inside the horizontal pipe connection portion 230 of the upper manifold joint 226.

[0074]

Next, a method for manufacturing the upper manifold joint 226 of the manifold joint unit 225 configured as described above will be described. The upper manifold joint 226 is manufactured by injection molding.

As shown in FIGs. 27 and 28, the upper manifold joint 226 is manufactured by a mold 100 including a first core 101, a second core 102, a third core 103, and a cavity (not shown).

25 The first core 101 forms the inner surface portion 231a of the vane support portion

231, the upper surface 232a of the first swirl vane 232, the first ridge inner surface 233b of the first ridge portion 233, the second ridge inner surface 234b of the second ridge portion 234, and the like, and is pulled upward with respect to the upper manifold joint 226.

5 The second core 102 forms the first ridge outer surface 233a of the first ridge portion 233 and the like, and is pulled downward with respect to the upper manifold joint 226.

 The third core 103 forms the lower surface of the first swirl vane 232, the second ridge outer surface 234a of the second ridge portion 234, and the like, and is pulled outward
10 in the radial direction with respect to the upper manifold joint 226.
[0075]

 The lower surface of the first swirl vane 232 and the second ridge outer surface 234a of the second ridge portion 234 may be formed by the second core 102. In this case, the lower surface of the first swirl vane 232 may be formed by the second core 102 and the
15 second ridge outer surface 234a of the second ridge portion 234 may be formed by the third core 103, or both the lower surface of the first swirl vane 232 and the second ridge outer surface 234a of the second ridge portion 234 may be formed by the second core 102, or the second core 102 and the third core 103 may each form a predetermined range of the lower surface of the first swirl vane 232.

20 In addition, when a reinforcing rib 236 for suppressing vibration of the first swirl vane 232 is provided on the lower surface of the first swirl vane 232, the reinforcing rib 236 is formed by the second core 102 or the third core 103. When the reinforcing rib 236 is formed of a plane parallel to the axis O1, it is formed together with the lower surface of the first swirl vane 232 by the second core 102, and when the reinforcing rib 236 is formed
25 of a plane parallel to a pipe axis of the horizontal pipe connection portion 230, it is formed

together with the lower surface of the first swirl vane 232 by the third core 103. The reinforcing rib 236 may be formed by both of the two cores, the second core 102 and the third core 103.

[0076]

5 As shown in FIG. 34, when the plate surface of the reinforcing rib 236 is arranged so as to extend in a direction parallel to axis O1, the reinforcing rib 236 is preferably formed by the second core 102.

[0077]

10 A molten synthetic resin is caused to flow into the space between the cavity and the cores 101, 102, and 103, and the mold 100 is cooled to solidify the molten synthetic resin. By withdrawing the cores 101, 102, and 103 from the cavity and appropriately separating the cavity, the molded upper manifold joint 226 is obtained.

[0078]

15 As described above, in the upper manifold joint 226 of the present embodiment, the joint body 237, the first swirl vane 232, and the first ridge portion 233 are integrally formed and manufactured by injection molding. When the first swirl vane 232 includes the reinforcing rib 236, the reinforcing rib 236 is also integrally formed and manufactured. For example, drainage discharged from a drainage facility flows into the joint body 237 through the horizontal pipe 220 and strikes the first swirl vane 232. This drainage can be made to flow downward inside the joint body 237 while swirling around the axis O1 by the first swirl vane 232. Then, generation of sound and vibration from the first swirl vane 232 by the drainage can be suppressed by the first ridge portion 233. This drainage then flows through the vertical pipe 215 and is treated by drainage treatment equipment.

[0079]

25 The first ridge portion 233 is arranged at a position corresponding to an end

portion on the first side D1 of the first swirl vane 232 when viewed along the direction of the axis O1, and the first ridge outer surface 233a of the first ridge portion 233 is inclined such that, as going downward, the first ridge outer surface 233a gradually inclines toward the second side D2. Therefore, when the upper manifold joint 226 is manufactured by injection molding, the first ridge outer surface 233a can be formed by the second core 102 that is pulled downward with respect to the upper manifold joint 226 while suppressing friction between the first ridge outer surface 233a and the second core 102 during the pulling process.

As described above, even when the first swirl vane 232 and the first ridge portion 233 are provided on the inner peripheral surface of the joint body 237, the upper manifold joint 226 can be easily manufactured by injection molding.

[0080]

The first ridge inner surface 233b is inclined such that, as going upward, the first ridge inner surface 233b gradually inclines toward the first side D1. Therefore, when the upper manifold joint 226 is manufactured by injection molding, the first ridge inner surface 233b can be formed by the first core 101 that is pulled upward with respect to the upper manifold joint 226 while suppressing friction between the first ridge inner surface 233b and the first core 101 during the pulling process.

The inner surface portion 231a of the vane support portion 231 is inclined such that, as going upward, the inner surface portion 231a gradually extends toward a radial outer side. Accordingly, when the upper manifold joint 226 is manufactured by injection molding, the inner surface portion 231a can be formed by the first core 101 that is pulled upward with respect to the upper manifold joint 226 while suppressing friction between the inner surface portion 231a and the first core 101 during the pulling process.

[0081]

As in an upper manifold joint 226A of a first modification example shown in FIGs. 29 and 30, a flow-straightening member 250 may be provided at a peripheral edge portion of the opening 227a of the upper joint body 227. The flow-straightening member 250 is arranged at an upper part of the peripheral edge portion of the opening 227a of the upper joint body 227. The flow-straightening member 250 projects from this peripheral edge portion toward a radial inner side. The flow-straightening member 250 is curved so as to be convex in a direction between an upper side and a radial inner side.

In the upper manifold joint 226A of the first modification example configured as described above, drainage that strikes the flow-straightening member 250 from above the flow-straightening member 250 flows down in a divided manner, for example, as indicated by arrows A1 and A2, by means of the flow-straightening member 250.

Accordingly, it is possible to prevent the opening 227a of the upper joint body 227 from being blocked by a water film of the drainage.

[0082]

As described above, the first swirl vane 232 may be provided with the reinforcing rib 236. When the first swirl vane 232 is provided with the reinforcing rib 236, it is possible to suppress vibration of the first swirl vane 232 that occurs when drainage strikes the first swirl vane 232. Therefore, it is possible to suppress occurrence of noise caused by vibration of the first swirl vane 232 and reduce noise.

In addition, when the reinforcing rib 236 is provided in parallel with the axis O1, it is possible to make a structure in which the second core 102 can be easily withdrawn even when the reinforcing rib 236 is formed. Moreover, when the reinforcing rib 236 has a draft angle, it becomes even easier to withdraw the second core 102. Accordingly, it is possible to easily manufacture the upper manifold joint 226 by injection molding.

[0083]

(Fourth Embodiment)

Next, a fourth embodiment of the present invention will be described with reference to FIGs. 31 to 33. In this description, the same reference numerals are given to the same parts as those in the above embodiments and their explanation is omitted, and
 5 only the differences will be described.

As shown in FIGs. 31 and 32, an upper manifold joint 256 of the present embodiment includes a vane support portion 231A, a first ridge portion 233A, and a second ridge portion 234A instead of the vane support portion 231, the first ridge portion 233, and the second ridge portion 234 of the upper manifold joint 226 of the third embodiment.

10 The upper joint body 227 and the vane support portion 231A together constitute a joint body 237A. In FIG. 32, a mold 105, which will be described later, is also shown.

[0084]

In the respective configurations of the vane support portion 231, the vane support portion 231A has an inner surface portion 231aA instead of the inner surface portion 231a.

15 The inner surface portion 231aA is parallel to the axis O1.

In the respective configurations of the first ridge portion 233, the first ridge portion 233A has a first ridge inner surface 233bA instead of the first ridge inner surface 233b. The first ridge inner surface 233bA is parallel to the axis O1.

In the respective configurations of the second ridge portion 234, the second ridge
 20 portion 234A has a second ridge inner surface 234bA instead of the second ridge inner surface 234b. The second ridge inner surface 234bA is parallel to the axis O1.

The ridge inner surfaces 233bA and 234bA gradually move away from each other as they go in a direction of an arrow A5 along one of directions toward a radial inner side.

A direction indicated by the arrow A5 is a direction that intersects directions in which the

25 inner surfaces 233bA and 234bA face.

[0085]

Next, a method for manufacturing the upper manifold joint 256 configured as described above will be described.

As shown in FIGs. 32 and 33, the upper manifold joint 256 is manufactured by a mold 105 including a first core 106, a second core 107, a third core (slide core) 108, and a cavity (not shown).

The first core 106 forms the locking portion 228 and the vertical pipe connection portion 229 in the upper manifold joint 256 and is pulled upward with respect to the upper manifold joint 256.

The second core 107 forms an inner peripheral surface and the like in a portion where the first swirl vane 232 and the ridge portions 233A and 234A are arranged along the direction of the axis O1 and which faces the first swirl vane 232 and the ridge portions 233A and 234A across the axis O1, and is pulled downward with respect to the upper manifold joint 256.

The third core 108 forms the first swirl vane 232, the ridge portions 233A and 234A, and the like. After the second core 107 has been pulled downward with respect to the upper manifold joint 256 to some extent, the third core 108 is first moved in the direction indicated by the arrow A5 with respect to the upper manifold joint 256 and is then pulled upward.

[0086]

In this process, the first core 106 may be previously pulled upward with respect to the upper manifold joint 256 to some extent, or after the third core 108 is moved in the direction indicated by the arrow A5, the first core 106 may be pulled upward together with the third core 108 with respect to the upper manifold joint 256.

Further, after the second core 107 has been pulled downward with respect to the

upper manifold joint 256 to some extent, the second core 107 may be once moved in the direction indicated by the arrow A5 with respect to the upper manifold joint 256 and then pulled downward.

[0087]

5 As described above, in the upper manifold joint 256 of the present embodiment, even when the first swirl vane 232 and the first ridge portion 233A are provided on the inner peripheral surface of the joint body 237A, the upper manifold joint 256 can be easily manufactured by injection molding.

 Furthermore, the first ridge inner surface 233bA is parallel to the axis O1.
10 Therefore, when the upper manifold joint 256 is manufactured by injection molding, the first ridge inner surface 233bA can be formed by the third core 108 that is pulled in the direction indicated by the arrow A5 with respect to the upper manifold joint 256 while suppressing friction between the first ridge inner surface 233bA and the third core 108 during the pulling process.

15 The inner surface portion 231aA is parallel to the axis O1. Accordingly, when the upper manifold joint 256 is manufactured by injection molding, the inner surface portion 231aA can be formed by the third core 108 that is pulled in the direction indicated by the arrow A5 with respect to the upper manifold joint 256 while suppressing friction between the inner surface portion 231aA and the third core 108 during the pulling process.

20 [0088]

 Although the third and fourth embodiments of the present invention have been described in detail above with reference to the drawings, specific configurations are not limited to these embodiments, and modifications, combinations, deletions, and the like of the configurations within a range not departing from the gist of the present invention are
25 also included. Furthermore, it goes without saying that the respective configurations

shown in the embodiments can be used in appropriate combinations.

For example, in the third and fourth embodiments, the upper manifold joints 226, 226A, and 256 may not have the second ridge portion 234.

The joint bodies 237 and 237A may not have the locking portion 228 and the vane
5 support portion 231. That is, the joint body may be constituted only by the upper joint body 227.

In addition, the joint bodies 237 and 237A may have an outer layer composed of a fiber mortar layer on outer peripheral surfaces.

[0089]

10 In addition, a member (fireproof material) including a heat-expandable material (not shown) may be provided on an outer surface or an inner surface of a portion, among a lower portion of the upper joint body 227 and the lower joint body 242, that is located in a floor slab through-hole. For example, a heat-expandable sheet containing expandable graphite may be wound around an outer surface of the upper joint body 227 positioned
15 below the horizontal pipe connection portion 230, an outer surface of the connecting portion 243 positioned above the lower joint body 242, or an outer surface of the lower joint body 242, or an intermediate pipe or an intermediate joint (not shown) connecting the upper joint body 227 and the lower joint body 242 may contain a heat-expandable material such as expandable graphite. The fireproof material may be provided on an outer surface
20 or an inner surface of any one of a lower end of the upper manifold joint 226, an upper end of the lower manifold joint 241, and an outer surface of the lower joint body 242 of the lower manifold joint 241 (a reduced-diameter portion that is reduced in diameter in a tapered shape in the illustrated example).

[0090]

25 Further, in order to suppress drainage noise generated when drainage strikes the

first swirl vane 232 provided in the upper joint body 227 and vibration of the upper joint body 227, it is preferable that a damping material (not shown) is provided on an outer surface of the upper joint body 227.

Examples of the damping material include rubber such as butyl rubber and
5 elastomers, and the damping material may be molded into a sheet shape so as to be wound around an outer peripheral surface of the upper joint body 227, or may be in a putty form.

The damping material may be provided on a portion of the outer peripheral surface of the upper joint body 227 on a lower side than the horizontal pipe connection portion 230, or on a side surface of the upper joint body 227 where the horizontal pipe connection
10 portion 230 is not provided, for example, on the recess 227b.

[0091]

In the manifold joint unit 225 of the third embodiment shown in FIG. 21, it is preferable that the second swirl vane 244 is located inside the floor slab through-hole. Thereby, even when drainage strikes the second swirl vane 244, sound is less likely to be
15 generated (sound is less likely to be transmitted to the surroundings).

From such a viewpoint, it is preferable that the second swirl vane 244 is located below the horizontal pipe connection portion 230 in the manifold joint unit 225. In the illustrated example, the second swirl vane 244 is provided in the lower manifold joint 241.

Meanwhile, the lower manifold joint 241 (the lower joint body 242) has a shape
20 in which, as a whole, the diameter is reduced from an upper side toward a lower side, and when a projection such as the second swirl vane 244 is provided in the lower manifold joint 241, it becomes difficult to perform injection molding. Further, in a case where the second swirl vane 244 is provided in the lower manifold joint 241, as described above, when a fireproof material including a heat-expandable material is arranged on an outer
25 surface or an inner surface of a portion located in the floor slab through-hole, there is a

possibility that the second swirl vane 244 and the fireproof material interfere with each other, thereby imposing restrictions on installation of the fireproof material.

Furthermore, when the floor slab is thin, the second swirl vane 244 provided in the lower manifold joint 241 may be located below the floor slab (a ceiling slab as viewed from a lower floor). In this case, when drainage strikes the second swirl vane 244, sound is generated. From the viewpoint of minimizing unnecessary space under the floor on an upper floor, the following can be said. In the manifold joint unit 225, it is preferable that, for example, a portion of the upper manifold joint 226 located directly below the horizontal pipe connection portion 230 is located in the floor slab through-hole so that the horizontal pipe connection portion 230 is arranged as close as possible to an upper surface of the floor slab.

[0092]

Accordingly, as a second modification example of the upper manifold joint 226 according to the third embodiment, an upper manifold joint 226B as shown in FIG. 38 may be adopted.

In this upper manifold joint 226B, the first swirl vane 232 is located below the horizontal pipe connection portion 230. In the illustrated example, the entirety of the first swirl vane 232 (an upper end of the first swirl vane 232) is located below the horizontal pipe connection portion 230; however, at least a lower end (at least a part) of the first swirl vane 232 may be located below the horizontal pipe connection portion 230. By locating the first swirl vane 232 below the horizontal pipe connection portion 230, drainage flowing in from the horizontal pipe connection portion 230 is less likely to be hindered by the first swirl vane 232.

[0093]

On the other hand, by adopting such an upper manifold joint 226B, in a lower

manifold joint 241B, the second swirl vane 244 is not provided. In the illustrated example, a distance in the vertical direction between the first swirl vane 232 and the lower manifold joint 241B is, for example, shorter than a distance in the vertical direction between the first swirl vane 232 and the vertical pipe connection portion 229, and the first swirl vane 232 and the lower manifold joint 241B are close to each other.

Thus, by bringing the first swirl vane 232 close to the lower manifold joint 241B, a swirling flow generated when drainage strikes the first swirl vane 232 is maintained even inside the lower manifold joint 241B. Therefore, even when the second swirl vane 244 is not provided, as in the lower manifold joint 241B shown in FIG. 38, drainage is less likely to become clogged inside the lower manifold joint 241B. As described above, since the lower manifold joint 241B has a shape in which, as a whole, the diameter is reduced from an upper side toward a lower side, if no swirling flow is generated in the lower manifold joint 241B, drainage is likely to become clogged, and there is a possibility that pressure fluctuation due to drainage clogging occurs.

By omitting the second swirl vane 244, it is possible to eliminate concerns about sound caused by the second swirl vane 244 and problems of moldability. Regarding concerns about sound, there may also be concerns about sound caused by the first swirl vane 232 (generation of noise due to drainage striking the first swirl vane 232 and causing vibration); however, since the first swirl vane 232 is located below the horizontal pipe connection portion 230, the first swirl vane 232 is more easily arranged inside the floor slab through-hole. As a result, even when drainage strikes the first swirl vane 232, sound is less likely to be generated.

Furthermore, by omitting the second swirl vane 244, when a fireproof material including a heat-expandable material is arranged on an outer surface or an inner surface of the lower manifold joint 241B, it is possible to quickly expand the material in the event of

a fire and close a pipeline.

[0094]

Similarly to the third embodiment, a recess 227b recessed toward a radial inner side may be provided; however, since the first swirl vane 232 is arranged inside the floor slab through-hole, the recess 227b is also arranged inside the floor slab through-hole, and therefore there is a possibility that the recess 227b cannot be buried with mortar when mortar is placed to fill a gap between the manifold joint unit 225 and the floor slab through-hole.

Accordingly, unlike the third embodiment, the recess 227b may be omitted, and the recess 227b may be filled with a filler such as a fireproof putty containing a heat-expandable fireproof material or a damping material having a vibration-preventing effect so that no recess is present on the outer peripheral surface of the upper joint body 227, or the outer peripheral surface of the upper joint body 227 including the recess 227b may be covered in advance with a soundproof cover and then arranged in the floor slab through-hole.

[0095]

Meanwhile, conventionally, in order to silence drainage when it flows through a manifold joint, it has been studied to manufacture a joint body and a first swirl vane as an integrated component. Furthermore, in order to silence the manifold joint, it has been studied to provide, on an inner peripheral surface of the joint body above the first swirl vane, a ridge portion that extends along an axial direction, thereby increasing rigidity of the first swirl vane.

However, when the joint body, the first swirl vane, and the ridge portion are integrated and manufactured by injection molding, an undercut portion or the like that requires a slider in a mold is formed in the manifold joint during its manufacturing. As

a result, manufacture of the manifold joint may prove difficult.

[0096]

The third and fourth embodiments described above have been made in view of such problems and are intended, for example, to provide a manifold joint that can be easily
5 manufactured by injection molding even when a swirl vane and a ridge portion are provided on an inner peripheral surface of a joint body.

[0097]

(Addendum 2)

The third and fourth embodiments described above can be understood, for
10 example, as follows.

(1) According to a first aspect of the present invention, there is provided a manifold joint including: a joint body arranged such that its own axis extends along a vertical direction; a swirl vane provided on an inner peripheral surface of the joint body; and a ridge portion provided on the inner peripheral surface of the joint body above the swirl
15 vane and extending along the axial direction, wherein the ridge portion is arranged, when viewed along the axial direction, at a position corresponding to an end portion on a first side in a circumferential direction of the swirl vane, a ridge outer surface of the ridge portion facing the first side in the circumferential direction is inclined such that, as going downward, the ridge outer surface gradually inclines toward a second side in the
20 circumferential direction, and the joint body, the swirl vane, and the ridge portion are integrally formed.

[0098]

In this invention, the manifold joint is manufactured such that the joint body, the swirl vane, and the ridge portion are integrally formed by injection molding. For example,
25 drainage that flows into the joint body strikes the swirl vane. This drainage can be made

to flow downward inside the joint body while swirling around the axis by the swirl vane. Then, generation of sound and vibration from the swirl vane due to the drainage can be suppressed by the ridge portion.

The ridge portion is arranged, when viewed along the axial direction, at a position
5 corresponding to an end portion on the first side in the circumferential direction of the swirl vane, and the ridge outer surface of the ridge portion is inclined such that, as going downward, the ridge outer surface gradually inclines toward the second side in the circumferential direction. Therefore, when the manifold joint is manufactured by injection molding, the ridge outer surface can be formed by a core that is pulled downward
10 with respect to the manifold joint while suppressing friction between the ridge outer surface and the core during the pulling process.

As described above, even when the swirl vane and the ridge portion are provided on the inner peripheral surface of the joint body, the manifold joint can be easily manufactured by injection molding.

15 [0099]

(2) According to a second aspect of the present invention, the manifold joint according to (1) may have a configuration in which a ridge inner surface of the ridge portion facing the second side in the circumferential direction is inclined such that, as going upward, the ridge inner surface gradually inclines toward the first side in the
20 circumferential direction.

In this invention, when the manifold joint is manufactured by injection molding, the ridge inner surface can be formed by a core that is pulled upward with respect to the manifold joint while suppressing friction between the ridge inner surface and the core during the pulling process.

25 [0100]

(3) According to a third aspect of the present invention, the manifold joint according to (1) or (2) may have a configuration in which an inner surface portion of a part of an inner surface of the joint body located above the swirl vane is inclined such that, as going upward, the inner surface portion gradually extends toward a radial outer side.

5 In this invention, when the manifold joint is manufactured by injection molding, the inner surface portion can be formed by a core that is pulled upward with respect to the manifold joint while suppressing friction between the inner surface portion and the core during the pulling process.

[0101]

10 (4) According to a fourth aspect of the present invention, the manifold joint according to (1) may have a configuration in which a ridge inner surface of the ridge portion facing the second side in the circumferential direction is parallel to the axis.

In this invention, when the manifold joint is manufactured by injection molding, the ridge inner surface can be formed by a core that is pulled in a direction intersecting a direction
15 in which the ridge inner surface faces, with respect to the manifold joint, while suppressing friction between the ridge inner surface and the core during the pulling process.

[0102]

(5) According to a fifth aspect of the present invention, the manifold joint according to (1) or (4) may have a configuration in which an inner surface portion of a part of an
20 inner surface of the joint body located above the swirl vane is parallel to the axis.

In this invention, when the manifold joint is manufactured by injection molding, the inner surface portion can be formed by a core that is pulled in a direction intersecting a direction in which the inner surface portion faces, with respect to the manifold joint, while suppressing friction between the inner surface portion and the core during the pulling
25 process.

[Industrial Applicability]

[0103]

The present invention can provide a manifold joint which can be easily manufactured by injection molding even when a swirl vane is provided on an inner
 5 peripheral surface of the joint body. Therefore, the present invention has industrial applicability.

EXPLANATION OF REFERENCE NUMERALS

[0104]

25 to 25F, 55: Manifold joint

10 27b1, 27b2, 27b3, 27b4: Inner surface

27b1: First inner surface

27b2, 27b2A: Second inner surface

27b3: Third inner surface

27b4: Fourth inner surface

15 28, 230: Horizontal pipe connection

28a: Opening

30: Swirl vane

231a, 231aA: Inner surface

233A, 234A: Ridge portion

20 233bA, 234bA: Inner surface of ridge portion

D1: First side

D2: Second side

CLAIMS

[Claim 1]

A manifold joint comprising:

a joint body arranged to have its axis (first axis) extend along a vertical direction;

5 a horizontal pipe connection portion provided on an outer peripheral surface of the joint body; and

a swirl vane provided on an inner peripheral surface of the joint body so as to at least partially overlap an opening of the horizontal pipe connection portion in a direction of the first axis;

10 the inner peripheral surface having:

a first inner surface that is inclined so as to approach the first axis in a gradual manner from an upper position toward a lower position in the first inner surface; and

a second inner surface disposed below the swirl vane,

15 wherein at least a portion of the joint body where the swirl vane is provided, the horizontal pipe connection portion, and the swirl vane are integrally formed.

[Claim 2]

The manifold joint according to claim 1, wherein the inner peripheral surface has a third inner surface that is inclined so as to move away from an axis (second axis) of the horizontal pipe connection portion in a gradual manner as a position in the inner peripheral surface approaches the horizontal pipe connection portion.

20

[Claim 3]

The manifold joint according to claim 1 or 2, wherein the second inner surface is inclined radially outward in a gradual manner from an upper position toward a lower position in the second inner surface.

25 [Claim 4]

The manifold joint according to claim 1 or 2, wherein the inner peripheral surface has a fourth inner surface formed so as to be continuous with the first inner surface and the second inner surface,

wherein the fourth inner surface is inclined radially outward in a gradual manner
5 from a lower position toward an upper position in the fourth inner surface.

[Claim 5]

The manifold joint according to claim 3, wherein a recess is provided on the outer peripheral surface,

wherein the recess is formed on at least a portion of a radially outer side of the
10 second inner surface.

[Claim 6]

The manifold joint according to claim 1 or 2, which further comprises a ridge portion provided on the inner peripheral surface at a position above the swirl vane so as to extend along the direction of the first axis;

15 wherein when viewed along the direction of the first axis, the ridge portion is disposed at a position corresponding to an end of the swirl vane at a first side in its circumferential direction,

an outer surface of the ridge portion facing the first side in the circumferential direction is inclined toward a second side in the circumferential direction in a gradual
20 manner from an upper position toward a lower position in the outer surface of the ridge portion, and

the joint body, the swirl vane, and the ridge portion are integrally formed.

[Claim 7]

The manifold joint according to claim 6, wherein an inner surface of the ridge
25 portion facing the second side in the circumferential direction is inclined toward the first

side in the circumferential direction in a gradual manner from a lower position toward an upper position in the inner surface of the ridge portion.

[Claim 8]

5 The manifold joint according to claim 6, wherein the inner surface of the joint body at its position above the swirl vane is inclined radially outward in a gradual manner from a lower position toward an upper position in the inner surface of the joint body.

[Claim 9]

The manifold joint according to claim 6, wherein an inner surface of the ridge portion facing the second side in the circumferential direction is parallel to the first axis.

10 [Claim 10]

The manifold joint according to claim 6, wherein the inner surface of the joint body at its position above the swirl vane is parallel to the first axis.