

Method of making piping joints and joining tool

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

A known method for joining piping materials such as metallic pipes, pipe couplings, etc is to thread end portions of the piping materials and screw one into the other. However, such method has not been satisfactory with respect to workability, pressure resistance, airtightness, etc. The present applicant has previously proposed a joining method to form a diametrical enlargement at an end portion of one piping material that is tapered and into which an annular gasket having a wedge-shaped cross-section is interposed and an end portion of the other piping material is inserted, followed by application of pressure from the periphery to achieve plastic deformation of the diametrically enlarged portion, see Japanese Provisional Patent Publication No 130729/1982. Also, from subsequent work by the present applicant, it has been found that more effective joining can be done by inserting a C ring, see Japanese Utility Model Publication No. 75582/1986, together with the annular gasket into the diametrically enlarged portion.

For such methods and required plastic deformation in the diametrically enlarged portion, joining of piping materials was effected by axial movements of a first jaw having a tapering lateral cross-sectional shape for clamping action and a second jaw also tapered for

clamping action in the opposite direction, so that the jaws (of a joining tool) are required to move complicatedly. A large joining tool is required, and a particular problem arises from being impossible to use for joining of piping materials near walls.

An object of the present invention is to mitigate problems as noted above and provide a improved method of joining piping materials and joining tool.

A method of joining piping materials according to one aspect of this invention comprises forming at an end portion of one piping component to be joined a socket comprising a tapered portion which is diametrically enlarged gradually toward the pipe end and a maximum diameter portion extending from said tapered portion further towards the pipe end, then fitting an intermediary insertion member along the internal peripheral surface of said tapered portion in the socket so as to be in intimate contact therewith and thereafter inserting an end portion of the other piping component thereinto, further applying pressure to and radially of said socket using two clamping members having a sectional shape longitudinally of the piping components that tapers away from a medial position of deepest indentation to present tapered clamping surfaces having clamping action in a radial direction, thereby effecting plastic deformation of said maximum diameter portion in a diameter reducing manner.

A joining tool for piping materials, in another aspect of the present invention, comprises two clamping members each having at their tip ends a sectional shape

longitudinally of piping components to be joined that tapers away from a medial position of deepest indentation to present tapered clamping surfaces having clamping action in a radial direction, and at their other ends an actuating lever; a connecting plate supporting each of the clamping members with their tapered clamping surfaces opposed to each other and freely movable towards and away from each other about respective rotational axes; and a pushing rod to be forced between the actuating levers of the two clamping members.

Such joining tool is smaller than previously proposed, and yet capable of achieving comparable air tightness and pressure resistance.

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

Figs. 1 to 3 are sectional views of steps of a joining method embodying the present invention;

Figs. 4 to 6 are side views showing joining tool embodying the present invention;

Figs. 7 to 9 are sectional views of steps of another joining method embodying the present invention;

Fig. 10 is a plan view showing a C ring;

Fig. 11 is a sectional view showing that C ring impressed against an external peripheral surface at an

end portion of piping;

Fig. 12 is a sectional view of steps of a further joining method embodying the present invention;

Fig. 13 is a side view partially cut away showing another joining tool embodying the present invention;

Fig. 14 is a perspective view partially cut away of a pertinent portion of the joining tool of Fig. 13;

Fig. 15 is a side view partially cut away showing an enlargement of a pertinent portion of the joining tool of Fig. 13;

Fig. 16 is a sectional view showing piping components before joining; and

Fig. 17 is a front view partially cut away showing those piping components joined.

In Fig. 1, an end portion of one (1) of two piping components 1 and 2 which are to be joined has a socket with a diametrically enlarged portion 3 such that the other piping component 2 may be inserted therein. A tapered portion 4 of the socket gradually enlarges diametrically from the diametrically enlarged portion 3 toward the pipe end and a maximum diameter portion 5 of the socket extends from said tapered portion 4 parallel with the pipe axis. The tapered portion 4 is preferably allowed to form an angle θ_1 of about 10 to 30° with the axis of the piping component 1 as shown in cross-section along the axis of said piping component 1.

An annular gasket 7, which comprises synthetic material such as an ethylene propylene rubber (EPDM), and has a wedge-shaped cross-section, is shown inserted in intimate contact with the internal peripheral surface of the tapered portion 4 and the large diameter portion 5 of the socket. Then, end portion 6 of the other piping component 2 is inserted into the socket through the gasket 7 and into the portion 3.

As shown in Fig. 2, the external periphery of the above socket is sandwiched between two clamping members 10,10 of a joining tool 11 each clamping member (10,10) having a double-tapered cross-section with a centre position deepest and tapering clamping surfaces 8,9 to both sides.

As shown in Figs. 4 to 6, the two clamping members 10,10 with their tapered clamping surfaces 8,9 are at tips of actuating levers 12 medially connected pivotally (13) by a pair of front and back connecting plates 14,14 supporting the clamping members 10,10 with their tapering clamping surfaces 8,9 opposed to each other and movable towards and away from each other about axes of their pivots 13, which may be pins 13,13. A spring member, for example a plate spring 15, is shown fixed at a predetermined position on a tapered plane at the clamping action side of the pivot (13) of one clamping member and resiliently bears against the other clamping member so as to urge the tip ends of both clamping members 10,10 towards their closed position.

The clamping members 10,10 at tips of the actuating levers 12,12 are actuated by spreading and

return of other ends of the actuating levers 12,12 of both clamping members 10,10. That can be done manually by a user of the joining tool operating a push rod 16 having a curved surface at its tip that is pushed between other ends of the actuating levers 12,12 using hydraulic pressure assistance. As shown in Fig. 5 and Fig. 6, the curved tip of the rod 16 is guided by tapering faces 12a,12a on ends of the actuating levers 12 so that those are pushed apart and tips of the clamping members 10,10 are closed with a strong force using leverage at the pins 13,13.

Any spring member may be used to urge the clamping members 10,10 closed during non-use. Thus, instead of the illustrated plate spring 15, coil springs could be deployed at the opposite sides of the pivots to the clamping members 10,10.

The clamping members 10,10 can, as shown in Fig. 2, engage the external periphery of the socket with ones of their tapered clamping surfaces 8,8 in contact with the tapered portion 4 of the piping component 1. Then, the rod 16 of the joining tool 11 is pushed to close the clamping members 10,10. The result, as shown in Fig. 3, is that the central maximum diameter portion will remain, also the tapering portions 4, but the portion 5 will have a diameter reduction corresponding to other tapered clamping surfaces 9,9 of the clamping members 10,10 with accompanying plastic deformation to tapered form.

At the same time, the annular gasket 7 is pushed strongly into the tapered portion 4 and is compressively

deformed in the maximum diameter portion 5. Such wedge action compression forces the annular gasket 7 against the internal peripheral surface of the socket and the external peripheral surface of the end portion 6 of the other piping component 2, and resilience assists such contact. As a result, high air tightness and pressure resistance are obtained.

The second embodiment of Fig. 7 has additional insertion, beyond a shorter annular gasket 7, specifically by way of two C-rings 17 that closely contact the internal peripheral surface of the maximum diameter portion 5 and the end of the annular gasket 7. The joining tool used is the same as before.

Using that tool, the maximum diameter portion 5 extending from the tapered portion 4 is engaged and reduced in diameter as shown in Figs. 8 and 9. The annular gasket 7 is compressed between the internal peripheral surface of the socket and end portion 6 of the other piping component and the C-rings 17, 17 are simultaneously drawn down against the external peripheral surface of the end portion 6 of the other piping component, giving even better air tightness and pressure resistance.

The C-rings 17 can be punched out of a steel plate. As shown in Fig. 10, they preferably have sharp rims 17a on the pipe end side and over the entire internal peripheral surface of said ring 17 to be pressed against, even deform as shown, the external peripheral surface of the end portion 6 of the other piping component. Fig. 11 shows another cornered edge

17b formed along the internal peripheral surface of the ring 17 on the annular gasket side with a cut back at an acute angle θ_2 for the internal peripheral surface of the ring 17 from the cornered edge 17b relative to the external peripheral surface of the end portion 6 of the piping component 2. That angle may be about 5° to 15° , preferably 10° , and the cornered edge 17c formed along the external peripheral surface of the ring 17 on the pipe end side may also have an acute angle.

Then, the C-ring 17 can be readily impressed against the external peripheral surface of the end portion 6 of the other piping material 2, and, if a strong pull-out force is exerted on the joined two piping components in the directions shown by arrows P, the sharp cornered edges 17b, 17c are impressed against the internal peripheral surface of the maximum diameter portion and against the external peripheral surface of the end portion 6 of the other piping component 2, thereby giving rise to high pull-out resistance.

In Fig. 12, an annular gasket 7 having a wedge-shaped cross-section is shown disposed in intimate contact with the internal peripheral surface of the tapered portion 4, and back-up ring 18 is shown disposed in intimate contact with the internal peripheral surface of the maximum diameter portion 5 and the pipe end side face of the annular gasket 7. A C-ring 17 is shown disposed in intimate contact with the internal peripheral surface of the maximum diameter portion 5 and the pipe end side face of the back-up ring 18. The joining tool used has the same construction as before.

The back-up ring 18 has an external diameter which closely contacts the internal peripheral surface of the maximum diameter portion 5, and may be made of any material, provided that it has rigidity capable of preventing insertion of the annular gasket 7 into the gap 17d of the C-ring during application of working pressure.

Intermediate presence of the back-up ring 18, during application of working pressure, means the annular gasket 7 will not go into the gap 17d of the C-ring. Consequently, further improvement in air tightness and pressure resistance can be achieved.

The joining tool of Figs. 13 to 17 represents further improvement, but the joining method for piping components is essentially the same.

The joining tool 20 has a pair of clamping members 23,23 freely spreadable and closable at both ends of a pair of front and back connecting plates 21,21 with pins 22,22 as rotational axes.

In jaw frame 24, at the tip end side of each clamping member 23, half cylindrical clamping jaw 25 has clamping surfaces 25a,25b tapering from a central portion.

As shown in Fig. 14, on both sides of the jaw frame 24, pipe holders 27,27 are mounted by bolts 26, and the half cylindrical clamping jaw 25 is freely rotatably supported relative to the jaw frame 24 by way of arc-shaped jaw plate portions 25c,25c at the

peripheries of both ends of the half cylindrical clamping jaw 25 fitting into the arc-shaped grooves 27a inside the pipe holders 27,27.

At the tips of the respective jaw frames 24,24, flat square holes 28 are provided each accommodating a plate spring 29. Ends of the respective plate springs 29,29 engage notches 30,30 in facing sides of the clamping jaws 25,25, and end faces at the tips of the clamping jaws 25,25 slightly protrude from the biting faces 24a,24a of the jaw frames 24,24.

A grip lever 31 has two crotch portions 32 at its tip connected to the connecting plates 21,21 by an axial pin 33. Actuating levers 23a,23a which extend to free ends of both clamping members 23,23 and are disposed between the two crotch portion 32, have guide faces 23b,23b having curved shapes on their ends. The grip lever 31 is provided with a pushing rod 34 having a curved surface at its tip, which is pushed by a hydraulic cylinder (not shown) between the above actuating levers 23a,23a having guide faces with curved shape, so as to open said actuating levers 23a,23a and force the jaw frames 24,24 of both clamping members 23 and 23 towards each other. A plate spring 35 biases the clamping members 23,23 towards closure when no load is applied.

Joining piping materials by use of the above joining tool is described below. As shown in Fig. 16, annular gasket 7 having a wedge-shaped cross-section and C-ring 17 have been inserted into the end tapered portion 4 of the piping component 1 and the maximum

diameter portion 5 continuous therewith, and end portion 6 of the piping component 2 has been inserted.

Subsequently, the jaw frames 24,24 of the clamping members 23,23 are opened until the maximum diameter portion 5 of the piping material 1 can be inserted, thereby permitting tapered clamping surface 25a of the half cylindrical clamping jaws 25,25 to contact the tapered portion 4 of the piping material 1. Next, the rod 34 is pushed between the actuating levers 23a,23a at ends of the clamping members 23,23 to close the jaw frames 24,24. Then, the maximum diameter portion 5 continuous to the tapered portion 4 of the piping material 1 is compressed in diameter by the other tapered clamping surface 25b of the clamping jaws 25,25, thereby plastically deforming the gasket 7 to tapered form simultaneously with compressing the C-ring 17 against the surface of the piping material 2, to effect joining as shown in Fig. 17.

The clamping jaws 25,25 fit freely rotatably in the jaw frames 24,24, and end faces on the tips of the clamping jaws 25,25 slightly protrude from the faces 24a,24a of said jaw frames 24,24 subject to elastic resistance of the plate springs 29,29, whereby the tips of the clamping jaws 25,25 narrow earlier than the faces 24a,24a of the jaw frames 24,24 during clamping of the jaw frames 24,24. There is no inconvenience from the joined portion being extruded to the forward side of the clamping members 23,23 during clamping.

When clamping is further continued, clamping can be done while the tip end faces of the clamping jaws

25,25 are rotated against the plate springs 29,29 to the same positions of the biting faces 24a,24a of the jaw frames 24,24 to effect uniform joining.

During joining of piping components, since the centres for the clamping movement (pins 22,22) and the centre axis of piping materials are eccentric from each other, the clamping members 23,23 undergo clamping movement while describing an arc-shaped locus for which the pins 22,22 for rotational axes are the centres, similarly to the clamping members 10,10 above. So, the clamping members 23,23 at the end sides near the pins 22,22 will contact piping materials first, so that the piping components are pushed forward to the tip end side of the clamping members 23,23. As a result, it might be thought that correct joining could sometimes be obstructed and pressure resistance at the joined portion slightly lowered compared with before. However, since the tip ends of the clamping jaws 25,25 are slightly protruded from the faces 24a,24a of the jaw frames 24,24, the tip end sides of the clamping jaws 25,25 will close before the jaw frames 24,24, thus joining can be correctly effected on the centre axis of piping components.



Claims

1. A method of joining piping components which comprises,

forming at an end portion of one piping component to be joined a socket comprising a tapered portion which is diametrically enlarged gradually toward the pipe end and a maximum diameter portion extending from said tapered portion further towards the pipe end,

then fitting an intermediary insertion member along the internal peripheral surface of said tapered portion in the socket so as to be in intimate contact therewith and thereafter inserting an end portion of the other piping component thereinto,

further applying pressure to and radially of said socket using two clamping members having a sectional shape longitudinally of the piping components that tapers away from a medial position of deepest indentation to present tapered clamping surfaces having clamping action in a radial direction,

thereby effecting plastic deformation of said maximum diameter portion in a diameter reducing manner.

2. A method according to Claim 1, wherein the intermediary insertion member is an annular gasket having a wedge-shaped cross-section.

3. A method of joining piping materials according to Claim 2, wherein the wedge-shaped annular gasket is accompanied by a C-ring closely contacting the internal peripheral surface of the maximum diameter portion and that face of the annular gasket closest to the pipe end.



4. A method according to Claim 2, wherein the wedge-shaped annular gasket is accompanied by a back-up ring closely contacting the internal peripheral surface of the maximum diameter portion and that face of the annular gasket closest to the pipe end and a C-ring closely contacting the internal peripheral surface of the maximum diameter portion and the face of the back-up ring closest to the pipe end.

5. A joining tool comprising:

two clamping members each having at their tip ends a sectional shape longitudinally of piping components to be joined that tapers away from a medial position of deepest indentation to present tapered clamping surfaces having clamping action in a radial direction, and at their other ends an actuating lever;

a connecting plate supporting each of the clamping members with their tapered clamping surfaces opposed to each other and freely movable towards and away from each other about respective rotational axes; and

a pushing rod to be forced between the actuating levers of the two clamping members.

6. A joining tool according to Claim 5, wherein each said clamping member comprises:

a jaw frame provided at its tip end;

a clamping jaw of half cylindrical shape providing said tapered clamping surface internally and supported for free rotation circumferentially with respect to said jaw frame; and

a spring member on said jaw frame for presenting an end face at the tip end side of the clamping jaw that



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slightly protrudes from a pipe engaging surface of the jaw frame.

7. A joining tool according to Claim 5 or Claim 6, wherein each said clamping member has an end face shaped for guiding the pushing rod.

8. A joining tool according to Claim 5, 6 or 7, wherein said pushing rod has a curved surface at its tip end.

9. A joining tool according to any one of Claims 5 to 8, comprising a spring member between said two clamping members for urging closure of both clamping members.

10. A method of joining tubular elements substantially as described herein with reference to the accompanying drawings.

11. A joining tool constructed and arranged for use and operating substantially as described herein with reference to the accompanying drawings.
