

Coupling Having Seal with Retracting Center Leg

Cross Reference to Related Applications

This application is based upon and claims benefit of priority to US Provisional Application No. 62/514,229, filed June 2, 2017, which application is
5 hereby incorporated by reference herein.

Field of the Invention

This invention relates to mechanical couplings and seals for joining pipe elements.

Background

10 One form of mechanical pipe coupling comprises segments attached to one another end to end surrounding a central space. A seal, for example a ring seal formed of an elastomeric material, is captured between the segments. The segments are attached end to end using adjustable attachment members, for example, lugs positioned at each end of each segment which receive fasteners
15 joining the ends. Examples of such couplings are disclosed in US Patent No. 7,712,796. The segments surround and engage the ends of pipe elements to form a mechanical joint, and the seal is compressed between the segments and the pipe elements to ensure fluid tightness.

It is advantageous to support the segments in spaced apart relation
20 sufficient to permit pipe elements to be inserted into the central space defined by the segments while the segments are held together by the fasteners. This “preassembled state” of the coupling promotes rapid formation of the joint as the coupling need not be disassembled and reassembled when connecting the pipe elements. Prior art couplings support the segments in the preassembled state on
25 the outer circumference of the ring seal. However, there are opportunities to achieve a more compact coupling design where the segments are still supported on the seal in spaced relation sufficient to permit pipe elements to be inserted into the central space.

Summary

One aspect of the invention concerns a coupling for joining pipe elements in end to end relation. In one example embodiment, the coupling comprises first and second segments attached to one another end to end and surrounding a central space. Each of the segments has a channel extending circumferentially around and facing the central space. Each of the channels is defined by first and second shoulders located on opposite sides of the segments and a back surface extending between the shoulders. Each shoulder comprises a first surface facing the central space and a second surface oriented at an angle with respect to the first surface.

5 The first and second surfaces of the first shoulder meet at a first cusp, the first and second surfaces of the second shoulder meet at a second cusp. A seal is positioned within the central space. The seal comprises a ring having first and second lobes positioned on opposite sides thereof. First and second attachment members are positioned at opposite ends of each of the segments attaching the

10 segments to one another. The attachment members are adjustably tightenable for drawing the segments toward one another. Contact between the first cusp and the first lobe and the second cusp and the second lobe between the first and second attachment members on each the segment maintains the first and second segments in spaced relation sufficient to permit insertion of the pipe elements into the

15 central space. The first and second lobes contact the second surfaces of the first and second shoulders adjacent to the first and second attachment members when the first and second segments are in the spaced relation.

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By way of example the seal further comprises a center leg positioned between the first and second lobes. The center leg projects toward the central space. When the seal is seated within the channel such that at least a portion of the first lobe contacts the second surface of the first shoulder and at least a portion of the second lobe contacts the second surface of the second shoulder the seal is deformed such that the center leg is retracted toward the back surface.

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An example embodiment may further comprise first and second arcuate projections arranged on opposite sides of each of the first and second segments. The first projections extend from the first shoulders on the first and second segments, the second projections extend from the second shoulders of the first and second segments in this example. Further by way of example, the first arcuate projections may have a greater radius of curvature than the second arcuate projections.

Another example coupling for joining pipe elements in end to end relation comprises first and second segments attached to one another end to end and surrounding a central space. Each of the segments has a channel extending circumferentially around and facing the central space. Each of the channels is defined by first and second shoulders located on opposite sides of the segments and a back surface extending between the shoulders. Each shoulder comprises a first surface facing the central space and a second surface oriented at an angle with respect to the first surface. The first and second surfaces of the first shoulder meet at a first cusp, the first and second surfaces of the second shoulder meet at a second cusp. A seal is positioned within the central space. The seal comprises a ring having first and second lobes positioned on opposite sides thereof and a center leg between the first and second lobes. The center leg projects toward the central space. First and second attachment members are positioned at opposite ends of each of the segments attaching the segments to one another. The attachment members are adjustably tightenable for drawing the segments toward one another and seating the seal within the channel, thereby deforming the seal. When the seal is seated within the channel, at least a portion of the first and second lobes are in contact with the second surfaces of the first and second shoulders so as to deform the seal. The center leg is retracted toward the back surface upon deformation of the seal.

Further by way of example, contact between the first cusp and the first lobe and the second cusp and the second lobe between the first and second attachment members on each the segment maintains the first and second segments

in spaced relation sufficient to permit insertion of the pipe elements into the central space. While in the preassembled state, the first and second lobes may contact the second surfaces of the first and second shoulders adjacent to the first and second attachment members when the segments are in the spaced relation.

5 In another example, first and second arcuate projections may be arranged on opposite sides of each of the first and second segments. The first projections extend from the first shoulders on the first and second segments, the second projections extend from the second shoulders of the first and second segments. Also by way of example, the first arcuate projections may have a greater radius of
10 curvature than the second arcuate projections.

 The invention also encompasses, in combination, a pair of pipe elements and a coupling for joining the pipe elements in end to end relation. By way of example the coupling comprises first and second segments attached to one another end to end and surrounding a central space. Each of the segments has a channel
15 extending circumferentially around and facing the central space. Each of the channels is defined by first and second shoulders located on opposite sides of the segments and a back surface extending between the shoulders. Each shoulder comprises a first surface facing the central space and a second surface oriented at an angle with respect to the first surface. The first and second surfaces of the first
20 shoulder meet at a first cusp, the first and second surfaces of the second shoulder meet at a second cusp. A seal is positioned within the central space. The seal comprises a ring having first and second lobes positioned on opposite sides thereof. First and second attachment members are positioned at opposite ends of each of the segments attaching the segments to one another. The attachment
25 members are adjustably tightenable for drawing the segments toward one another. Contact between the first cusp and the first lobe and the second cusp and the second lobe between the first and second attachment members on each the segment maintain the first and second segments in spaced relation sufficient to permit insertion of the pipe elements into the central space.

The first and second lobes contact the second surfaces of the first and second shoulders adjacent to the first and second attachment members when the first and second segments are in the spaced relation.

5 The invention also includes, in combination, a pair of pipe elements and a coupling for joining the pipe elements in end to end relation. In an example embodiment the coupling comprises first and second segments attached to one another end to end and surrounding a central space. Each of the segments has a channel extending circumferentially around and facing the central space. Each of the channels is defined by first and second shoulders located on opposite sides of
10 the segments and a back surface extending between the shoulders. Each shoulder comprises a first surface facing the central space and a second surface oriented at an angle with respect to the first surface. The first and second surfaces of the first shoulder meet at a first cusp, the first and second surfaces of the second shoulder meet at a second cusp. A seal is positioned within the central space. The seal
15 comprises a ring having first and second lobes positioned on opposite sides thereof and a center leg between the first and second lobes. The center leg projects toward the central space. First and second attachment members are positioned at opposite ends of each of the segments attaching the segments to one another. The attachment members are adjustably tightenable for drawing the segments toward
20 one another and seating the seal within the channel, thereby deforming the seal. When the seal is seated within the channel, at least a portion of the first and second lobes are in contact with the second surfaces of the first and second shoulders so as to deform the seal, the center leg being retracted toward the back surface upon deformation of the seal. By way of example, contact between the
25 first cusp and the first lobe and the second cusp and the second lobe between the first and second attachment members on each the segment maintains the first and second segments in spaced relation sufficient to permit insertion of the pipe elements into the central space.

The invention also encompasses a method of connecting first and second pipe elements to one another using a coupling comprising first and second segments attached to one another end to end surrounding a central space. A seal is positioned between the segments, the seal comprising first and second lobes on opposite sides thereof and a center leg positioned between the lobes, the center leg projecting toward the central space. IN an example embodiment the method comprises:

supporting the segments in spaced apart relation on the seal by contacting first and second points on the first lobe with first cusps of first shoulders of the first and second segments, the first and second points on the first lobe being between ends of the first and second segments, and by contacting first and second points on the second lobe with second cusps of second shoulders of the first and second segments, the first and second points on the second lobe being between ends of the first and second segments;

inserting the pipe elements into the central space, the center leg being between the pipe elements;

drawing the first and second segments toward one another and thereby deforming the seal such that the center leg is retracted in a direction away from the central space.

Brief Description of the Drawings

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

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

Figure 3 is a sectional view taken at line 3-3 of Figure 1;

Figure 4 is an isometric view of the coupling shown in Figure 1 receiving pipe elements when in its preassembled state;

Figure 5 is a sectional view taken at line 5-5 of Figure 4;

Figure 6 is an isometric view of the coupling shown in Figure 1 joining pipe elements;

Figure 7 is a sectional view taken at line 7-7 of Figure 6; and

Figure 8 is a longitudinal sectional view of another embodiment of a coupling according to the invention.

Detailed Description

Figure 1 shows an example embodiment of a coupling 10 according to the invention. Example coupling 10 comprises first and second segments 12 and 14 attached to one another end to end and surrounding a central space 16. In this example attachment of the segments 12 and 14 to one another is effected by first and second adjustably tightenable attachment members 18 which comprise lugs 20, 22 positioned at opposite ends of each segment 12, 14. Lugs 20, 22 receive fasteners, such as bolts 24 and nuts 26 which draw the segments 12 and 14 toward one another when tightened. A seal 28 is positioned between the segments 12 and 14. As shown in Figure 2, seal 28 comprises a ring 30 having first and second lobes 32 and 34 positioned on opposite sides of the ring. Lobes 32 and 34 extend circumferentially around the ring 30. A circumferentially extending sealing surface 36 is positioned at the end of each lobe 32, 34. Sealing surfaces 36 face the central space 16 and engage pipe elements to effect a fluid tight joint as explained below. A center leg 38 extends from ring 30 toward the central space 16. The center leg 38 extends circumferentially around the ring 30 and acts as a pipe stop to ensure that pipe elements are properly seated within the coupling as described below.

As shown in Figure 2, each segment 12 and 14 (14 shown) comprises a channel 40 extending circumferentially around each segment, the channels 40 facing the central space 16. Each channel 40 is defined by first and second shoulders 42 and 44 and a back surface 46. Shoulders 42 and 44 are located on opposite sides of segments 12 and 14 and the back surface 46 extends between the shoulders. First shoulder 42 comprises a first surface 48 which faces the central

space 16, and a second surface 50 oriented at an angle with respect to the first surface 48. The first and second surfaces 48, 50 meet at a first cusp 52. Second shoulder 44 comprises a first surface 54 which faces the central space 16, and a second surface 56 oriented at an angle with respect to the first surface 54. The first and second surfaces 54, 56 meet at a second cusp 58. In this example embodiment the first and second cusps 52, 58 are rounded, but other shapes are feasible. In this example coupling the segments 12 and 14 also comprise arcuate projections 60 and 62 arranged on opposite sides of each segment 12 and 14. The arcuate projections, also called “keys” engage circumferential grooves in the pipe elements to provide mechanical engagement as described below.

Figure 1 shows the coupling 10 in the “preassembled state” wherein the segments 12 and 14 are supported on the seal 28 in spaced apart relation sufficient to permit pipe elements to be inserted into the central space 16 as described below. The fasteners (bolts 24, nuts 26) hold the segments 12 and 14 against the seal 28 in the preassembled state. As shown in Figure 2, separation of the segments 12 and 14 in the preassembled state is maintained because the first and second cusps 52 and 58 respectively contact the first and second lobes 32 and 34 of the seal 28. Contact between the cusps 52, 58 and the lobes 32, 34 extends circumferentially over a substantial portion of the segments 12 and 14. As shown in Figure 3, when the coupling 10 is in the preassembled state, portions of the seal 28 adjacent to the attachment members 18 seat within the channel 40, as evinced by deformation of the lobes 32 and 34 toward one another as the first lobe 32 contacts the first surface 50 of the first shoulder 42 and the second lobe 34 contacts the second surface 56 of the second shoulder 44.

Figures 4-7 illustrate use of the example coupling 10. As shown in Figure 4, with the coupling 10 in the preassembled state pipe elements 64 and 66 are inserted into the central space 16 defined by the segments 12 and 14. Insertion is possible because the segments 12 and 14 are supported in spaced relation by contact between the cusps 52 and 58 and the lobes 32 and 34 as shown in Figure 5. The pipe elements are inserted into the central space 16 to the extent that they

contact the center leg 38 of the seal 28, which acts as a pipe stop. When the ends of the pipe elements 64 and 66 contact the center leg 38 each arcuate projection 60, 62 aligns with a respective circumferential groove 68, 70 in each pipe element.

Next, as shown in Figure 6, the fasteners (bolts 24, nuts 26) are tightened
5 and the segments 12 and 14 are drawn toward one another. As shown in Figure 7 the seal 28 is thus compressed between the segments 12 and 14 and the pipe elements 64, 66 and deforms as it seats within channel 40 over the region between the attachment members 18 (see also Figure 6). As the seal 28 deforms, the sealing surfaces 36 sealingly engage the pipe elements 64 and 66 and the lobes 32
10 and 34 move toward one another as they contact the second surfaces 50 and 56 of the first and second shoulders 42 and 44. Motion of the lobes 32 and 34 toward one another as the seal 28 seats causes the center leg 38 to retract toward the back surfaces 46 of segments 12 and 14 (14 shown). Retraction of the center leg 38 removes it from the flow path through the pipe elements 64 and 66 and thereby
15 reduces turbulence and consequent head loss. As the segments 12 and 14 are further drawn toward one another the arcuate projections 60 and 62 engage their respective circumferential grooves 68 and 70 to effect a mechanical connection between the coupling 10 and the pipe elements 64 and 66.

Figure 8 shows another embodiment of a pipe coupling 80 according to the
20 invention. Coupling 80 differs from the example embodiments described above in that the first arcuate projections on one side of segments 86 and 88 have a greater radius of curvature 90 than the radius of curvature 92 of the second arcuate projections 94 and 96 on the opposite side of segments 86 and 88. Coupling 80 is a “transition” coupling which permits larger diameter pipe elements 98 to be
25 connected to smaller diameter pipe elements 100. Figure 8 shows the lobes 102 of seal 102 deformed and forming a fluid tight seal between the pipe elements 98 and 100 and the coupling 80. Center leg is shown retracted from the fluid flow path so that it does not cause turbulence and head loss.

Using pipe couplings according to the invention, wherein the segments are
30 supported in spaced relation in the preassembled state on the lobes of the seal, as

opposed to the seal's outer circumference, allows a preassembled coupling to be formed with minimized ovality of the ring seal, permits greater separation of the segments for a given ring seal diameter, and retracts the center leg out of the fluid flow path to reduce head loss due to turbulence.

What is claimed is:

1. A coupling for joining pipe elements in end to end relation, said coupling comprising:

5 first and second segments attached to one another end to end and surrounding a central space, each of said segments having a channel extending circumferentially around and facing said central space, each of said channels being defined by first and second shoulders located on opposite sides of said segments and a back surface extending between said shoulders, each said shoulder comprising a first surface facing said central space and a second surface oriented
10 at an angle with respect to said first surface, said first and second surfaces of said first shoulder meeting at a first cusp, said first and second surfaces of said second shoulder meeting at a second cusp;

a seal positioned within said central space, said seal comprising a ring having first and second lobes positioned on opposite sides thereof;

15 first and second attachment members positioned at opposite ends of each of said segments attaching said segments to one another, said attachment members being adjustably tightenable for drawing said segments toward one another; wherein

20 contact between said first cusp and said first lobe and said second cusp and said second lobe between said first and second attachment members on each said segment maintaining said first and second segments in spaced relation sufficient to permit insertion of said pipe elements into said central space.

wherein said first and second lobes contact said second surfaces of said first and second shoulders adjacent to said first and second attachment members
25 when said first and second segments are in said spaced relation.

2. The coupling according to claim 1, wherein:

said seal further comprises a center leg positioned between said first and second lobes, said center leg projecting toward said central space; wherein

when said seal is seated within said channel such that at least a portion of said first lobe contacts said second surface of said first shoulder and at least a portion of said second lobe contacts said second surface of said second shoulder said seal is deformed such that said center leg is retracted toward said back surface.

3. The coupling according to claim 1, further comprising first and second arcuate projections arranged on opposite sides of each of said first and second segments, said first projections extending from said first shoulders on said first and second segments, said second projections extending from said second shoulders of said first and second segments.

4. The coupling according to claim 3, wherein said first arcuate projections have a greater radius of curvature than said second arcuate projections.

5. A coupling for joining pipe elements in end to end relation, said coupling comprising:

first and second segments attached to one another end to end and surrounding a central space, each of said segments having a channel extending circumferentially around and facing said central space, each of said channels being defined by first and second shoulders located on opposite sides of said segments and a back surface extending between said shoulders, each said shoulder comprising a first surface facing said central space and a second surface oriented at an angle with respect to said first surface, said first and second surfaces of said first shoulder meeting at a first cusp, said first and second surfaces of said second shoulder meeting at a second cusp;

a seal positioned within said central space, said seal comprising a ring having first and second lobes positioned on opposite sides thereof and a center leg between said first and second lobes, said center leg projecting toward said central space;

first and second attachment members positioned at opposite ends of each of said segments attaching said segments to one another, said attachment

members being adjustably tightenable for drawing said segments toward one another and seating said seal within said channel, thereby deforming said seal; wherein

5 when said seal is seated within said channel, at least a portion of said first and second lobes being in contact with said second surfaces of said first and second shoulders so as to deform said seal, said center leg being retracted toward said back surface upon deformation of said seal.

6. The coupling according to claim 5, wherein contact between said first cusp and said first lobe and said second cusp and said second lobe between said 10 first and second attachment members on each said segment maintains said first and second segments in spaced relation sufficient to permit insertion of said pipe elements into said central space.

7. The coupling according to claim 6, wherein said first and second lobes contact said second surfaces of said first and second shoulders adjacent to said 15 first and second attachment members when said segments are in said spaced relation.

8. The coupling according to claim 5, further comprising first and second arcuate projections arranged on opposite sides of each of said first and second segments, said first projections extending from said first shoulders on said first 20 and second segments, said second projections extending from said second shoulders of said first and second segments.

9. The coupling according to claim 8, wherein said first arcuate projections have a greater radius of curvature than said second arcuate projections.

10. In combination, a pair of pipe elements and a coupling for joining said 25 pipe elements in end to end relation, said coupling comprising:

first and second segments attached to one another end to end and surrounding a central space, each of said segments having a channel extending circumferentially around and facing said central space, each of said channels being defined by first and second shoulders located on opposite sides of said

segments and a back surface extending between said shoulders, each said shoulder comprising a first surface facing said central space and a second surface oriented at an angle with respect to said first surface, said first and second surfaces of said first shoulder meeting at a first cusp, said first and second surfaces of said second shoulder meeting at a second cusp;

a seal positioned within said central space, said seal comprising a ring having first and second lobes positioned on opposite sides thereof;

first and second attachment members positioned at opposite ends of each of said segments attaching said segments to one another, said attachment members being adjustably tightenable for drawing said segments toward one another; wherein

contact between said first cusp and said first lobe and said second cusp and said second lobe between said first and second attachment members on each said segment maintaining said first and second segments in spaced relation sufficient to permit insertion of said pipe elements into said central space.

wherein said first and second lobes contact said second surfaces of said first and second shoulders adjacent to said first and second attachment members when said first and second segments are in said spaced relation.

11. The combination according to claim 10, wherein:

said seal further comprises a center leg positioned between said first and second lobes, said center leg projecting toward said central space; wherein

when said seal is seated within said channel such that at least a portion of said first lobe contacts said second surface of said first shoulder and at least a portion of said second lobe contacts said second surface of said second shoulder said seal is deformed such that said center leg is retracted toward said back surface.

12. The combination according to claim 10, further comprising first and second arcuate projections arranged on opposite sides of each of said first and

second segments, said first projections extending from said first shoulders on said first and second segments, said second projections extending from said second shoulders of said first and second segments.

13. The combination according to claim 12, wherein said first arcuate
5 projections have a greater radius of curvature than said second arcuate projections.

14. In combination, a pair of pipe elements and a coupling for joining said pipe elements in end to end relation, said coupling comprising:

first and second segments attached to one another end to end and
surrounding a central space, each of said segments having a channel extending
10 circumferentially around and facing said central space, each of said channels
being defined by first and second shoulders located on opposite sides of said
segments and a back surface extending between said shoulders, each said shoulder
comprising a first surface facing said central space and a second surface oriented
at an angle with respect to said first surface, said first and second surfaces of said
15 first shoulder meeting at a first cusp, said first and second surfaces of said second
shoulder meeting at a second cusp;

a seal positioned within said central space, said seal comprising a
ring having first and second lobes positioned on opposite sides thereof and a
center leg between said first and second lobes, said center leg projecting toward
20 said central space;

first and second attachment members positioned at opposite ends of
each of said segments attaching said segments to one another, said attachment
members being adjustably tightenable for drawing said segments toward one
another and seating said seal within said channel, thereby deforming said seal;
25 wherein

when said seal is seated within said channel, at least a portion of
said first and second lobes being in contact with said second surfaces of said first
and second shoulders so as to deform said seal, said center leg being retracted
toward said back surface upon deformation of said seal.

15. The combination according to claim 14, wherein contact between said first cusp and said first lobe and said second cusp and said second lobe between said first and second attachment members on each said segment maintains said first and second segments in spaced relation sufficient to permit insertion of said pipe elements into said central space.

16. The combination according to claim 15, wherein said first and second lobes contact said second surfaces of said first and second shoulders adjacent to said first and second attachment members when said segments are in said spaced relation.

17. The combination according to claim 14, further comprising first and second arcuate projections arranged on opposite sides of each of said first and second segments, said first projections extending from said first shoulders on said first and second segments, said second projections extending from said second shoulders of said first and second segments.

18. The combination according to claim 17, wherein said first arcuate projections have a greater radius of curvature than said second arcuate projections.

19. A method of maintaining first and second segments of a coupling in spaced relation in a preassembled state to permit pipe elements to be inserted into a central space surrounded by said segments when said segments are attached end to end, said method comprising:

positioning a seal within said central space, said seal having first and second lobes positioned on opposite sides thereof;

contacting said first lobe with a cusp of a first shoulder of said first and second segments at first and second points between ends of said first and second segments and contacting said second lobe with a cusp of a second shoulder at first and second points between ends of said first and second segments;

contacting said first lobe with a surface of said first shoulder of said first and second segments at points proximate said ends of said first and second segments and contacting said second lobe with a surface of said second

shoulder of said first and second segments at points proximate said ends of said first and second segments.

20. A method of connecting first and second pipe elements to one another using a coupling comprising first and second segments attached to one another
5 end to end surrounding a central space, a seal being positioned between said segments, said seal comprising first and second lobes on opposite sides thereof and a center leg positioned between said lobes, said center leg projecting toward said central space, said method comprising:

supporting said segments in spaced apart relation on said seal by
10 contacting first and second points on said first lobe with first cusps of first shoulders of said first and second segments, said first and second points on said first lobe being between ends of said first and second segments, and by contacting first and second points on said second lobe with second cusps of second shoulders of said first and second segments, said first and second points on said second lobe
15 being between ends of said first and second segments;

inserting said pipe elements into said central space, said center leg being between said pipe elements;

drawing said first and second segments toward one another and thereby deforming said seal such that said center leg is retracted in a direction
20 away from said central space.