

JOINING PIPES

This invention relates to a method and means for joining piping components, which is suitable for joining two thin-wall stainless steel pipes and for joining a metallic pipe and a metallic pipe coupling, and to results of the method.

A known method for joining piping components such as metallic pipes, pipe couplings, etc is to thread end portions of the piping materials and screw one piping component into the other. However, such method has not always been satisfactory with respect to workability, pressure resistance, airtightness, etc. The present applicant has previously proposed joining involving forming a diametrically enlarged end portion of one piping component, specifically a tapered portion, into which an annular gasket having a wedge-shaped cross-section is located and an end portion of the other piping material is inserted, followed by application of pressure at the periphery to achieve plastic deformation of the diametrically enlarged portion, see Japanese Provisional Patent Publication No 130729/1982.

Piping components joined in that way, specifically stainless steel pipes each having an outer diameter of 22.2 mm and a wall thickness of 1.0 mm, with an ethylene propylene rubber as the annular gasket, exhibited a pressure resistance of about 30 kgf/cm² and a pull-out resistance of about 100 kgf. It is desirable to join piping components with superior airtightness, pressure resistance and pull-out resistance, and an

object of this invention to provide for doing so.

According to this invention, there is provided a method of joining piping components which comprises, forming at an end portion of one piping component to be joined a socket having a tapered portion that diametrically enlarges gradually towards the pipe end, and a maximum diameter portion extending from the tapered portion further towards the pipe end; fitting in the socket an annular gasket having a wedge-shaped section to extend along the internal peripheral surface of said tapered portion and be in intimate contact therewith; fitting in the maximum diameter portion a C-ring to extend along the internal peripheral surface of the maximum diameter portion and about the face of the annular gasket nearest the pipe end with which face the C-ring is to be in intimate contact, the C-ring having a sharp annular rim along its internal peripheral surface nearest the pipe end, and the C-ring further having a cross-section with a cornered edge along its internal peripheral surface nearest the annular gasket side and another cornered edge along its external peripheral surface nearest the pipe end, each of which cornered edges has an acute included angle; inserting an end portion of the other piping component thereto; and then holding the piping components by means of a pair of clamping jaws having opposed conical clamping surfaces operative by moving the jaws closer to each other along the axis of the pipes for pressurising the piping components to effect plastic deformation of the maximum diameter portion into a taper through the position of the C-ring which is thereby pressed deformingly into the one piping component.

Specific implementation for this invention will be described, by way of example, with reference to the accompanying drawings, in which:

Figs. 1 to 3 each show a fragmental sectional view for joining by a method embodying this invention;

Fig. 4 shows a plan view of a C-ring;

Fig. 5 shows a fragmental sectional view illustrating a state where a C-ring is impressed against the external peripheral surface of an end portion of a piping component; and

Fig. 6 shows a fragmental sectional view illustrating a joining method where a back-up ring is used.

In Fig. 1, an end portion of one (1) of two piping components 1 and 2 to be joined, has a socket first formed as a diametrically enlarged portion 3 having a diameter slightly enlarged such that the other piping component 2 may be inserted thereto, followed by a tapered portion 4 gradually enlarging diametrically from the portion 3 towards the pipe end and a maximum diameter portion 5 extending from the tapered portion 4 parallel with the pipe axis. The tapered portion 4 preferably forms an angle θ_1 of about 10 to 30° with the center axis of the piping component 1, as shown in the section of Fig. 1 taken in a plane including the axis of said piping component 1.

Next, an annular gasket 7 having a wedge-shaped section to make intimate contact with the internal peripheral surface of the tapered portion 4, and one or more C-rings 8 to make intimate contact with the

internal peripheral surface of the maximum diameter portion 5 and with the end face of the annular gasket 7 closest to the pipe end, and then with the end portion 6 of the other piping material 2, are inserted into the socket.

The C-ring 8 can be formed by stamping a steel plate such that the stamped ring has a generally planar C-shape, as shown in Fig. 4, but with a sharp rim 8a at its side to be closest to the pipe end and along the entire internal periphery to be impressed against the external peripheral surface of the end portion 6 of the other piping component 2. As indicated in Fig. 5, the sectional configuration of said C-ring 8 has a cornered edge 8b formed along the internal peripheral surface of the ring 8 nearest the annular gasket side with an acute angle θ_2 formed between the internal peripheral surface of the ring 8 going from the cornered edge 8b and the external peripheral surface of the end portion 6 of the piping component 2. The angle θ_2 may be about 5 to 15°, preferably 10°. A cornered edge 8c along the external peripheral surface of the ring 8 nearest the pipe end may also make an acute angle.

Next, the tapered portion 4 of the one piping component 1 is held by a first clamping jaw 9 having a tapered clamping surface 9a, as shown in Fig. 2, and the other piping component 2 is held by a second clamping jaw 10 having a tapered clamping surface 10a which opposes that of said first clamping jaw 9. The jaws 9 and 10 are moved towards each other along the axis of the piping components 1 and 2 to effect plastic deformation of the maximum diameter portion 5 of the

socket such that it is diametrically reduced along the piping component 2 by the clamping surface 10a of the second clamping jaw 10 to form another tapered portion as shown in Fig. 3.

As a result, the annular gasket 7 is pressurized strongly by the two jaws 9 and 10 to be compressed tightly between the internal peripheral surface of the socket and the external peripheral surface of the end portion 6 of the other piping component 2, due to wedging action.

With the plastic deformation of the maximum diameter portion 5 of the socket, the C-ring 8 comes to have a reduced internal diameter compared with its original size. The rim 8a and also the cornered edge 8b will be impressed against the external peripheral surface of the end portion 6 of the other piping component 2, and the cornered edge 8c will be impressed against the internal peripheral surface of the maximum diameter portion 5, as shown in Fig. 5. In this process, since the cornered edge 8b of the C-ring 8 is impressed against the external peripheral surface of the end portion 6 of the piping component 2, the principle of leverage causes the rim 8a to act as a supporting point and the cornered edge 8c acts as a point of application, and the C-ring thus never slips along the axis of the pipe even when the maximum diameter portion 5 is subject to plastic deformation.

Also, for the C-ring 8, the cornered edge 8b formed along the internal peripheral surface of the ring on the annular gasket side and the cornered edge 8c

formed along the external peripheral surface on the pipe end side forms an acute angle. Accordingly, when a strong pull-out force is exerted in the direction of the arrow P in Fig. 5, pull-out resistance will result from said cornered angles 8b and 8c being impressed against the external peripheral surface of the end portion 6 of the other piping component 2 and the internal peripheral surface of the maximum diameter portion 5 of the socket, respectively. Consequently, a joint having extremely high airtightness, pressure resistance and pull-out resistance can be achieved.

As a result of an experiment using stainless steel pipes each having an outer diameter of 22.2 mm and a wall thickness of 1.0 mm, an ethylene propylene rubber as the annular gasket, and a C-ring having a ring width of 1.8 mm, a height of 2.65 mm in cross-section, a rim tip width of 0.25 mm, and an impression depth of 0.35 mm with the angle $\theta_2 = 10^\circ$, the thus joined piping components could withstand an internal pressure of 50 kgf/cm², and resist without release from each other a pulling load of 1,109 kgf applied thereto.

Possibility of the annular gasket 7 being caught in the gap 8d of the C-ring 8 during the pressure compression process can be obviated by interposing a back-up ring 11 between the annular gasket 7 and the C-ring 8 as shown in Fig. 6, and also achieve further improved airtightness and pressure resistance.

It should be noted that the back-up ring 11 may be made of any material so long as it can be fitted in intimate contact with the internal peripheral surface of

the maximum diameter portion of the socket and also can prevent the annular gasket 7 from being caught in the gap of the C-ring 8.

As described, piping components can be joined with excellent airtightness, pressure resistance and pull-out resistance simply by compressing the end part of the socket of the piping component towards the axis of the pipe, particularly since the C-ring has an annularly depressed rim and sharp cornered edges.



CLAIMS

1. A method of joining piping components which comprises,

forming at an end portion of one piping component to be joined a socket having a tapered portion that diametrically enlarges gradually towards the pipe end, and a maximum diameter portion extending from the tapered portion further towards the pipe end;

fitting in the socket an annular gasket having a wedge-shaped section to extend along the internal peripheral surface of said tapered portion and be in intimate contact therewith;

fitting in the maximum diameter portion a C-ring to extend along the internal peripheral surface of the maximum diameter portion and about the face of the annular gasket nearest the pipe end with which face the C-ring is to be in intimate contact, the C-ring having a sharp annular rim along its internal peripheral surface nearest the pipe end, and the C-ring further having a cross-section with a cornered edge along its internal peripheral surface nearest the annular gasket side and another cornered edge along its external peripheral surface nearest the pipe end, each of which cornered edges has an acute included angle;

inserting an end portion of the other piping component thereto;

and then holding the piping components by means of a pair of clamping jaws having opposed conical clamping surfaces operative by moving the jaws closer to each other along the axis of the pipes for pressurising the piping components to effect plastic deformation of the maximum diameter portion into a taper through the



position of the C-ring which is thereby pressed deformingly into the one piping component.

2. A method according to Claim 1, wherein a back-up ring is further interposed between the annular gasket and the C-ring.

3. A method according to Claim 1 or Claim 2, wherein the taper through the position of the C-ring makes an angle of about 10 to 30° relative to the axis of the piping component concerned.

4. A method according to any preceding Claim, wherein the cornered edge at the annular gasket side forms an internal peripheral surface of the C-ring that makes an angle of 5° to 15° with the external peripheral surface of the other piping component.

5. A method according to any preceding Claim, wherein one of the clamping jaws has its conical surface correspond to that of the taper.

6. A method of joining a pair of pipe lengths substantially as described herein with reference to the accompanying drawings.

7. A pipe joint made by a method according to any preceding claim.

8. A pipe joint made substantially as described herein with reference to the accompanying drawings.
