

Adapter Coupling

Cross Reference to Related Application

This application is based upon and claims the benefit of priority to U.S. Provisional Application No. 62/271,395, filed December 28, 2015 and hereby
5 incorporated by reference.

Field of the Invention

This invention relates to mechanical couplings for joining pipe elements end to end, and in particular, for joining flanged pipe elements to non-flanged pipe elements.

10 Background

As taught in the prior art, connecting a non-flanged polymer pipe element to a flanged pipe element of either polymer or metal, requires the use of a backing ring, usually made of metal, and a polymer butt flange adapter. To effect the connection, the backing ring is slipped over the free end of the non-flanged polymer pipe element
15 and then the butt flange adapter is coaxially aligned with and fused to the free end of the non-flanged pipe element in a butt joint. This creates a flanged facing on the previously non-flanged polymer pipe element which is then engaged, flange to flange, with the flanged pipe element. The backing ring is then brought to bear on the flange of the butt flange adapter and bolts are used to attach the backing ring to the flange of
20 the flanged pipe element, capturing and retaining the flange of the butt flange adapter to the flanged pipe element. For polymer to metal flange engagement under low pressure applications the soft polymer flange of the butt flange adapter deforms upon contact with the metal flange of the flanged pipe element to form a fluid-tight seal. For higher pressure applications a face seal may be used between the interfacing
25 flanges to ensure fluid tightness.

While effective, this prior art practice suffers various disadvantages. Multiple parts, namely, the butt flange adapter and the backing ring, must be supplied and assembled onto the non-flanged polymer pipe element. A fusing operation is

necessary to join the butt flange adapter to the non-flanged polymer pipe. This requires a fusing machine, which requires power or a heat source for operation. The fusing operation itself takes time and is affected by the weather when joints are to be made in the field. For example, cold weather will slow the fusing process, and can
5 stop it entirely if severe enough. There is clearly a need for improved components and a method for joining non-flanged polymer pipe elements to flanged pipe elements.

Summary

The invention concerns a coupling for joining a flanged pipe element to a
10 plain end pipe element. In one example embodiment the coupling comprises a plurality of segments attached to one another in spaced apart relation end to end surrounding a central space. By way of example each of the segments comprises first and second sides oppositely disposed. A first channel is positioned proximate to the first side and extends circumferentially around and facing the central space. A first
15 flange is positioned proximate to the second side and extends outwardly away from the central space. The first flange has a plurality of holes therethrough. A second channel is positioned between the first channel and the flange and extends circumferentially around and faces the central space. The coupling further comprises a split ring positioned in the first channel. A seal is positioned in the second channel.
20 A tube is positioned within the central space and extends outwardly from the second sides of the segments. The tube engages the seal. A second flange may extend outwardly from the tube and positioned adjacent to the first flange. A barb may extend outwardly from the tube proximate one end thereof.

In an example embodiment the first channel comprises two side surfaces
25 arranged in spaced relation. At least one of the segments may have at least one notch positioned in the two side surfaces adjacent to an end of the at least one segment. A floor surface extends between the side surfaces. The floor surface comprises first and second surface portions arranged respectively at opposite ends of the segments. A third surface portion is positioned between the first and second surface portions. The
30 first and second surface portions each have a radius of curvature greater than a radius

of curvature of the third surface portion. In a specific example embodiment the radius of curvature of the first and second surface portions on at least one of the segments is equal to an outer radius of curvature of the split ring. By way of further example, at least one of the first and second surface portions has a length extending
5 from 5% to 45% of a total circumferential length of the first channel.

In an example embodiment the seal comprises a flexible, resilient sealing ring having first and second ring inner surfaces adapted to respectively engage outer surfaces of the tube and the pipe element. One of the ring inner surfaces has a diameter sized to receive the pipe element upon insertion of the pipe elements
10 between the segments. Further by way of example, the seal has an outer surface engaged with and supporting the segments in a preassembled state in spaced apart relation sufficient to allow the pipe element to be inserted into the central space. In an example embodiment, the split ring has an outer radius of curvature and an inner radius of curvature. The inner radius of curvature is equal to or greater than an outer
15 radius of the pipe element.

In an example embodiment, the split ring supports the segments in a preassembled state in spaced apart relation sufficient to allow the pipe elements to be inserted into the central space. By way of further example, the split ring has sufficient stiffness to maintain the segments in the preassembled state through handling of the
20 coupling during insertion of the pipe element. By way of further example, the split ring comprises a plurality of teeth arranged in spaced relation to one another and extending circumferentially around the split ring, the teeth projecting toward the central space.

In an example embodiment the segments comprise adjustably tightenable
25 attachment members for drawing the segments toward the central space. In a specific example, the adjustably tightenable attachment members comprise projections extending from opposite ends of each segment. Each projection defines an opening for receiving a fastener. The fasteners extend between the segments and hold the segments together in a preassembled state.

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Brief Description of the Drawings

Figure 1 is an isometric exploded view of an example coupling according to the invention;

Figure 1A is an isometric view of an example coupling according to the invention shown in a preassembled state;

Figure 2 is a longitudinal sectional view taken at line 2-2 of Figure 1A;

Figure 3 is a cross sectional view taken at line 3-3 of Figure 2;

Figure 3A is a cross sectional view taken at line 3A-3A of Figure 2;

Figure 4 is an isometric view of the coupling shown in Figure 1 shown engaging a non-flanged pipe element;

Figure 5 is a longitudinal sectional view showing the coupling of Figure 1 connecting a flanged pipe element to a non-flanged pipe element; and

Figure 6 is an axial view of the coupling shown in Figure 1.

Detailed Description

Figure 1 shows an example embodiment of a coupling 10 for joining flanged pipe elements to non-flanged pipe elements according to the invention. Coupling 10 comprises a plurality of segments, in this example, two segments 12 and 14 attached to one another end to end and surrounding a central space 16. Segments 12 and 14 are advantageously formed of cast ductile iron, although other materials may also be used. Attachment of the segments 12 and 14 is effected via adjustable attachment members 18 positioned at each end of each segment. In this example attachment members 18 comprise projections 20 that extend from the ends of the segments, the projections having openings 22 that receive a fastener, such as bolt 24 and nut 26. Upon tightening of the fasteners 24, 26 the segments 12 and 14 are drawn toward one another and the central space 16 to effect connection with a pipe element 28 as shown in Figures 4 and 5 and described below.

As shown in Figure 2, coupling 10 has first and second sides 30 and 32 oppositely disposed from one another. A first channel 34 is positioned in the segments 12 and 14 proximate to the first side 30. First channels 34 extend circumferentially around and face the central space 16. First channels 34 are each defined by two side surfaces 36 and 38 arranged in spaced apart relation to one another. A floor surface 40 extends between the side surfaces. As shown in Figure 3, the floor surface 40 comprises first and second surface portions 42 and 44 arranged respectively at opposite ends 46 and 48 of the segments 12 and 14 (segment 12 being shown). A third surface portion 50 is positioned between the first and second surface portions 42 and 44. Each surface portion 42, 44 and 50 has a respective radius of curvature 42a, 44a and 50a. Radii 42a and 44a are greater than the radius of curvature 50a of the third surface portion 50. The centers of radii 42a and 44a are offset from the center of radius 50a as depicted in Figure 3. The first and second surface portions 42 and 44 may each have a length extending from about 5% to about 45% of the total length of the first channel 34 for practical coupling designs.

As shown in Figures 1 and 2, coupling 10 further comprises a first flange 52 positioned proximate to the second sides 32 of each segment 12 and 14. Flange 52 is formed of flange portions 52a and 52b on respective segments 12 and 14 and extends outwardly away from the central space 16. Flange 52 has a plurality of through holes 54 (see also Figure 1A). The flange 52 and through holes 54 are designed to mate with the flange of a flanged end pipe element as described below. A second channel 56 is positioned in each segment 12, 14 between the first channels 34 and the first flanges 52. Second channels 56 extend circumferentially around and face the central space 16. Similar to first channels 34, second channels 56 are each defined by two side surfaces 57 and 59 arranged in spaced apart relation to one another as shown in Figure 2. A floor surface 61 extends between the side surfaces. As shown in Figure 3A, the floor surface 61 comprises first and second surface portions 63 and 65 arranged respectively at opposite ends 46 and 48 of the segments 12 and 14 (segment 12 being shown). A third surface portion 67 is positioned between the first and second surface portions 63 and 65. Each surface portion 63, 65 and 67 has a respective radius of curvature 63a, 65a and 67a. Radii 63a and 65a are greater than

the radius of curvature 67a of the third surface portion 67. The centers of radii 63a and 65a are offset from the center of radius 67a as depicted in Figure 3A. The first and second surface portions 63 and 65 may each have a length extending from about 5% to about 45% of the total length of the second channel 56 for practical coupling designs.

As shown in Figures 1 and 2, a split ring 58 is positioned within the first channels 34 of segments 12 and 14. Split ring 58 in this example comprises a plurality of teeth 60 arranged in spaced relation to one another. Teeth 60 extend circumferentially around the split ring 58 and project toward the central space 16. Such split rings are made of metal, such as spring steel, stainless steel or copper-beryllium alloys and are effective at retaining pipe elements made of HDPE or other polymer resins, to the coupling 10. The split ring 58 has an inner diameter 62 equal to or greater than the outer diameter of the pipe element. Teeth 60 may furthermore be angularly oriented to permit insertion of the pipe element into central space 16, but prevent its withdrawal.

Split ring 58 may be used to hold the segments 12 and 14 in spaced apart relation in the so-called “preassembled state”, illustrated in Figure 1A. Split ring 58 has an outer diameter 64 sized to engage the first and second surface portions 42 and 44 of floor surface 40 (see Figure 3). These surface portions have radii of curvature 42a and 44a larger than the third surface portion 50 and are designed to cooperate with the split ring 58 for support of the segments 12 and 14 such that the pipe element 28 may be inserted into the central space 16 from side 30 when coupling 10 is in the preassembled state. Fasteners (bolts 24 and nuts 26) hold the segments 12 and 14 together and against the split ring 58, which has sufficient stiffness to support the segments during handling for installation but, being a split ring, is collapsible to a smaller diameter and permits the segments to be drawn toward one another and effect a fluid tight, mechanically restrained joint when the fasteners are tightened as described below.

Fluid tightness of the joint is afforded by a seal 66 positioned in the second channels 56 of segments 12 and 14 as shown in Figure 2. In this example seal 66

comprises a flexible, resilient sealing ring 68. Sealing ring 68 has an outer surface 70 having a diameter 71. In an example embodiment, diameter 71 is sized either to support the segments 12 and 14 in spaced relation in the preassembled state, or to assist split ring 58 in supporting the segments. To this end outer diameter 71 is sized to engage the first and second surface portions 63 and 65 of floor surface 61 of the second channel 56 (see Figure 3A). These surface portions have radii of curvature 63a and 65a larger than the third surface portion 67 and are designed to cooperate with the sealing ring 68 for support of the segments 12 and 14 to permit insertion of the pipe element 28 into the central space 16 from side 30 when coupling 10 is in the preassembled state shown in Figure 1A. Sealing ring 68 may also have sufficient stiffness to support the segments during handling for installation. Sealing ring 68 may be formed of elastomers such as EPDM and is thus deformable upon tightening of the fasteners 24, 26 to permit a joint to be formed as described below.

To effect a fluid tight seal, sealing ring 68 has first and second ring inner surfaces 72 and 74 positioned on opposite sides of the sealing ring. Surface 72 is positioned and adapted to engage the outer surface of pipe element 28 upon insertion of the pipe element into the central space 16 (described below). As shown in Figure 2, surface 74 is adapted to engage the outer surface of a tube 76 positioned within the central space 16. A barb 77 is positioned proximate one end of tube 76 to engage the lobe 74a on which inner surface 74 is positioned. Barb 77 extends circumferentially around and outwardly from tube 76 and helps retain the tube within sealing ring 68. Tube 76 is part of the coupling 10 and extends outwardly from the second sides 32 of the segments 12 and 14. A second flange 78 may extend outwardly from tube 76 and is positioned in spaced relation away from barb 77, adjacent to the first flange 52 when the opposite end of the tube 76 is engaged by the inner surface 74 of sealing ring 68 as illustrated in Figure 2. It is advantageous to form tube 76 and its flange 78 as a unitary piece from a polymer resin such as HDPE. This design helps ensure fluid tightness of the joint as noted below. Sealing ring 68 may also have an inwardly projecting rib 80 that engages both the tube 76 and the pipe element 28 and acts as a stop to ensure proper depth of engagement between these components and the coupling 10.

Installation of the coupling 10 is illustrated with reference to Figures 1A, 4, 5 and 6. Pipe element 28 is to be connected to a flanged pipe element 82 (see Figure 5). As shown in Figures 1A and 6, the pipe element 28 is inserted into the central space 16 of coupling 10 from the first side 30 of the segments 12 and 14. Insertion is possible because the coupling 10 is in the preassembled state, with segments 12 and 14 supported in spaced relation either on seal 66 alone, split ring 58 alone, or on both the seal and the split ring. Insertion is further aided by notches 94 positioned in side surfaces 36, 38 of each segment 12 and 14. The notches 94 are positioned adjacent to the attachment members 18 (projections 20) and provide clearance for pipe element insertion which permits the segments 12 and 14 to be closer together in the preassembled state than would be possible in the absence of the notches. Once pipe element 28 is properly seated (the end engaging stop rib 80, the sealing ring inner surface 72 engaging the outer surface of the pipe element) fasteners 24, 26 are tightened thereby drawing segments 12 and 14 toward one another as shown in Figures 4 and 5. Motion of the segments 12 and 14 deforms both the split ring 58 and the seal 66.

Split ring 58 shrinks in circumference and diameter as it is forced to conform within the first channel 34. Shrinking of split ring 58 causes teeth 60 on the split ring to bite into the outer surface of the pipe element 28 and prevent its withdrawal from the coupling 10. Seal 66, constrained within the second channel 56, is compressed between the segments 12 and 14 as the segments are brought together. As shown in Figure 5, the sealing ring inner surface 72 is forced into sealing engagement with the outer surface 84 of the pipe element 28, and sealing ring inner surface 74 is brought into sealing engagement with the outer surface 86 of tube 76.

With the segments 12 and 14 brought together as depicted in Figures 4 and 5, the first flange 52 is thus arranged so that its holes 54 may be aligned with corresponding holes 88 in the flange 90 of the flanged pipe element 82 to which the pipe element 28 is to be joined. As shown in Figure 5, the coupling 10 is aligned with the flanged pipe element 82, holes 54 in the first flange 52 are aligned with holes 88 in flange 90 and fasteners 92 are received in holes 54 and 88 to connect the first flange 52 to the flange 90 of the flanged pipe element 82. Second flange 78 of tube

76 is captured between flange 90 and first flange 52. This configuration provides stiffness and stability to the joint as well as fluid tightness between the coupling 10 and the flanged pipe element 82 as the softer polymeric material comprising the second flange 78 is compressed between the metal flanges 90 and 52, which may
5 comprise cast iron, steel or other durable metals.

Couplings according to the invention provide advantages over prior art methods and couplings for joining non-flanged polymeric pipe elements to flanged pipe elements. Being in a pre-assembled state, couplings according to the invention reduce the number of parts that must be handled during installation. Furthermore, the
10 step of fusing a butt flange adapter to the non-flanged polymer pipe element is eliminated along with the need for a fusing machine. Installation time and complexity is thereby reduced substantially.