[CLAIMS]

[Claim 1]

A pipe connection device for connecting facing end portions of two pipes to each other, the pipe connection device comprising:

an outer body into which an end portion of a first pipe is inserted from a rear side and an end portion of a second pipe is inserted from a front side; and

a swage ring which surrounds, contacts, and presses an outer circumference of the outer body,

wherein the contact and pressing of the swage ring are performed with respect to a middle portion except for a rear introducing portion which contacts the swage ring only upon introduction of the swage ring and a front end portion which does not contact the swage ring in the outer body, and

an initial inner diameter of the swage ring before swaging is smaller than an initial outer diameter of the outer body before the swaging,

by the swaging of the swage ring which deforms the middle portion in a direction of decreasing the outer diameter, the outer diameter of the front end portion is relatively larger than that of the middle portion and a front tapered portion is formed at the front end portion of the inner circumferential surface of the swage ring, so as to come into contact with a part of the outer circumferential surface of the front end portion, and

by the outer diameter relatively larger than the middle portion and the frictional resistance due to the contact with the front tapered portion, the front end portion is in the role of a limiting jaw to prevent a forward detachment of the swage ring.

[Claim 2]

The pipe connection device of claim 1, wherein the rear introducing portion is deformed by the swage ring, and then at least a portion of the rear introducing portion is restored after the swage ring passes, or at least a portion of an outer circumferential surface side thereof is pulled forward according to a movement of the swage ring to have the outer diameter relatively larger than that of the middle portion and prevents a backward detachment of the swage ring by the outer diameter relatively larger than the middle portion.

[Claim 3]

The pipe connection device of claim 1, wherein the rear introducing portion has an annular groove formed on an inner circumferential surface thereof and an outer circumferential surface portion corresponding to the groove has a bead formed to convexly protrude outward to have a larger outer diameter than the middle portion.

[Claim 4]

The pipe connection device of claim 3, wherein when the axial compressive force is applied to the rear introduction portion, a deformation of which the length is shortened and the outer diameter is increased is induced to the rear introduction portion by the groove, so that the bead is formed.

[Claim 5]

The pipe connection device of claim 4, further comprising:

a fastening tool which is removed after fastening the swage ring to the intermediate portion such that the swage ring surrounds and swages the middle portion,

wherein the fastening tool includes a rear support unit coming into contact with a rear end surface of the swage ring, a front support unit coming into contact with a front end surface of the front end portion of the outer body, and a driving unit which provides

an axial compressive force by a driving force and the driving force by which the rear support unit relatively moves to the front support unit side so that the swage ring moves from the rear side of the outer body to a position surrounding the middle portion.

[Claim 6]

The pipe connection device of claim 5, wherein the rear support unit has a first ring contact circumferential surface coming into contact with the rear end surface of the swage ring, and a first body contact recessed surface formed to be recessed backward ahead of the first ring contact circumferential surface by a first step and coming into contact with the rear end surface of the rear introducing portion of the outer body,

the front support unit has a second ring contact circumferential surface coming into contact with the front end surface of the swage ring, and a second body contact recessed surface formed to be recessed forward ahead of the second ring contact circumferential surface by a second step and coming into contact with the front end surface of the front end portion of the outer body,

the second step is set to correspond to the length of the front end portion, and

the first step is set to correspond to the length of the rear introducing portion shorter than that before the formation of the bead while the bead is formed.

[Claim 7]

The pipe connection device of claim 3, wherein the rear introducing portion includes a rear end portion of which an outer diameter size is less than a outer diameter size of the middle portion and equal to or larger than an inner diameter size of the swage ring and an inclined connection portion obliquely connecting the rear end portion and the middle portion.

[Claim 8]

The pipe connection device of claim 1, wherein an inner circumferential surface of the middle portion has an inner protrusion which comes into contact with the first pipe and the second pipe during swaging of the swage ring, and

the inner protrusion includes a sealing-type protrusion which seals between the middle portion and the first pipe or between the middle portion and the second pipe and resists an axial force applied to the first pipe or the second pipe.

[Claim 9]

The pipe connection device of claim 8, wherein the inner protrusion further includes a torsion resistant protrusion that resists torsion acting on the first pipe or the second pipe.

[Claim 10]

The pipe connection device of claim 8, wherein the sealing-type protrusion is a lattice-type protrusion in which if there is a defect on an outer circumferential surface of the first pipe or the second pipe, lattices adjacent to the defect form a closed space of a local area and are repeatedly arranged in a circumferential direction on an inner circumferential surface of the middle portion so as to resist torsion together.

[Claim 11]

The pipe connection device of claim 1, wherein an inner circumferential surface of the middle portion corresponding to a center of the outer body has a stopper which limits forward movement of the first pipe and limits backward movement of the second pipe.

[Claim 12]

The pipe connection device of claim 1, wherein an inner circumferential surface of the swage ring is formed so that a middle portion thereof has a constant inner diameter,

and a rear tapered portion is formed at the rear end portion thereof.

[Claim 13]

The pipe connection device of claim 1, wherein a minimum thickness of the middle portion of the outer body is set to be larger than a larger value of a half of the difference between a maximum outer diameter and a minimum outer diameter of the pipe in consideration of a tolerance of the pipe and a minimum thickness of the pipe, and

the pipe is the first pipe or the second pipe.

[Claim 14]

The pipe connection device of claim 1, wherein a minimum thickness of the middle portion of the outer body is larger than a thickness of the first pipe and a thickness of the second pipe to have a strength that exceeds a strength of the first pipe and a strength of the second pipe.

[Claim 15]

The pipe connection device of claim 1, wherein a minimum thickness of the swage ring is larger than a value obtained by adding a maximum thickness before plastic deformation of the first pipe or the second pipe and a maximum thickness before plastic deformation of the middle portion of the outer body.

[Claim 16]

The pipe connection device of claim 1, further comprising:

an insert ring provided longer than the outer body to be disposed at a position including a length section of the outer body of insides of the first pipe and the second pipe,

wherein the insert ring supports inner circumferential surfaces of the first pipe and the second pipe when swaging the swage ring.

[Claim 17]

The pipe connection device of claim 16, wherein an outer circumferential surface of the insert ring has an outer protrusion which comes into contact with the first pipe and the second pipe during the swaging of the swage ring, and

the outer protrusion includes a sealing-type protrusion which seals between the insert ring and the first pipe or between the insert ring and the second pipe and resists an axial force applied to the first pipe or the second pipe.

[Claim 18]

The pipe connection device of claim 17, wherein the outer protrusion further includes a torsion resistant protrusion that resists torsion acting on the first pipe or the second pipe.

[Claim 19]

The pipe connection device of claim 18, wherein the torsion resistant protrusion is provided to partially protrude from the outer circumferential surface of the insert ring to a front and rear of the outer body.

[Claim 20]

The pipe connection device of claim 17, wherein the sealing-type protrusion is a lattice-type protrusion in which if there is a defect on the inner circumferential surface of the first pipe or the second pipe, lattices adjacent to the defect form a closed space of a local area and are repeatedly arranged in a circumferential direction on the outer circumferential surface of the insert ring so as to resist torsion together.