

- [54] Title: MEANS AND METHOD OF JOINING PIPING MATERIALS
- [75] Inventor (s): TAIJI GOTCH, HIDETOSHI YAMAMOTO, KIYOKAZU and KIYOSHI YAMADA, all of Mie-ken, Japan
- [73] Assignee (s): MIE MORO CO., LTD. of Mie-ken, Japan
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## [56] Reference (s) Cited and/or Considered:

|                         |          |             |
|-------------------------|----------|-------------|
| U.S. Pat. No. 4,616,858 | 10-14-86 | Heinz Sauer |
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[57] ABSTRACT

disclosed are pipe fittings for piping materials and a method of joining piping materials using the same. The pipe fittings have a main body with a substantially equal diameter to that of the piping materials to be joined, having formed at least at one end portion thereof an annular expanded portion and enlarged diameter portions on each side of the annular expanded portion. Piping materials can be joined by inserting them to the pipe fittings and by the pressing the outer enlarged diameter portion along the circumference thereof to subject the enlarged diameter portion and the piping materials to deformation of plasticity. By virtue of the recesses formed at the pressed portions, the pipe fittings and the piping materials can firmly be fixed together, the tapered portion provided at the end of the pipe fittings effectively increases the slip-off checking force, and also the joint can perfectly be sealed by the sealing material interposed in the internal space of the annular expanded portion, having been deformed by the application of pressing. Further, crevice corrosion can completely be prevented since an adequate clearance is defined between the non-pressed enlarged diameter portion and the piping materials inserted to the pipe fittings.



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MEANS AND METHOD OF JOINING PIPING MATERIALS

BACKGROUND OF THE INVENTION

This invention relates to thin pipe fittings for joining mutually thin stainless steel pipes and the like and a  
5 method of joining the piping materials using said pipe fittings.

As a method of joining mutually thin stainless steel pipes and the like, known is a method, as disclosed in Japanese  
10 Patent Publication No. 33449/1984, in which a pipe having been processed to have a reduced diameter at the end portion is inserted into a pipe fitting, and then the circumferential surface of the pipe fitting is allowed to undergo deformation of plasticity using a compressing tool.  
15 However, this method suffers problems that it requires an increased number of processing steps since the end portion of the pipe to be joined must be processed to have a reduced diameter at the job site and that the sectional area of the flow path is slightly reduced at the reduced diameter portion to increase flow resistance consequently.

20 In Japanese Provisional Patent Publication No. 88939/1980 or Japanese Patent Publication No. 39873/1978, there is

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disclosed a method in which a pipe is directly inserted to the end of a pipe fitting, and the joint is subjected to deformation of plasticity using a compressing tool to achieve joining of pipes. However, this method suffers a problem that the circumferential surface of the end portion of the pipe which is brought into contact with a liquid flowing therethrough is in close contact with the internal surface of the pipe fitting to cause a phenomenon of crevice corrosion at this portion where an occluded corrosion cell is formed and the corrosion proceeds, so that the joint may be corroded in a relatively short period if said pipe is of stainless steel.

SUMMARY OF THE INVENTION

This invention has been accomplished for the purpose of overcoming these conventional problems and providing the pipe fittings which allows secured joining of piping materials without applying any diameter reducing process to an end portion of the pipes or pipe fittings (hereinafter simply referred to as piping materials) to be joined thereby and free from a fear of crevice corrosion and also to provide a method of joining the piping materials using the same.

This invention characteristically employs the pipe fittings having an annular expanded portion and a first enlarged diameter portion both formed at least at one end portion of its main body having a substantially equal diameter to that of the piping materials to be joined, and a second enlarged diameter portion which can define a clearance with circumferential surfaces of the piping materials to be joined, which is of a size large enough to prevent crevice corrosion.

The method of joining piping materials according to this invention characteristically comprises:

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(5) and second enlarged portions (6) formed in this order at both end portions of its main body (3) having substantially equal diameter to that of the pipes (1) to be joined. It is preferred that the first enlarged diameter portions (4) have an inner diameter which is large enough to receive the pipes (1) therein and also have cross-sectionally tapered portions (7) at the end portions with a degree of taper such that the clearance to be formed between the internal surface of the first enlarged diameter portions and the external surface of the pipes inserted thereto may be substantially equal to the wall thickness of the pipe fitting, whereby to facilitate smooth insertion of the pipes (1), and further that each end portions of the pipe fitting (2) have an increased section modulus, since the end portions of the pipe fitting (2) are prevented from deformation, in combination with the plurality of recesses formed thereon to bite in the pipes to be joined, to bring about an increased force of checking slip off of the pipes, if any pulling force should be applied to the joint. The annular expanded portions (5) should be appreciated to have an arcuate cross-section, so that sealing materials (8) such as an O-ring can be fitted to the internal annular spaces defined thereby. The second enlarged diameter portions (6) formed on the other side of the annular expanded portions (5) relative to said first enlarged diameter portions (4) are designed to have a size to allow formation of a clearance (9) of not less than 100  $\mu\text{m}$  with the circumference of the pipes (1) to be joined. The clearance (9) of less than 100  $\mu\text{m}$  may readily cause crevice corrosion as described above. Besides, the second enlarged diameter portions (6) are preferably designed to have a length shorter than that of the first expanded diameter portions (4).

35 In order to achieve joining of piping materials using the present pipe fittings and the method employing the same, a

fitting a sealing material in the internal annular space of the annular expanded portion;

inserting piping materials to be joined into the pipe fittings until the end of said piping materials reaches to  
5 the second enlarged diameter portion;

pressing the circumference of the pipe fittings with a compressing tool which press the annular expanded portion of the pipe fittings at least at the maximum diameter portion and partially at the first enlarged diameter  
10 portion, but not at the second enlarged diameter portion to press the sealing material to achieve sealing between the pipe fittings and the piping materials to be joined; and also

forming a plurality of recesses which bite in the  
15 piping materials to be joined along the circumference of the first enlarged diameter portion.

#### BRIEF DESCRIPTION OF THE DRAWINGS

20 Fig. 1 and Fig. 2 are a side elevational view, partially in section, showing the joint construction in accordance with the features of this invention; Fig. 3 shows a cross-section of joined piping materials and pipe fittings cut along a plane cross-section along the line A-A at a center  
25 of recessed portions; and Fig. 4 shows another embodiment of this invention in partially cut away front view.

#### DESCRIPTION OF PREFERRED EMBODIMENTS

30 This invention will be described below in more detail referring to the illustrated embodiments.

In Fig. 1, the reference numeral (1) shows a pipe to be joined, and (2) a pipe fitting, both of which are made of  
35 thin stainless steel pipes. The pipe fitting (2) has first enlarged diameter portions (4), annular expanded portions

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sealing material (8) such as an O-ring is first fitted in the internal space of the annular expanded portion (5) of the pipe fitting (2), and then the pipe (1) to be joined is inserted to the pipe fitting (2) until the end of the pipe may reach to the distal extremity of the second enlarged diameter portion (6). Next, the circumference of the pipe fitting (2) is pressed by means of a compressing tool (10) as shown in Fig. 2. While the said tool (10) are each designed to have a groove (11) for pressing the annular expanded portion (5) at least at the maximum diameter portion thereof, and groups of protrusions (12) symmetrically disposed relative to the groove (11), the said tool (10) has a shape that one group of protrusions thereof are designed to partially press the area slightly inner than the end of the first enlarged diameter portion (4), whereas the other group of protrusions are designed not to press the circumference of the second enlarged diameter portion (6). By pressing the pipe fitting (2) by use of such compressing tool (10), the crest of the annular expanded portion (5) is crushed to allow tight application of the sealing material ( 8 ) disposed to the internal annular space thereof to the circumferential surface of the pipe (1) to achieve secure sealing of the joint, and also a plurality of recesses (13) formed by pressing with the protrusions (12) of the compressing tool (10) at the first enlarged diameter portion (4) along the circumference of the pipe fitting (2), as shown in Fig. 3, bite in the circumference of the pipe (1) to fix the pipe (1) firmly to the pipe fitting (2).

Incidentally, the shape of the recesses (13) may suitably be selected, for example, from circular, ellipsoidal, square, rectangular and groove-shaped forms, viewed in radial cross-section, and the number thereof can also be selected suitably.

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the second enlarged diameter portion (6) can be prevented from being pressed.

While the pipe fitting has heretofore been described as having formed first enlarged diameter portions (4), annular expanded portions (5) and second enlarged diameter portions (6) on both longitudinal sides of the main body (3) with a diameter substantially equal to that of the pipes (1) to be joined, the main body (3) may also be a length of pipe itself having a diameter equal to that of the pipes (1) to be joined; or otherwise, as shown in Fig. 4, the main body (3) may correspond to a length of pipe having a diameter equal to that of the pipe (1) to be joined and has a first enlarged diameter portion (4), an annular expanded portion (5) and a second enlarged diameter portion (6) formed at one end of the main body (3). In the latter form of pipe fitting, not only mutually joining of the pipe fittings may be feasible, but also various types of conventional pipe fittings can be used as the piping materials to be joined.

Incidentally, while the pipe fitting has been illustrated as a linear socket, it may be an elbow, a bend, a tee, a lateral, cross, etc.

As can be appreciated from the above description, in the pipe fittings and the method of joining piping materials according to this invention, not only the number of processing steps can be reduced since there is no need of subjecting the end of the piping materials to be joined to the diameter reducing processing but also increase in the flow resistance can be prevented which may be caused by the diameter reduction. Further, according to the present pipe fittings and the method of joining piping materials using the same, the piping materials and the pipe fittings are firmly fixed together by virtue of the recesses formed by application of pressing at the first enlarged diameter



To demonstrate the effect to be brought about by forming a tapered portion (7) at the distal extremity of the first enlarged diameter portion (4) to increase the section modulus ~~at the end of the pipe fitting (2)~~, for example, the force of checking slip off of the joint using a light gauge stainless steel pipes for ordinary piping 13 Su (JIS G 3448), having an outer diameter of 15.88 mm and a wall thickness of 0.8 mm, with no tapered portion at the end thereof showed a slip-off checking force of 298 kgf, whereas the same joint with a tapered portion (7) showed the force of 502 kgf. In the case of the joint using 20 Su pipe, having an outer diameter of 22.22 mm and a wall thickness of 1.0 mm, the force thereof was increased to 739 kgf by forming a tapered portion (7) as opposed to the level of 396 kgf exhibited when the tapered portion (7) is not formed.

In forming such tapered portion (7), it is preferred that the distance (L1) from the annular expanded portion (5) of the pipe fitting (2) to the distal extremity of the second enlarged diameter portion (6) is designed to be equal to the distance (L2) from the annular expanded portion (5) to the proximal extremity of the recess (13). The reason is that the second enlarged diameter portion (6) must be prevented from being pressed by the compressing tool (10), as shown in Fig. 2 by the solid line, having protrusions (12) formed symmetrically relative to the groove (11) by allowing the groups of idle protrusions provided on one side to be positioned beyond the distal extremity of the second enlarged diameter portion (6). When the counterpart pipe is to be processed likewise, the same compressing tool (10) may preferably be used by sliding them directly to a predetermined position, as shown in Fig. 2 by the dashed line, wherein the group of right side protrusions (12) are likewise positioned beyond the distal extremity (right side in Fig. 2) of the second enlarged diameter portion, whereby

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portion, and also the tapered portion provided at the end of the pipe fittings effectively increases the slip-off checking force, whereby there is no fear of loosening or slip off of piping materials after joining them. Moreover, 5 the sealing material disposed in the internal annular space of the annular expanded portion is deformed by application of pressing and applied tightly to the circumferential surface of the piping materials to achieve perfect sealing of the joint. Still further, according to this invention, 10 since the second enlarged diameter portion of the pipe fittings is not subjected to pressing, the clearance of not less than 100  $\mu\text{m}$  is formed between the internal surface of the pipe fittings and the circumference of the piping materials, whereby crevice corrosion which might otherwise 15 be caused can perfectly be prevented since there is no fear of occluded corrosion cell formation.

Therefore, this invention, having completely overcome the conventional problems, can be deemed to have high practical 20 values.

Claims:

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1. Pipe fittings (2) for piping materials (1) having a first enlarged diameter portion (4) having the inner diameter which is large enough to receive the piping materials (1) to be firmly fixed to said first enlarged diameter portion and an annular expanded portion (5) for accomodating a sealing material (8) in the internal space thereof both formed in the order at least at one end portion of its main body (3) with a substantially equal diameter to that of the piping materials (1) to be joined, and a second enlarged diameter portion (6) formed on the other side of the annular expanded portion (5) relative to the first enlarged diameter portion (4) and which can define the clearance with the circumference of the piping materials (1) to be joined, wherein the clearance is of the size large enough to prevent crevice corrosion.

2. The pipe fittings (2) according to Claim 1, wherein the first enlarged diameter portion (4) has a tapered portion (7) formed at the distal extremity thereof.

3. The pipe fittings (2) according to Claim 1, wherein the first enlarged diameter portion (4) has the length which is long enough for forming recesses (13) at a distance (L2) as measured from the annular expanded portion (5), which is equal to the distance (L1) as measured from the annular expanded portion (5) to the distal extremity of the second enlarged diameter portion (6).

4. The pipe fittings (2) according to Claim 2, wherein the first enlarged diameter portion (4) has the length which is long enough for forming recesses (13) at a distance (L2) as measured from the annular expanded portion (5), which is equal to the distance (L1) as measured from the annular expanded portion (5) to the distal extremity of the second enlarged diameter portion (6)

5. A method of joining piping materials, which comprises the steps of:

- fitting a sealing material (8) in the internal annular space of the annular expanded portion (5) of pipe fittings (2) according to Claim 4;

- inserting piping materials (1) to be joined into the pipe fittings until the end of said piping materials reach to the second enlarged diameter portion (6);

- pressing the circumference of the pipe fittings (2) with a compressing tool (10) which press the annular expanded portion (5) of the pipe fitting (2) at least at the maximum diameter portion partially at the first enlarged diameter portion (4), to press the sealing material and

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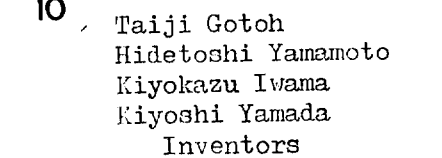
achieve sealing between the pipe fittings (2) and the piping materials (1) to be joined; and

- forming a plurality of recess (13) which bite in the piping materials (1) to be joined along the circumference of the first enlarged diameter portion (4).

6. The method according to Claim 5, wherein the distance (L1) as measured from the annular expanded portion (5) to the distal extremity of the second enlarged diameter portion (6) is designed to be equal to the distance (L2) as measured from the annular expanded portion (5) to the proximal extremity of the recess to be formed at the first enlarged diameter portion (4).

TAIJI GOTOH  
HIDETOSHI YAMAMOTO  
KIYOKAZU IWAMA  
KIYOSHI YAMADA  
Inventors

FIG. 1



ELLA T. FEDERIS

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FIG. 2

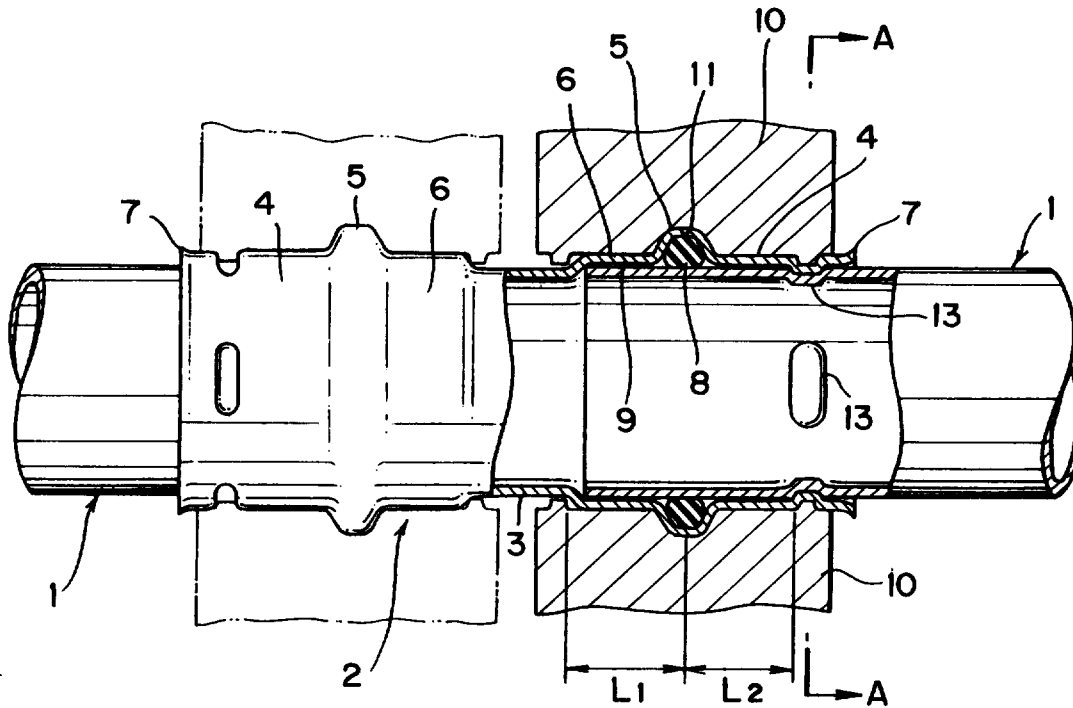
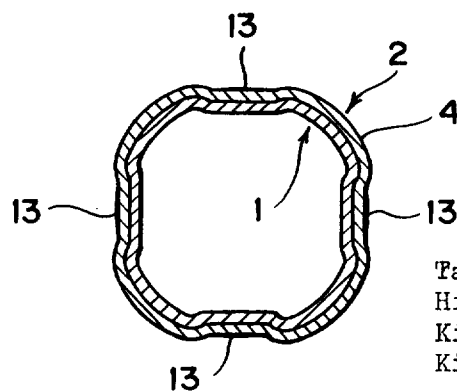


FIG. 3



Taiji Gotoh  
Hidetoshi Yamamoto  
Kiyokazu Iwama  
Kiyoshi Yamada  
Inventors

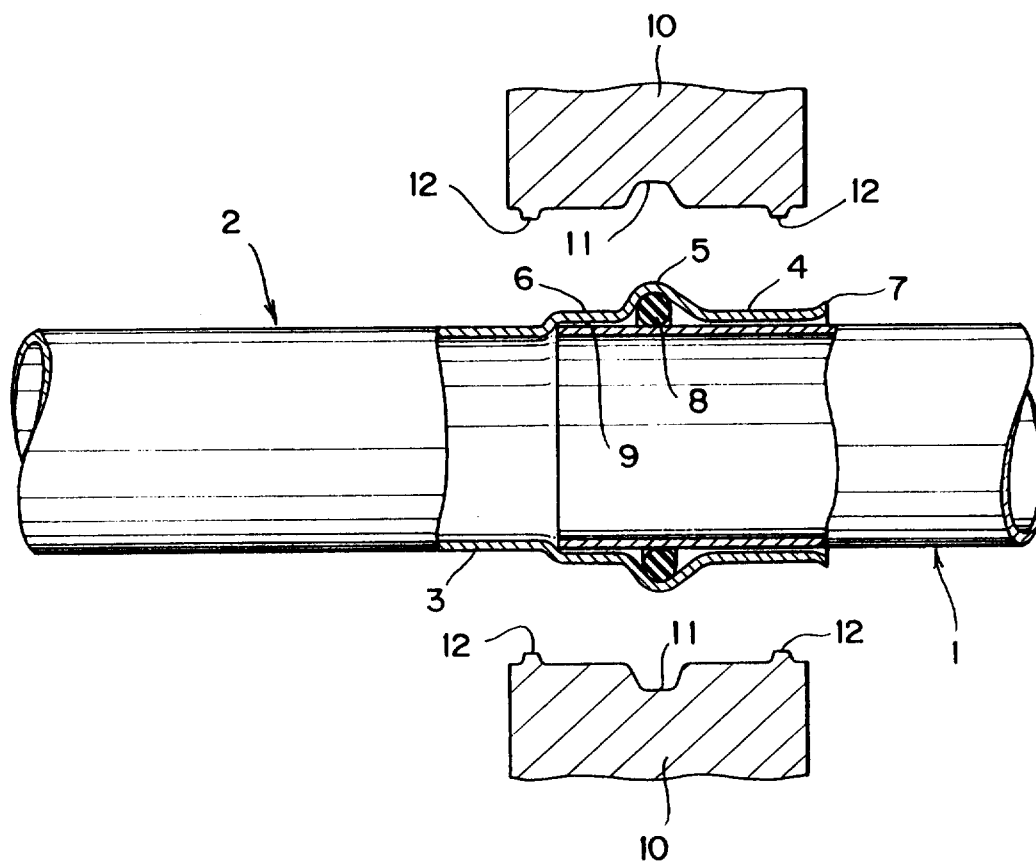
TAN & FEDERIS LAW OFFICE

By:

*[Signature]*  
WILA T. FEDERIS

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FIG. 4



Taiji Gotoh  
Hidetoshi Yamamoto  
Kiyokazu Iwama  
Kiyoshi Yamada  
Inventors

TAN & FEDERIS LAW OFFICE  
By: *[Signature]*

MYLA T. FEDERIS