

PIPE JOINT CONSTRUCTION

This invention relates to a pipe joint construction.

Conventionally, a pipe joint, in which a male screw portion of a retainer is screwed to a female screw portion of a joint main body to make outer peak portions of plural small discs, protruding from an inner peripheral face of the retainer, bite into a peripheral face of a pipe as to prevent the pipe from being drawn in an axis direction, is known (refer to Japanese Patent No. 3122385).

However, in the pipe joint disclosed by Japanese Patent No. 3122385, very high fastening force is required to screw the retainer to the joint main body because the small discs are made biting spirally around the peripheral face of the pipe and biting gradually deeper, and working efficiency is made worse thereby. Further, the pipe joint may be drawn out of the pipe leaving scratch in longitudinal direction on the peripheral face of the pipe, or the pipe may be drawn off by breaking of the small discs when strong drawing force works on the pipe after connection completed because the several small discs, biting into the peripheral face of the pipe, stop drawing of the pipe.

Therefore, it is an object of the present invention to provide a pipe joint construction with which strong force is not required, connection is possible with fastening by small force, connecting work can be easily and

swiftly conducted, and, dropping doesn't occur even with strong drawing force loaded on the pipe for certain and strong connection.

The present invention will be described with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional side view showing an embodiment of the present invention;

Figure 2 is a perspective exploded view;

Figures 3A through 3D are perspective views for serial explanation of connecting work of the present invention;

Figure 4A is a cross-sectional entire view showing a state before an insertion member is pushed in;

Figure 4B is an enlarged cross-sectional view of a principal portion showing the state before the insertion member is pushed in;

Figure 4C is an enlarged cross-sectional view of another principal portion showing the state before the insertion member is pushed in;

Figure 5A is an enlarged cross-sectional view of a principal portion showing another cross section before the insertion member is pushed in;

Figure 5B is an enlarged cross-sectional view of the principal portion showing the other cross section of connection completed state;

Figure 6A is an enlarged cross-sectional view of a

principal portion showing another embodiment of the present invention before the insertion member is pushed in;

Figure 6B is an enlarged cross-sectional view of the principal portion showing the other embodiment of the present invention of connection completed state;

Figure 7 is a side view to explain a working tool and working method for forming a convex ridge on a thin metal pipe;

Figure 8 is a side view to explain a working tool and working method for forming a convex ridge intermittently on the thin metal pipe in a peripheral direction;

Figure 9 is a side view to explain the working tool and working method for forming the convex ridge intermittently on the thin metal pipe in the peripheral direction;

Figure 10A is a front view of a principal portion corresponding to figure 8;

Figure 10B is a front view of a principal portion corresponding to figure 9;

Figure 11 is a front view of a metal pipe on which a plastic-worked convex ridge is intermittently formed in the peripheral direction;

Figure 12A is a cross-sectional view of a principal portion showing a still another embodiment of the present invention;

Figure 12B is an enlarged cross-sectional view of a Z portion showing the still another embodiment of the present

invention;

Figure 13 is an enlarged cross-sectional view of a principal portion showing a state just before connection;

Figure 14A is a perspective view showing a principal portion of a joint main body;

Figure 14B is a front view showing the principal portion of the joint main body;

Figure 14C is a cross-sectional view along (a-0-a) of figure 14B showing the principal portion of the joint main body;

Figure 15A is a front view showing a press-holding ring;

Figure 15B is a rear view showing the press-holding ring;

Figure 15C is a cross-sectional view along (b-0-b) of figure 15A showing the press-holding ring;

Figure 16A is a front view showing an insertion member;

Figure 16B is a view of figure 16A observed in an arrow b direction showing the insertion member;

Figure 16C is a view of figure 16A observed in an arrow c direction showing the insertion member;

Figure 17 is a cross-sectional view to explain a method for plastic work of the convex ridge on the metal pipe;

Figure 18 is a schematic explanatory view to explain working process to connect the metal pipe with the joint;

and

Figures 19A through 19C are cross-sectional views to explain concrete configurations of the plastic-worked convex ridge.

Preferred embodiments of the present invention will now be described with reference to the accompanying drawings.

In an embodiment shown in figure 1 through figure 5B, a mark 4 represents a thin metal pipe on which a plastic-worked convex ridge 9 is protruding (formed) on a predetermined dimensional position from a forth end 4a.

A pipe joint construction relating to the present invention is provided with a joint main body 10 to which the thin metal pipe 4 is inserted, and a press-holding ring 3 attached as to be mounted to the joint main body 10.

The thin metal pipe 4 (simply called the pipe 4 in some cases below) is, for example, a stainless steel pipe defined by JIS G3448 mainly used for piping of water supply, drainage, etc.

The relationship of an outer diameter D of the thin metal pipe 4 and a thickness dimension t is shown in Table 1. In the thin metal pipe 4, it is preferable to set the outer diameter D to be 10mm to 65mm, and the thickness dimension t to be 1.0mm to 1.6mm.

TABLE 1

Outer Diameter D(mm)	Thickness Dimension t(mm)
9.52	0.7
12.70	0.8
15.88	0.8
22.22	1.0
28.58	1.0
34.00	1.2
42.70	1.2
48.60	1.2
60.50	1.5
76.30	1.5

The plastic-worked convex ridge 9 of the thin metal pipe 4 is intermittently protruding in a peripheral direction (refer to figure 11), or, protruding for entire periphery (360°). The convex ridge 9 is triangular as shown in figure 19A, triangular with round top shown in figure 19B, or round hill shape shown in figure 19C.

And, a hitching means 100 is disposed on an end peripheral portion 10A of the joint main body 10 and an inner peripheral portion 3A of the press-holding ring 3 can be mutually hitched. That is to say, as shown in figures 3A through 3D, the end peripheral portion 10A of the joint main body 10 and the inner peripheral portion 3A of the

press-holding ring 3 mutually hitch by the hitching means 100 with (mutual) fitting by closing in axial direction of the press-holding ring 3 shown with an arrow N and a small angle rotation in radial direction shown with an arrow M to keep hitched state without separation of the press-holding ring 3 from the joint main body 10 in the axial direction.

Further, a mark 32 represents an insertion member. An inner peripheral outer end area 3B of the press-holding ring 3 and an inner peripheral end area 10B of the joint main body 10 are indirectly clamping the convex ridge 9 of the pipe 4 (in figures 1 through 5B) on outer and inner sides in the axial direction by the hitching means 100, and, the insertion member 32 is inserted to the press-holding ring 3 in an axial direction (shown with an arrow P in figure 3D) for stopping reverse rotation of the small angle rotation M to keep the clamping state by the hitching means 100. In other words, the insertion member 32 is a member for loosening prevention of the press-holding ring 3.

The outer end area 3B of the press-holding ring 3 is "indirectly" pressed (corresponding) to the convex ridge 9 of the metal pipe 4 from outside in the axial direction. Namely, the outer end area 3B corresponds (presses) to an outer sloped face 9A of the convex ridge 9 through a clamp ring 1 (made of soft metal, hard resin, etc.) having a tapered inner peripheral face 6.

Further, the end area 10B of the joint main body 10 is "indirectly" pressed (corresponding) to the convex

ridge 9 from inside in the axial direction. Namely, the end area 10B corresponds (presses) to an inner sloped face 9B of the convex ridge 9 through a clamp ring 2 of closed ring (made of hard resin, etc.) having a tapered inner peripheral face 7.

In the embodiment of figures 1 through 5B, the tapered inner peripheral faces 6 and 7 of the clamp rings 1 and 2 correspond to the outer sloped face 9A and the inner sloped face 9B of the convex ridge 9 to clamp and hold in connection completed state.

And, as shown in figures 5A and 5B, a large-diameter hole portion 86 is formed with a staged portion 85 on the end area 10B of the joint main body 10, and a seal member protection ring 14, a sealing member 12 (O-ring, etc.) and the clamp ring 2 are serially fit from an inner portion. It is preferable to preliminarily fit the three parts to the large-diameter hole portion 86 of the joint main body 10 in unconnected state. Therefore, the clamp rings 1 and 2, being small parts, are not disassembled (dropped) before the connection work to improve working efficiency.

Material of the clamp rings 1 and 2 is preferably soft metal such as copper, and heat-resistant hard resin such as PPS, PPSU, and PSU.

Next, the convex ridge 9 in the present invention is formed on the metal pipe 4 for entire periphery of 360° in one case, and intermittently protruding (divided) in

peripheral direction when observed in an axis L direction as shown in figure 11 in another case.

Although the convex ridge 9 is formed divided in 4 pieces in figure 11, the pieces may be reduced to 2 or 3, or increased to 5 to 8 (production method and working tool will be described with figures 8 through 10B later).

In the joint main body 10, the open-end large-diameter hole portion 86 is formed with the staged portion 85, and the sealing member protection ring 14 of flat washer is attached to an inner side of the large-diameter hole portion 86 as to contact the staged portion 85. Further, as described with figures 5A and 5B, the sealing member 12 such as an O-ring and a part of the clamp ring 2 are serially attached, the sealing member protection ring 14 is a ring to effectively prevent corrosion and degeneration of the sealing material 12 by ozone(active oxygen), chlorine, hydrogen, etc. mixed with sealed fluid (hot and cold water, etc.), and, the inner and outer peripheral edges of the sealing member protection ring 14 are tightly press-fit to the peripheral face of the (inserted) metal pipe 4 and the inner peripheral face of the large-diameter hole portion 86 to prevent direct contact of the sealed fluid with the sealing member 12.

The clamp ring 2 is preliminarily press-fit to the large-diameter hole portion 86 of the joint main body 10 (under unconnected state), and a concave peripheral groove portion 18, to hold the above-described protection ring 14

and the sealing member 12, is formed with the end face of the inner portion of the clamp ring 2, the staged portion 85, and the inner peripheral face of the large-diameter hole portion 86.

And, a middle diameter hole portion 38, slightly larger than the outer diameter D (refer to figure 4A) of the metal pipe 4, is formed on an inner side of the large-diameter hole portion 86. That is to say, the large diameter hole portion 86 and the middle diameter hole portion 38 are divided by the staged portion 85. And, a peripheral contact portion 15 is formed on the inner side of the middle diameter hole portion 38 to which the forth end 4a of the inserted metal pipe 4 contacts to be positioned, and a small diameter hole portion 39 is formed on an inner side of the peripheral contact portion 15.

The metal pipe 4 is jointed (connected) to the pipe joint by the peripheral contact portion 15 and the clamp ring 1 receiving pressing force F accompanying the attachment of the press-holding ring 3 as not to shear in the axial direction.

Next, another embodiment is shown in figures 6A and 6B. Although this pipe joint construction is provided with a joint main body 10 and a press-holding ring 3, and the press-holding ring 3 has a cap nut configuration having a tapered inner peripheral face 3C, diminishing in diameter toward an opening end side, on the outer end area 3B.

And, when the press-holding ring 3 is attached to

the joint main body 10 as shown in figures 6A and 6B, the tapered inner peripheral face 3C of the press-holding ring 3 is directly press-fit to the outer sloped face 9A of the convex ridge 9, and the tapered inner peripheral face 7 of the closed clamp ring 2 is press-fit to the inner sloped face 9B of the convex ridge 9 to clamp the convex ridge 9 of the metal pipe 4 on the axial inner and outer sides.

That is to say, the tapered inner peripheral face 3C formed on the outer end area 3B of the press-holding ring 3 directly corresponds to the outer sloped face 9A of the convex ridge 9 of the metal pipe 4.

Next, still another embodiment shown in figure 12A through 17 is described. The convex ridge 9, formed on the metal pipe 4 by plastic work, is round hill type of which top is large R-shaped (refer to figure 19C). And, the end area 10B of the joint main body 10 directly corresponds to the inner sloped face 9B of convex ridge 9 of the metal pipe 4. In figures, an inner peripheral corner portion 41 of the end area 10B of the joint main body 10 directly contacts a foot 40 of the inner sloped face 9B of the convex ridge 9 of low round mountain type (round hill type) of the metal pipe 4. As described above, the inner peripheral corner portion 41 of the joint main body 10 directly contacts the foot 40 on the inner sloped face of the convex ridge 9 by metal touch without the clamp ring 2 shown in figures 1 through 6B.

A sealing groove 42 is formed on the end area 10B

of the joint main body 10, and a sealing member 12 and a protection ring (flat washer) 14 are attached into the sealing groove 42. The above-mentioned inner peripheral corner portion 41 can directly correspond to (contact) the foot 40 with the presence of an outer side wall 42A of the sealing groove 42. The inner peripheral corner portion 41 may be sharp as in figures 12A, 12B, and 13, and, it is also preferable to form a small chamfer 43 as shown in figure 14C to reduce contact pressure to the foot 40. It can be said that the sealing groove 42 is formed on the middle diameter hole portion 38 of which inner portion is provided with the peripheral contact portion 15 to stop the forth end 4a of the inserted metal pipe 4 as not to be inserted deeper (inward).

Next, the above-mentioned hitching means 100 and relating constructions are described.

In figures 12A, 12B, 13, 14A through 14C, 2 through 5B, 6A, and 6B, plural arc outer ridge portions 19 and smooth arc bottom faces 20 are disposed on the end peripheral portion 10A of the joint main body 10 in turn. Further, each of the arc outer ridge portions 19 is composed of a pair of outer ridge single bodies 21 and 22, and a hitching groove portion 23 is formed between the pair of outer ridge single bodies 21 and 22.

On the other hand, plural arc inner protruding portions 30 are disposed on the inner peripheral portion 3A of the press-holding ring 3. The arc inner protruding

portion 30 can be freely hitched to the hitching groove portion 23 of the joint main body 10 side by "small angle" rotation in radial direction (refer to the arrow M). This "small angle" is about 45° in case that 4 arc inner protruding portions 30 are disposed with 90° pitch.

The arc inner protruding portions 30 and the hitching groove portions 23 may be 2, 3, or 6 respectively. In these cases, the "small angle" is about 90° , 60° , and 30° respectively.

And, an arc slit portion 25 is formed in the axial direction between neighboring inner protruding portions 30 in the press-holding ring 3.

The hitching means 100 is provided at least with the hitching groove portion 23 and the arc inner protruding portion 30.

Further concretely, the hitching means 100 is composed of the ridge portion 19, the smooth arc bottom face 20, the hitching groove portion 23, and the arc inner protruding portion 30.

Next, the insertion member 32 has a C-shaped base ring portion 33 as shown in figure 16A in one case, and has a closed base ring portion 33 as shown in figures 2 through 3D in another case. Plural protruding pieces 81, 82, 83, and 84 are protruding from the base ring portion 33.

In figure 16A, the protruding pieces 81 and 82, and the base ring portion 33 are formed as one unit of synthetic resin, two protruding pieces 81 disposed on

opposite positions for 180° are simply arc-shaped in cross section, and, the protruding piece 82, disposed on an opposite position of a notched portion 87 of the C-shaped base ring portion 33 for 180° , is divided into three, namely, a central piece 82A and left and right side pieces 82B. A hitching claw 88 is formed on a forth end of the side piece 82B. And, the small hitching claw 88 is protruding in peripheral direction as shown in figure 16B.

In the insertion member 32 shown in figures 2 through 3D, two protruding pieces 83 and two protruding pieces 84, of which lateral cross section is arc-shaped, are disposed on the closed base ring portion 33 with a pitch of 90° in peripheral direction. Each of the pair of protruding pieces 84 is formed with a hitching claw piece portion 88B as one unit with a U-shaped separation line.

And, the protruding pieces 81, 82, 83, and 84 of the insertion member 32 are inserted to the arc slit portion 25 of the press-holding ring 3 and to the smooth arc bottom face 20 of the joint main body 10. That is to say, when the press-holding ring 3 is rotated in the arrow M direction for the small angle as shown in figure 3C, the hitching means 100 is hitched, the arc slit portion 25 and the smooth arc bottom face 20 simultaneously become facing on the same position in peripheral direction, arc slits (gaps) are formed through the ring 3 when observed in the axial direction, and, the protruding pieces 81 and 82, or 83 and 84 are inserted to the through arc slits (gaps) as

shown in figures 3D, 5B, 6B, and 12A.

Further, the hitching claw piece portion 88B hitches to a part of the press-holding ring 3 as shown in figure 5B and figure 6B simultaneously with completion of the insertion of the protruding pieces 81, 82, 83, and 84 to the through arc slits (gaps), or, the hitching claw 88 (refer to figures 16B and 16C) hitches to a small concave portion 89 of the outer ridge single body 21 of the joint main body 10 to stop the insertion member 32.

As described above, reverse rotation (against the arrow M) of the press-holding ring 3 is stopped by the insertion of the insertion member 32 in the arrow P direction to keep the clamped state of the convex ridge 9 by the hitching means 100.

As a working tool for forming the convex ridge 9 (for the entire periphery of 360°) on the thin metal pipe 4, a convex forming tool 35 shown in figure 7 can be used. The convex ridge 9 can be easily formed by that a roller 34 with a small convex ridge is inserted to the metal pipe 4 and faced to a roller 98 with a concave peripheral groove, and the entire tool is rotated.

The working tool (convex forming tool 35) shown in figure 7 is appropriate to form the convex ridge 9 for 360° (the entire periphery). Instead of that, an intermittent convex ridge forming jig 55 can be used to intermittently form the convex ridge as shown in figure 11. That is to say, the convex ridge 9 is composed of 4 convex

portions 75 in peripheral direction. The jig 55 is independently invented by the inventors of the present invention. The construction and operation method (function) of the jig 55 is briefly described below.

A mark 56 represents a jig main body (working tool main body) to which a pair of pipe gripping arms 58 is pivoted with a shaft portion 57, and half-arc concave portions 58A are provided to form a pipe holding hole 59 in closed state. The above-described pipe holding hole 59 of 360° can be strongly kept by fastening means such as bolts and nuts not shown in figures. Further, a concave groove 60 (as a female die) to form the convex ridge 9 is formed in the holding hole 59. The forth end portion of the worked thin metal pipe 4 is inserted to the pipe holding hole 59 having the concave groove 60.

A mark 61 represents a guiding cylinder body composing a part of the jig main body and having a small cylinder portion 61A of which outer diameter dimension is slightly smaller than the inner diameter of the metal pipe 4 and a large cylinder portion 61B of which outer diameter dimension is slightly larger than that of the small cylinder portion 61A. A staged face portion 61C of the small cylinder portion 61A and the large cylinder portion 61B is a "contact face" to contact the forth end face of the worked metal pipe 4 for positioning.

And, the large cylinder portion 61B has a circular hole portion 62 opening leftward of figure 8 and

figure 9, and a small-diameter hole portion 64 opening on a bottom wall portion 63 on right side of figure 8 and figure 9 on the same axis. And, a tapered hole 65, gradually increasing in diameter from the bottom wall portion 63 to the small cylinder portion 61A toward the side of the pipe gripping arm 58 (called a forth end side), is formed through the guiding cylinder body 61 on the same axis with circular hole portion 62 and the small-diameter hole portion 64.

A movable shaft body 66 is inserted along the axis of the guiding cylinder body 61 as to freely reciprocate. The movable shaft body 66 is provided with a diameter-opening shaft 69 having a reverse-tapered cone shaft portion 67 gradually increasing in diameter toward the forth end and a bolt shaft portion 68, and a driving shaft portion 71 inserted to the circular hole portion 62 as to freely reciprocate and having a tapped hole 70. The bolt shaft portion 68 is screwed (connected) to the tapped hole 70 of the driving shaft portion 71 to reciprocate the bolt shaft portion 68 and the driving shaft portion 71 as one unit along the axis direction. The driving shaft portion 71 is connected to an oil-hydraulic cylinder or an electric driving mechanism (on the left side out of figure 8 and figure 9).

And, as shown in figures 8, 9, 10A, and 10B, 4 sector arc convex portion forming bodies 72 are mounted to the cone shaft portion 67. The arc convex portion forming

body 72, of which tapered inner face 72A contacts the cone shaft portion 67 as to freely slide, has a ridge portion 72B to intermittently form the convex ridge 9 on the metal pipe 4 as shown in figure 11.

That is to say, the ridge portion 72B of the arc convex portion forming body 72 as a male die in a state of figures 8 and 10A works from the inner face side of the metal pipe 4 against the concave groove 60 as a female die in arrow Y directions (radial directions) in figure 9 to plastically form the intermittent convex ridge 9 (as shown in figure 11), namely, 4 convex portions 75 when the diameter-opening shaft 69 is moved in an arrow Z direction as shown in figures 9 and 10B by the driving mechanism out of figures. In case that the convex ridge 9 is triangular, it is preferable to form a sufficiently sharp triangular concave portion (having a peak) on the inner face side of the metal pipe 4. Therefore, it is also preferable to make the ridge portion 72B of the arc convex portion forming body 72 triangular having a sharp peak. In case that the convex ridge 9 is round-top or round hill shape as in figures 19B and 19C, the ridge portion 72B is made round (R-shaped).

Although the plastic-worked convex ridge 9 is composed of 4 convex portions 75 in the description above on figures 8 through 11, the convex portions 75 may be decreased to 2 or 3, and increased to 5 through 9.

And, advantage of forming the convex ridge 9

intermittently composed of plural convex portions 75 is described. As shown in figure 11, each convex portion 75 has a three-dimensional configuration (shell construction) reducing the height on end portions 75A in peripheral direction when observed in the axis direction. The end portions 75A are hard to deform when loaded with outer force and having high rigidity to play a role to stop the deformation of the convex ridge 9 when drawing force works on the metal pipe 4 in the connection completed state in figures 1, 5B, 6B, 12A, and 12B, and anti-drawing force can be increased thereby.

Next, another method and jig to form the convex ridge 9 on the metal pipe 4 with plastic work are described with figure 17. An upper half on an axis L shows a state just before plastic work, and a lower half below the axis L shows the plastic work completed.

A linear reciprocating portion (not shown in figures) such as a rod of a linear reciprocating cylinder of hand pump, electric pump, etc., or a rod of an electric linear reciprocating actuator, is disposed on the left side out of figure 17, and a rod-shaped jig 45 is connected to the linear reciprocating portion.

A body 47, on which a hole portion 46 to which the forth end portion of the metal pipe 4 to be worked can be inserted for a small dimension, is provided.

The jig 45, on the forth end side, has a short column head portion 49, having an outer diameter dimension

to tightly fit to the inner portion of the metal pipe 4 with a staged face portion 48. The forth end 4a of the metal pipe 4 contacts a staged portion 47A of the body 47 to work. And, a mark 50 represents a spacer cylinder body, a mark 51 represents an elastic ring of rubber, etc. elastically deformable, the spacer cylinder body 50 and the elastic ring 51 are mounted to a small-diameter shaft 52 of the jig 45, and the elastic ring 51, receiving force in axial direction, is elastically deformed from the original short cylinder configuration to another configuration (below the axis L) to locally bulge the mounted metal pipe 4.

In figure 17, a part of the pipe joint construction itself is used as a female die 53 necessary to bulge (plastically deform) as described above. That is to say, the press-holding ring 3 shown in figures 15A through 15C is used.

Concretely, an outer ridge single body 22, a hitching groove portion 23, and a smooth arc bottom face 20 as shown in figures 13 and 14A are disposed on an outer face 54 of the end portion of the body 47. Therefore, the press-holding ring 3 as the female die 53 applied directly to the metal pipe 4 is hitched to the end portion outer face 54 of the body 47.

As shown in figure 17, although it is difficult to form the convex ridge 9 in the configurations as in figure 19C or 19B only with the female die 53, a small ridge

portion 76, slightly inserted to a straight spherical face 3D (continuing from the tapered inner peripheral face 3C) shown in figure 15C, and, a concave chamfer 46A on an opening end corner portion of the hole portion 46, are formed on the tip end of the body 47 to add to (cooperate with) the inner peripheral face 3C of the female die 53 (holding ring 3) to form a concave portion for female die corresponding to the triangular with R-shaped top as in figure 19B and the round hill shape as in figure 19C.

The peripheral face of the elastic ring 51 is elastically bulged by the movement of the jig 45 in arrow K direction from the upper half to the lower half of figure 17 by the actuator, etc. on the left side out of figure 17, and the convex ridge 9 can be locally formed on the metal pipe 4 (for the entire periphery of 360°) as shown with arrows P_{51} .

The press-holding ring 3 can be separated along with the metal pipe 4 by reverse rotation of small angle opposite to the above-mentioned arrow M because the configuration of the end peripheral portion 10A of the joint main body 10 shown in figures 14A, 14B, and 14C is formed on the end portion outer face 54 of the body 47. The jig 45, etc. are simultaneously separated from the metal pipe 4 to make the state of figure 13, and the connecting work can be conducted similar to the sequence explained with figures 3A through 3D, namely, the sequence of $3A \rightarrow 3B \rightarrow 3C \rightarrow 3D$, or the sequence of the arrows $N \rightarrow M \rightarrow P$.

According to the convex ridge forming apparatus and method shown in figure 17, the convex ridge 9 in the configuration of figure 19B or 19C can be easily and swiftly formed with high accuracy.

In the present invention, as shown in figures 3A through 3D and figure 18, after the metal pipe 4 is inserted to the joint main body 10, (i) the press-holding ring 3 is pushed in the arrow N direction (axial direction), then, (ii) the press-holding ring 3 is rotated in the arrow M direction for the small angle to switch to the clamped state by the hitching means 100, and (iii) the inserted member 32 is inserted along the arrow P direction to make the connection completed state easily and swiftly.

According to the present invention, strong anti-drawing force is shown by the convex ridge 9 formed on the metal pipe 4, and the outer end area 3B of the press-holding ring 3 and the end area 10B on the inner periphery of the joint main body 10 clamping the convex ridge 9 from the outer and inner side in the axial direction. The embodiment in figures 1 through 5B and figures 6A and 6B shows the construction in which the joint main body 10 and the metal pipe 4 make little or no micro movement relatively in the axial direction (the direction along the axis L) in the clamped state. This is ideologically preferable for strong anti-drawing force and high sealing ability.

However, in the other embodiment shown in figures

12A through 17, the convex ridge 9 is R-shaped on top portion (refer to figure 19B) or entirely round hill shape (refer to figure 19C), relative micro movement in the axial direction may be possible when the end area 10B on the inner periphery of the joint main body 10 directly contacts. Further, sealing ability is secured because the sealing member 12 is fit to the independent sealing groove 42 as shown in figure 12A and not influenced by the micro movement, and scratches are not generated on the metal pipe 4 and sufficiently strong anti-drawing force is shown because the tapered inner peripheral face 3C of the holding ring 3 is press-fit to the outer sloped face 9A of the convex ridge 9 with relatively large contact area.

As described above, in the present invention, the joint main body 10 and the metal pipe 4 can make micro movement in the axial direction under the connection completed state.

And, it is also desirable to reduce (or prevent) the micro movement by the forth end 4a of the metal pipe 4 corresponding to the contact portion 15 in the hole of the joint main body 10 to stop the movement of the metal pipe 4 in the axial inner direction.

And, it is desirable to color the hitching claw piece 88B shown in figures 3D, 5B, and 6B, or the hitching claw 88 shown in figures 16B and 16C to be conspicuous color or high brightness color such as red, yellow, etc. As the coloring method, two-color plastic molding of the

insertion member 32, or, coloring on the outer faces of the hitching claw piece 88B and the hitching claw 88 by painting, adhesion of colored piece, etc., can be applied. With the coloring, there is an advantage that pipe connection completed state can be certainly confirmed by eyes (an advantage that working defects of pipe connecting work can be prevented).

As described above in detail, with the present invention, the press-holding ring 3, not required to be rotated for many times as a conventional cap nut, is rotated only for the small angle of 15° to 90° to make the clamping state, and the connecting work can be conducted easily and swiftly because the joint main body 10 and the press-holding ring 3 attached to the joint main body 10 are provided; the plastically-worked convex ridge 9 is protruding from the thin metal pipe 4 in peripheral direction intermittently or for the entire periphery; the end peripheral portion 10A of the joint main body 10 and the inner peripheral portion 3A of the press-holding ring 3 are provided with the hitching means 100 for mutual hitching by fitting of the press-holding ring 3 with closing in the axial direction and the rotation of the small angle in radial direction of the press-holding ring 3; and the inner peripheral outer end area 3B of the press-holding ring 3 and the inner peripheral end area 10B of the joint main body 10 clamp the convex ridge 9 of the metal pipe 4 on outer and inner sides in the axial direction, and

the insertion member 32, inserted to the press-holding ring 3 in the axial direction to stop reverse rotation of the rotation of the small angle to keep the clamp state by the hitching means 100, is provided. And, the connection completed state is instantly kept without loosening the press-holding ring 3 when the insertion member 32 is inserted to the press-holding ring 3 in the axial direction, and the entire work can be further easily and swiftly conducted. And, the worker can easily know that the rotation of the press-holding ring 3 for the small angle (as the preliminary process) is insufficient when the insertion member 32 can't be inserted, and working defects such as insufficient clamp state can be instantly known by the worker. And, the worker can easily confirm by eyes whether the insertion member 32 is inserted sufficiently deep in the axial direction or not. The pipe connecting work can be easily, certainly and swiftly conducted, especially, the worker can easily and swiftly conduct the pipe connection in a small space, attics, etc. Further, the construction can be made compact and simple, anti-drawing force of the pipe is made very high for the construction in which the convex ridge 9 is clamped on the both sides to prevent unintended drawing accidents of the metal pipe after the construction.

And, the clamp ring 1 is made stably and tightly press-fit to (clamping) the outer sloped face 9A of the convex ridge 9, high and stable anti-drawing force is

secured, and softening function of the clamp ring 1 works in case that large bending moment works on the metal pipe 4 to prevent damage on the press-holding ring 3, etc. because the inner peripheral outer end area 3B of the press-holding ring 3 corresponds to the outer sloped face 9A of the convex ridge 9 of the metal pipe 4 through the closed clamp ring 1 having the tapered inner peripheral face 6.

And, number of parts is reduced (as in figures 6A and 12A), and, in spite of the metal touch, contact pressure of the outer sloped face 9A and the tapered inner peripheral face 3C is low, sufficiently strong anti-drawing force can be shown with keeping stable posture even when drawing force and bending moment work on the metal pipe 4 because the tapered inner peripheral face 3C formed on the inner peripheral outer end area 3B of the press-holding ring 3 directly corresponds to the outer sloped face 9A of the convex ridge 9 of the metal pipe 4.

And, the joint can stably resist the pushing force of the metal pipe 4, excessive movement of the metal pipe 4 to the inner side of the joint main body 10 is prevented, and both axes of the metal pipe 4 and the joint main body 10 are prevented from being inclined and eccentric to keep the sealing ability well because the inner peripheral end area 10B of the joint main body 10 corresponds to the inner sloped face 9B of the convex ridge 9 of the metal pipe 4 through the closed clamp ring 2 having the tapered inner peripheral face 7.

And, the dimension in the axial direction can be made short (as shown in figures 12A through 14C), and number of parts is reduced because the inner peripheral end area 10B of the joint main body 10 directly corresponds to the inner sloped face 9B of the convex ridge 9 of the metal pipe 4. And, the joint can sufficiently resist the outer force of the metal pipe 4 pushed into the inner side of the joint main body 10. Further, the contact stage portion 15 is formed on the joint main body 10 to contact the forth end 4a of the metal pipe 4 to resist the outer pushing force, and micro movement of the convex ridge 9 in the axial direction can be prevented.

And, the configuration of the outer end face of the joint main body 10 can be made simple (refer to figures 13 through 14C) and compact when the inner peripheral corner portion 41 of the inner peripheral end area 10B of the joint main body 10 corresponds to the foot 40 of the inner sloped face 9B of the convex ridge 9 of the metal pipe 4 as to directly contact. This is advantageous in view of strength of the convex ridge 9, anti-drawing force has no problem when micro movement in the axial direction of the metal pipe 4 is slightly generated, and the joint is made excellently practical.

And, the movement of the press-holding ring 3 from the joint main body 10 in the axial direction can be strongly and certainly stopped to certainly keep the clamped state because the plural arc outer ridge portions

19 and the smooth arc bottom face portions 20 are disposed in turn on the end peripheral portion 10A of the joint main body 10, and each of the arc outer ridge portions 19 is composed of the pair of outer ridge single bodies 21 and 22 between which the hitching groove portion 23 is formed; the plural arc inner protruding portions 30, freely hitched to the hitching groove portion 23 between the pair of outer ridge single bodies 21 and 22, are disposed on the inner peripheral portion 3A of the press-holding ring 3, and the arc slit portion 25 is formed between the neighboring arc inner protruding portions 30 in the axial direction; and, the hitching means 100 is provided with the hitching groove portion 23 and the arc inner protruding portion 30. Further, the through arc slit, to which the insertion member 32 can be easily inserted, is automatically formed with relative hitching, and following insertion work can be smoothly conducted. That is to say, the processes of the arrows $N \rightarrow M \rightarrow P$ can be smoothly conducted.

And, the worker can easily insert the press-holding ring 3 to realize swift pipe connecting work and contribute to prevention of fluid leakage by unintended separation because the insertion member 32 has the C-shaped or closed base ring portion 33 and the plural protruding pieces 81, 82, 83, and 84 protruding from the base ring portion 33 in the axial direction as one unit; and the protruding pieces 81, 82, 83, and 84 of the insertion member 32 are inserted to the arc slit portion 25 of the

press-holding ring 3 and the smooth arc bottom face portion 20 of the joint main body 10 under hitched state of the hitching means 100 to stop reverse rotation of the press-holding ring 3 to keep the clamp state by the hitching means 100.

And, unintended separation of the insertion member 32 is prevented to keep the pipe connection completed state because the hitching claw 88 or the hitching claw piece portion 88B is disposed on at least one of the plural protruding pieces 81, 82, 83, and 84.

And, the completion of the pipe connecting work can be certainly checked, and water leakage by pipe connection defect can be prevented because the hitching claw 88 or the hitching claw piece portion 88B is disposed on at least one of the plural protruding pieces 81, 82, 83, and 84, and the hitching claw 88 or the hitching claw piece portion 88B is colored with conspicuous color or high-brightness color as to confirm pipe connecting completed state by eyes.

CLAIMS

1. A pipe joint construction characterized by that:

a joint main body (10), and a press-holding ring (3) attached to the joint main body (10) are provided;

a plastically-worked convex ridge (9) is protruding from a thin metal pipe (4) in peripheral direction intermittently or for an entire periphery;

an end peripheral portion (10A) of the joint main body (10) and an inner peripheral portion (3A) of the press-holding ring (3) are provided with a hitching means (100) for mutual hitching by fitting of the press-holding ring (3) with closing in an axial direction and a rotation of a small angle in radial direction of the press-holding ring (3); and

an inner peripheral outer end area (3B) of the press-holding ring (3) and an inner peripheral end area (10B) of the joint main body (10) clamp a convex ridge (9) of the metal pipe (4) on outer and inner sides in the axial direction, and an insertion member (32), inserted to the press-holding ring (3) in the axial direction to stop reverse rotation of the rotation of the small angle to keep the clamp state by the hitching means (100), is provided.

2. The pipe joint construction as set forth in claim 1, wherein the inner peripheral outer end area (3B) of the press-holding ring (3) corresponds to an outer sloped face (9A) of the convex ridge (9) of the metal pipe (4) through

a closed clamp ring (1) having a tapered inner peripheral face (6).

3. The pipe joint construction as set forth in claim 1, wherein a tapered inner peripheral face (3C) formed on the inner peripheral outer end area (3B) of the press-holding ring (3) directly corresponds to an outer sloped face (9A) of the convex ridge (9) of the metal pipe (4).

4. The pipe joint construction as set forth in claim 1, wherein the inner peripheral end area (10B) of the joint main body (10) corresponds to an inner sloped face (9B) of the convex ridge (9) of the metal pipe (4) through a closed clamp ring (2) having a tapered inner peripheral face (7).

5. The pipe joint construction as set forth in claim 1, wherein the inner peripheral end area (10B) of the joint main body (10) directly corresponds to an inner sloped face (9B) of the convex ridge (9) of the metal pipe (4).

6. The pipe joint construction as set forth in claim 1, wherein an inner peripheral corner portion (41) of the inner peripheral end area (10B) of the joint main body (10) corresponds to a foot (40) of an inner sloped face (9B) of the convex ridge (9) of the metal pipe (4) as to directly contact.

7. The pipe joint construction as set forth in claim 1, wherein plural arc outer ridge portions (19) and smooth arc bottom face portions (20) are disposed in turn on the end peripheral portion (10A) of the joint main body (10), and each of the arc outer ridge portions (19) is composed

of a pair of outer ridge single bodies (21) and (22) between which a hitching groove portion (23) is formed;

plural arc inner protruding portions (30), freely hitched to the hitching groove portion (23) between the pair of outer ridge single bodies (21) and (22), are disposed on the inner peripheral portion (3A) of the press-holding ring (3), and an arc slit portion (25) is formed between the neighboring arc inner protruding portions (30) in the axial direction; and

the hitching means (100) is provided with the hitching groove portion (23) and the arc inner protruding portion (30).

8. The pipe joint construction as set forth in claim 7, wherein the insertion member (32) has a C-shaped or closed base ring portion (33) and plural protruding pieces (81), (82), (83), and (84) protruding from the base ring portion (33) in the axial direction as one unit; and

the protruding pieces (81), (82), (83), and (84) of the insertion member (32) are inserted to the arc slit portion (25) of the press-holding ring (3) and the smooth arc bottom face portion (20) of the joint main body (10) under hitched state of the hitching means (100) to stop reverse rotation of the press-holding ring (3) to keep the clamp state by the hitching means (100).

9. The pipe joint construction as set forth in claim 8, wherein a hitching claw (88) or a hitching claw piece portion (88B) is disposed on at least one of the plural

protruding pieces (81), (82), (83), and (84).

10. The pipe joint construction as set forth in claim 8, wherein a hitching claw (88) or a hitching claw piece portion (88B) is disposed on at least one of the plural protruding pieces (81), (82), (83), and (84), and the hitching claw (88) or the hitching claw piece portion (88B) is colored with conspicuous color or high-brightness color as to confirm pipe connecting completed state by eyes.