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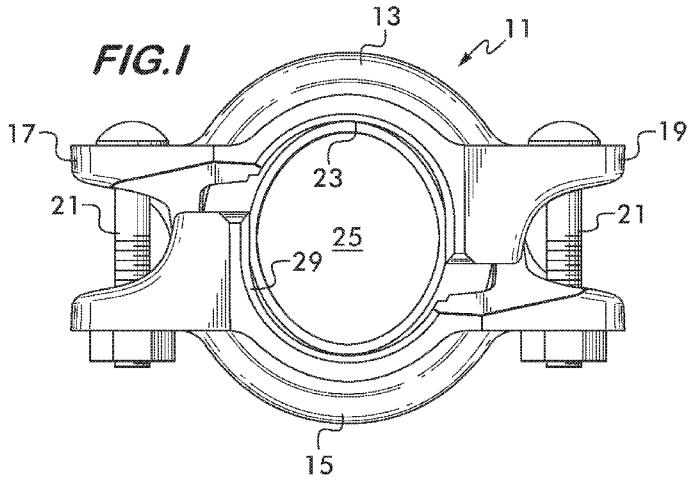
(54) **Title**: COUPLING WITH PROJECTIONS HAVING ANGULARLY ORIENTED SURFACE PORTIONS



(57) **Abstract**: A mechanical coupling for joining pipe elements has segments joined end to end, each segment having projections with surface portions oriented angularly with respect to other surface portions to serve as a guide for the insertion of pipe elements between the segments when arranged in spaced apart relation around a ring gasket. A method of assembling a pipe joint includes engaging the surfaces with ends of the pipe elements and rotating the segments relative to one another to permit insertion.

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COUPLING WITH PROJECTIONS HAVING ANGULARLY ORIENTED SURFACE PORTIONS

Cross-Reference to Related Application

[0001] This application claims priority to United States Patent Application No. 13/300,756, filed November 21, 2011, which application is incorporated herein fully by this reference.

Field of the Invention

[0002] This invention concerns mechanical couplings for joining pipe elements in end to end relation.

Background

[0003] Mechanical couplings for joining pipe elements together end-to-end comprise interconnectable segments that are positionable circumferentially surrounding the end portions of co-axially aligned pipe elements. The term "pipe element" is used herein to describe any pipe-like item or component having a pipe like form. Pipe elements include pipe stock, pipe fittings such as elbows, caps and tees as well as fluid control components such as valves, reducers, strainers, restrictors, pressure regulators and the like.

[0004] Each mechanical coupling segment comprises a housing having projections which extend radially inwardly from the housing and engage, for example, the outer surfaces of plain end pipe elements, pipe elements having a shoulder and bead, or circumferential grooves that extend around each of the pipe elements to be joined. Engagement between the projections and the pipe elements provides mechanical restraint to the joint and ensures that the pipe elements remain coupled even under high internal pressure and external forces. The housings define an annular channel or pocket that receives a gasket or seal, typically an elastomeric ring which engages the ends of each pipe element and cooperates with the segments and the pipe elements to provide a fluid tight seal. The segments have connection members, typically in the form of lugs which project outwardly from the housings. The lugs are adapted to receive fasteners, such as nuts and bolts, which are adjustably tightenable to draw the segments toward one another.

[0005] The projections on prior art couplings typically have arcuate surfaces with a radius of curvature that is substantially matched to the radius of curvature of the outer surface of the pipe element that is to be engaged. For couplings used with grooved pipe elements, the radii of curvature of the arcuate surfaces are smaller than the radii of curvature of the outer surfaces of the pipe elements outside of the grooves so that the arcuate surfaces fit within and engage the grooves.

[0006] Methods of securing pipe elements in end to end relation comprise a sequential installation process when mechanical couplings according to the prior art are used. Typically, the coupling is received by the technician with the segments bolted together and the ring gasket captured within the segments' channels. The technician first disassembles the coupling by unbolting it, removes the ring seal, lubricates it (if not pre-lubricated) and places it around the ends of the pipe elements to be joined. Installation of the ring gasket often requires that it be lubricated and stretched to accommodate the pipe elements. With the ring gasket in place on both pipe elements, the segments are then placed one at a time straddling the ends of the pipe elements and capturing the ring gasket against them. During placement, the segments engage the gasket, the projections are aligned with the grooves, the bolts are inserted through the lugs, the nuts are threaded onto the bolts and tightened, drawing the coupling segments toward one another, compressing the gasket and engaging the projections within the grooves.

[0007] As evident from the previous description, installation of mechanical pipe couplings according to the prior art typically requires that the technician totally disassemble and reassemble the coupling while handling at least seven individual piece parts (and more when the coupling has more than two segments). Significant time, effort and expense would be saved if the technician could install a mechanical pipe coupling without first totally disassembling it and then reassembling it, piece by piece.

[0008] Figure 1 shows a coupling 11 having coupling segments 13 and 15. The segments are joined end to end by connection members 17 and 19, the connection members including threaded fasteners 21. The segments 13 and 15 are shown supported in spaced relation from one another on the outer surface of the ring gasket 23 captured between the segments. When the segments are supported in this manner it is possible to insert pipe elements into the central space 25 between the segments without disassembling the coupling. However, there are some drawbacks to this solution to the

problem of installing mechanical couplings. Note in particular that there is a limit on the pipe element diameter tolerance variations which can be accepted by coupling 11. If the pipe elements are sufficiently out of round, or if their ends are flared near the maximum degree permitted by specification, it will be difficult to impossible to insert them into the central space 25 between the segments 13 and 15, as the pipe elements will not get past the projections 29 which extend into the central space. Furthermore, the ring gasket itself can resist pipe element insertion when the distortion is not controlled. Many mass produced pipe elements are out of round to some degree and roll grooved pipe elements may be flared to some degree. Use of the coupling 11 therefore places tighter tolerances on these parameters, limiting the pipe elements which can be effectively used with such couplings and making the pipe elements more expensive as they must either be "selected" pipe elements within a permissible tolerance or the tolerances determining manufacturing acceptance must be tighter.

[0009] Thus, there is clearly a need for a pipe coupling which can be used with pipe elements having a generous tolerance range on parameters such as out of roundness and flare, yet will allow pipe elements to be inserted reliably without disassembly of the coupling.

Summary

[0010] The invention concerns a coupling for joining pipe elements in end to end relation. In one example embodiment, the coupling comprises a plurality of segments joined end to end surrounding a central axis and defining a central space for receiving the pipe elements. At least one of the segments comprises a pair of projections positioned in spaced apart relation on opposite sides of the one segment and extending toward the central axis. At least a portion of each of the projections is engageable with a respective one of the pipe elements. Each of the projections has an arcuate surface facing the central axis. A back wall extends between the projections. The back wall has an arcuate surface facing the central axis.

[0011] In another example embodiment of the coupling, at least one of the projections comprises first and second outwardly facing surface portions. The first surface portion is angularly oriented relatively to the second surface portion. The first surface portion may subtend an angle of about 35° to about 60° measured with respect to the central axis. The first surface portion may be centered on a line extending from the

central axis and oriented from an angle of about 30° to about 50° measured from a first line extending between a first end of the one segment and a second end of the one segment. The first surface portion may have an orientation angle relative to the second surface portion from about 15° to about 60°. In this example embodiment the one projection may further comprise a third outwardly facing surface portion. The third surface portion is angularly oriented relatively to the second surface portion. The third surface portion subtends an angle of about 35° to about 60° measured with respect to the central axis. The second surface portion is positioned between the first and third surface portions. The third surface portion may be centered on a line extending from the central axis and oriented from an angle of about 30° to about 50° measured from the first line. The third surface portion may have an orientation angle relative to the second surface portion from about 15° to about 60°.

[0012] At least one notch may be positioned in at least one of the projections, the notch located at an end of the one segment. In an example embodiment, the at least one notch includes first and second notches positioned on opposite ends of the one segment.

[0013] In a particular example embodiment of the coupling according to the invention only a first and a second of the segments are joined end to end surrounding the central axis. In this example, the coupling further comprises a ring gasket positioned between the first and second segments. The ring gasket supports the first and second segments in spaced apart relation sufficient to insert the pipe elements between the segments. The first and second segments have sidewalls from which the projections extend. The back wall and the projections of each said segment cooperate to define a pocket for receiving the ring gasket.

[0014] The invention also encompasses a segment, used in a coupling for joining pipe elements in end to end relation. The coupling comprises a plurality of the segments joined end to end surrounding a central axis and defining a central space for receiving the pipe elements. In one example embodiment, the segment comprises a pair of projections positioned in spaced apart relation on opposite sides of the segment. The projections extend toward the central axis. At least a portion of each of the projections are engageable with a respective one of the pipe elements. Each of the projections has an arcuate surface facing the central axis. A back wall extends between the projections. The back wall has an arcuate surface facing the central axis.

[0015] In an example embodiment according to the invention, at least one of the projections comprises first and second outwardly facing surface portions. The first surface portion is angularly oriented relatively to the second surface portion. The first surface portion may subtend an angle of about 35° to about 60° measured with respect to the central axis. The first surface portion may be centered on a line extending from the central axis and oriented from an angle of about 30° to about 50° measured from a first line extending between a first end of the one segment and a second end of the one segment. The first surface portion may have an orientation angle relative to the second surface portion from about 15° to about 60°. The projection may further comprise a third outwardly facing surface portion. The third surface portion is angularly oriented relatively to the second surface portion. The third surface portion may subtend an angle of about 35° to about 60° measured with respect to the central axis. The second surface portion is positioned between the first and third surface portions. The third surface portion may be centered on a line extending from the central axis and oriented from an angle of about 30° to about 50° measured from the first line. The third surface portion may have an orientation angle relative to the second surface portion from about 15° to about 60°.

[0016] In an example embodiment, the segment may further comprise at least one notch positioned in at least one of the projections, the notch located at an end of the segment. The at least one notch may include first and second notches positioned on opposite ends of the one segment.

[0017] The invention also includes a method of coupling first and second pipe elements in end to end relation. In one embodiment, the method includes:

using a pipe coupling having first and second coupling segments attached to one another end to end surrounding a central axis and defining a central space, the coupling segments being supported in spaced apart relation on an elastic ring gasket, the coupling segments having adjustable connection members at each end for drawing the coupling segments toward the central space when the connection members are tightened, at least one of the coupling segments having:

a pair of projections positioned in spaced apart relation on opposite sides of the one coupling segment and extending toward the central axis, at least a portion of each of the projections being engageable with a respective one of the

pipe elements, each of the projections having an arcuate surface facing the central axis,

wherein at least one of the projections comprises first and second outwardly facing surface portions, the first surface portion being angularly oriented relatively to the second surface portion, the first surface portion subtending an angle of about 35° to about 60° measured with respect to the central axis;

inserting the first pipe element into the central space from one side of the pipe coupling, the first pipe element engaging and thereby rotating the coupling segments relatively to one another about an axis passing through the connection members to provide clearance for inserting the first pipe element;

inserting the second pipe element into the central space from an opposite side of the pipe coupling; and

tightening the connection members and thereby drawing the coupling segments toward one another and into engagement with the first and second pipe elements to couple them in end to end relation.

[0018] The method may further include the step of inserting the second pipe element into the central space from an opposite side of the coupling and engaging and thereby rotating the coupling segments relatively to one another about the axis passing through the connection members to provide clearance for inserting the second pipe element.

Brief Description of the Drawings

[0019] Figure 1 is an elevational view of an example mechanical pipe coupling according to the invention;

[0020] Figure 2 is an elevational view of an example mechanical pipe coupling according to the invention;

[0021] Figure 3 is a cross sectional view of a segment of an example mechanical pipe coupling according to the invention taken at line 3-3 of Figure 2;

[0022] Figures 4A and 4B are isometric views of segments of example mechanical pipe couplings according to the invention;

[0023] Figures 5A and 5B are elevational views of segments of example mechanical pipe couplings according to the invention; and

[0024] Figures 6-9 are longitudinal sectional views illustrating an example method of forming a pipe joint according to the invention. The longitudinal section view depicted in Figure 6 is taken at line 6-6 of Figure 5A. The longitudinal section view depicted in Figure 7 is taken at line 7-7 of Figure 5A.

Detailed Description

[0025] Figure 2 shows an example embodiment of a coupling 10 according to the invention. Coupling 10 comprises segments 12 and 14 that are joined to one another end to end surrounding a central axis 16 and defining a central space 18. Central space 18 receives the pipe elements to be joined in end to end relation, the longitudinal axis of the pipe elements substantially aligning with the central axis 16. Each of the segments 12 and 14 have connection members 20 and 22 at each end. In this example, the connection members comprise a lug 24 which projects from the segment and receives a threaded fastener 26. Fasteners 26 are adjustably tightenable so as to draw the segments 12 and 14 toward one another and the central axis 16 to engage the pipe elements and form the joint.

[0026] As shown in cross section in Figure 3, each segment (segment 12 being shown) has a pair of projections 28 and 30 positioned in spaced apart relation on opposite sides of the segment. The projections extend toward the central axis 16, and at least a portion of each projection is engageable with a respective pipe element to provide mechanical engagement and hold the pipe elements in end to end relation. The projections 28 and 30 engage the outer surface of the pipe elements, which may be a plain surface, a surface forming a circumferential groove, a surface having a raised shoulder, or a shoulder and bead for example. As shown in Figure 3, each projection has an arcuate surface 32 facing central axis 16.

[0027] The segments 12 and 14 also have sidewalls 36 and 38 from which the projections 28 and 30 extend. The sidewalls 36 and 38 are attached to a back wall 40, and together the sidewalls and back wall define a pocket 42. Back wall 40 extends between projections 28 and 30 and has an arcuate surface 44 which faces the central axis 16. Pocket 42 receives a ring gasket 43 (Figure 3) positioned between the segments 12 and 14 (see Figure 2) to ensure a fluid-tight seal.

[0028] As shown in Figures 4A-5B, projections such as 28 and 30 may comprise at least two outwardly facing surface portions 78 and 80. "Outwardly facing" in this context means facing outwardly away from the gasket pocket 42. In this example, surface portion 78 is angularly oriented with respect to surface portion 80.

[0029] As shown in Figures 4A and 5A, surface portion 80 may be angularly oriented relative to the outermost surface of projection 28 (the surface of projection 28 farthest away from gasket pocket 42), thereby defining an angled surface or chamfer extending between the outermost surface of projection 28 and arcuate surface 32 of projection 28 (See Fig. 3). In this example, surface portion 78 may have a relative orientation angle 82 from about 15° to about 45° and may subtend an angle 84 from about 35° to about 60° as measured with respect to the central axis 16. Alternatively, as shown in Figures 4B and 5B, surface portion 80 may correspond to the outermost surface of projection 28 such that surface portion 80 does not comprise an angled surface or chamfer extending between the outermost surface of projection 28 and arcuate surface 32 of projection 28. In this example, surface portion 78 may have a relative orientation angle 82 from about 15° to about 60° and may subtend an angle 84 from about 35° to about 60° as measured with respect to the central axis 16.

[0030] Surface portion 78 may further be centered on a line 86 extending from the central axis 16, as shown in Figures 5A and 5B. Center line 86 of surface portion 78 may have an orientation angle 88 measured from the line 55 which extends between the ends 56 and 58 of the segment 72. Orientation angle 88 may range from about 30° to about 50°. As shown in Figures 5A and 5B, segment 72 has a third outwardly facing surface portion 90 which is angularly oriented with respect to surface portion 80. The ranges for the angular orientation of surface portion 90 with respect to surface portion 80 may be the same as for surface portion 78, but the actual orientation angle of surface portion 90 for a particular coupling need not be the same as the orientation angle of surface 78, although for practical designs it is advantageous that all of such surface portions be the same on the segments forming a coupling.

[0031] The advantage of angularly oriented surface portions 78 and 90 is demonstrated in Figures 6-9, which illustrate an example method of coupling pipe elements according to the invention. It is advantageous to have a coupling 73 formed of segments such as 12, 13, 14, 15, 66, or 72 which does not have to be disassembled and

then reassembled around the pipe elements to form the joint between them. In the example shown in Figures 6-9, the coupling 73 is formed of segments 72, used by way of example. Couplings such as 10, 11 and 73 are regarded as "installation ready" from the factory because, as shown for coupling 10 in Figure 2 by way of example, the segments for such couplings are attached to one another with threaded fasteners 26 and supported in spaced apart relation on the ring gasket 43 at a sufficient distance to permit pipe elements to be inserted into the central space 18 without disassembling the coupling. Figure 6 illustrates insertion of a pipe element 92 into central space 18 of coupling 73. Insertion is initiated by contacting the end of the pipe element 92 with the angularly oriented surfaces 90 on projections 28 on segments 72.

[0032] Surfaces 90 facilitate insertion by acting as lead in guides to center the pipe element 92 and also initiate rotation of the segments 72 about an axis 94 passing through the connection members. This rotation of the segments is illustrated in Figure 7. The ring gasket 43, due to its elastic and resilient properties, acts as a spring which allows the segments 72 to rotate out of the way and admit the pipe element 92 into the central space 18. Once the pipe element 92 is sufficiently engaged with the coupling 10 within the central space 18 the elastic biasing of the ring gasket 43 restores the coupling segments 12 and 14 toward their original relative angular positions. "Sufficient engagement" may be defined, for example, as when the projections 28 align with groove 96 in the pipe element 92, or when the end of the pipe element contacts the gasket stop 98. As shown in Figure 8, the restoring force provided by the spring action of the ring gasket 43 permits another pipe element 100 to be inserted from the opposite side of coupling 10. Upon insertion into the central space 18, the pipe element 100 contacts angularly oriented surfaces 78 on the projections 30 of segments 72 and the segments rotate about axis 94, out of the way of the pipe element to permit insertion. Once pipe element 100 is sufficiently engaged with the coupling 73, as shown in Figure 9, the fasteners joining the segments 72 (see also Figure 2) are tightened to engage the projections 28 and 30 with the outer surface of the pipe elements 92 and 100. In this example the pipe outer surfaces happen to comprise circumferential grooves 96, but other types of pipe elements, such as plain end, shouldered, as well as shoulder and bead pipe elements are also feasible. As shown in Figures 2 and 4A-5B, a notch 102 may also be incorporated into the projections 28 and 30 near the ends of the segments 12, 14, 66, and 72 to provide additional clearance for the pipe element insertion. In an example

embodiment, first and second notches 102 can be positioned on opposite ends of the segments 12, 14, 66, and 72.

[0033] Use of the angularly oriented surface portions 78 and 90 permits pipe elements having flared ends to be received within the coupling 10 by the insertion method. End flare occurs when pipe elements are cold worked, by rolling for example, to form a circumferential groove, and the expanded diameter of the flared end might pose some difficulty to insertion but for the angularly oriented surface portions and the ability of the coupling segments to rotate relatively to one another about axis 94. The notches 102 also help in allowing flared pipe to be used with the joint assembly method according to the invention.

[0034] Use of the angularly oriented surface portions 78 and 90 also permits pipe elements that are not axially aligned with the central axis 16 of the coupling 10 to be readily received within the central space 18.

[0035] Figures 4A-5B illustrate another feature of the coupling according to the invention. Figures 4A and 4B depict a rigid coupling segment 66 for use with circumferentially grooved pipe elements. Segment 66 has interfacing surfaces 68 and 70 which have opposite angular orientations with respect to one another. When the fasteners joining such segments together are tightened, the interfacing surfaces 68 and 70 on one segment contact their counterpart surfaces on the mating segment and the segments are forced to rotate about a vertical axis in opposite directions relatively to one another. This causes the projections 28 and 30 to engage the sidewalls of the circumferential groove in the pipe elements and lock them in place so as to provide significant resistance to external bending forces and torque applied to the joint, thereby limiting the relative deflections of the pipe elements. Rigid couplings are disclosed in U.S. Patent No. 4,611,839 and U.S. Patent No. 4,639,020, both patents being hereby incorporated by reference.

[0036] Figures 5A and 5B show a segment 72 of a more flexible coupling. The interfacing surfaces 74 and 76 between the segments 66 and 72 are not angled and when they engage one another they do not cause any relative rotation of the segments. Thus the projections 28 and 30 do not engage the sidewalls of the circumferential groove due to twisting action of the segments which results in a more flexible joint, where the

relative deflections of the pipe elements in bending, torsionally and axially, are greater than for the rigid joint (described above) for the same applied loads.

[0037] The angularly oriented surfaces described above and claimed herein are applicable to both rigid and flexible couplings. Thus, it is understood that features or elements of the disclosed angularly oriented surfaces that are described or depicted with respect to only one of the segments (66 or 72) or to only one of the projections (28 or 30) are also applicable to, and includable in, the other segment (66 or 72) or the other projection (28 or 30).

[0038] Pipe couplings according to the invention permit non-deforming couplings to be used as installation ready couplings and require less energy to install because there is no significant energy expended to deform the couplings when effecting the pipe joint. This corresponds to lower fatigue when manually forming joints with hand tools as well as fewer battery changes when cordless electric power tools are used.

What is claimed is:

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

a plurality of coupling segments joined end to end surrounding a central axis and defining a central space for receiving said pipe elements, at least one of said coupling segments comprising:

a pair of projections positioned in spaced apart relation on opposite sides of said one coupling segment and extending toward said central axis, at least a portion of each of said projections being engageable with a respective one of said pipe elements, each of said projections having an arcuate surface facing said central axis,

wherein at least one of said projections comprises first and second outwardly facing surface portions, said first surface portion being angularly oriented relatively to said second surface portion, said first surface portion subtending an angle of about 35° to about 60° measured with respect to said central axis.

2. The pipe coupling according to claim 1, wherein said first surface portion is centered on a line extending from said central axis and oriented from an angle of about 30° to about 50° measured from a first line extending between a first end of said one coupling segment and a second end of said one coupling segment.

3. The pipe coupling according to claim 1, wherein said first surface portion has an orientation angle relative to said second surface portion from about 15° to about 60°.

4. The pipe coupling according to claim 2, wherein said at least one projection further comprises a third outwardly facing surface portion, said third surface portion being angularly oriented relatively to said second surface portion, said third surface portion subtending an angle along said projection of about 35° to about 60° measured with respect to said central axis, said second surface portion being positioned between said first and third surface portions.

5. The pipe coupling according to claim 4, wherein said third surface portion is centered on a line extending from said central axis and oriented from an angle of about 30° to about 50° measured from said first line.

6. The pipe coupling according to claim 4, wherein said third surface portion has an orientation angle relative to said second surface portion from about 15° to about 60°.

7. The pipe coupling according to claim 1, comprising only a first and a second of said segments joined end to end surrounding said central axis, said coupling further comprising a ring gasket positioned between said first and second segments, said ring gasket supporting said first and second segments in spaced apart relation sufficient to insert said pipe elements between said coupling segments.

8. The pipe coupling according to claim 7, wherein said first and second segments comprise sidewalls from which said projections extend and a back wall extending between said projections, said sidewalls being attached to said back wall, said sidewalls and said back wall together defining a pocket, said pocket being adapted to receive said ring gasket.

9. The pipe coupling according to claim 1, further comprising at least one notch positioned in at least one of said projections of each said segment, each said notch located at an end of one of said segments.

10. The pipe coupling according to claim 9, wherein said at least one notch comprises first and second notches positioned on opposite ends of said one segment.

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

first and second coupling segments joined end to end surrounding a central axis and defining a central space for receiving said pipe elements, each one of said coupling segments comprising:

first and second projections, each positioned in spaced apart relation on opposite sides of said coupling segments and extending toward said central axis, at least a portion of each of said projections being engageable with a respective one of said pipe elements, each of said projections having an arcuate surface facing said central axis,

wherein each of said projections comprises first and second outwardly facing surface portions, and wherein, for each of said projections, said first surface portion is angularly oriented relatively to said second surface portion, and wherein, for each of said projections, said first surface portion subtends an angle of about 35° to about 60° measured with respect to said central axis.

12. The pipe coupling according to claim 11, wherein, for each of said projections on each of said coupling segments, said first surface portion is centered on a line extending

from said central axis and oriented from an angle of about 30° to about 50° measured from a first line extending between a first end of said second coupling segment and a second end of said second coupling segment.

13. The pipe coupling according to claim 12, wherein, for each of said projections on each of said coupling segments, said first surface portion has an orientation angle relative to said second surface portion from about 15° to about 60°.

14. The pipe coupling according to claim 12, wherein each of said projections further comprises a third outwardly facing surface portion, wherein, for each of said projections, said third surface portion is angularly oriented relatively to said second surface portion, wherein, for each of said projections, said third surface portion subtends an angle along said projection of about 35° to about 60° measured with respect to said central axis, and wherein, for each of said projections, said second surface portion is positioned between said first and third surface portions.

15. The pipe coupling according to claim 14, wherein, for each of said projections on each of said coupling segments, said third surface portion is centered on a line extending from said central axis and oriented from an angle of about 30° to about 50° measured from said first line.

16. The pipe coupling according to claim 14, wherein, for each of said projections on each of said coupling segments, said third surface portion has an orientation angle relative to said second surface portion from about 15° to about 60°.

17. The pipe coupling according to claim 11, further comprising a ring gasket positioned between said first and second coupling segments, said ring gasket supporting said first and second segments in spaced apart relation sufficient to insert said pipe elements between said coupling segments.

18. The pipe coupling according to claim 17, wherein each of said coupling segments comprises sidewalls from which said projections extend and a back wall extending between said projections, and wherein, for each of said coupling segments, said sidewalls are attached to said back wall, said sidewalls and said back wall together define a pocket, and said pocket is adapted to receive said ring gasket.

19. The pipe coupling according to claim 11, wherein, each of said projections on each of said coupling segments further comprises at least one notch positioned in said projection, each said notch located at an end of one of said coupling segments.

20. The pipe coupling according to claim 19, wherein, for each of said projections on each of said coupling segments, said at least one notch comprises first and second notches positioned on opposite ends of said one segment.

21. A pipe coupling segment, used in a coupling for joining pipe elements in end to end relation, said coupling comprising a plurality of said segments joined end to end surrounding a central axis and defining a central space for receiving said pipe elements, said segment comprising:

a pair of projections positioned in spaced apart relation on opposite sides of said coupling segment and extending toward said central axis, at least a portion of each of said projections being engageable with a respective one of said pipe elements, each of said projections having an arcuate surface facing said central axis,

wherein at least one of said projections comprises first and second outwardly facing surface portions, and wherein, for said at least one projection, said first surface portion is angularly oriented relatively to said second surface portion, and wherein, for said at least one projection, said first surface portion subtends an angle of about 35° to about 60° measured with respect to said central axis.

22. The pipe coupling segment according to claim 21, wherein said first surface portion is centered on a line extending from said central axis and oriented from an angle of about 30° to about 50° measured from a first line extending between a first end of said coupling segment and a second end of said coupling segment.

23. The pipe coupling segment according to claim 22, wherein said first surface portion has an orientation angle relative to said second surface portion from about 15° to about 60°.

24. The pipe coupling segment according to claim 22, wherein said at least one projection further comprises a third outwardly facing surface portion, said third surface portion being angularly oriented relatively to said second surface portion, said third surface portion subtending an angle of about 35° to about 60° measured with respect to

said central axis, said second surface portion being positioned between said first and third surface portions.

25. The pipe coupling segment according to claim 24, wherein said third surface portion is centered on a line extending from said central axis and oriented from an angle of about 30° to about 50° measured from said first line.

26. The pipe coupling segment according to claim 24, wherein said third surface portion has an orientation angle relative to said second surface portion from about 15° to about 60°.

27. A method for coupling first and second pipe elements in end to end relation, said method comprising:

using a pipe coupling having first and second coupling segments attached to one another end to end surrounding a central axis and defining a central space, said coupling segments being supported in spaced apart relation on an elastic ring gasket, said coupling segments having adjustable connection members at each end for drawing said coupling segments toward said central space when said connection members are tightened, at least one of said coupling segments comprising:

a pair of projections positioned in spaced apart relation on opposite sides of said one coupling segment and extending toward said central axis, at least a portion of each of said projections being engageable with a respective one of said pipe elements, each of said projections having an arcuate surface facing said central axis,

wherein at least one of said projections comprises first and second outwardly facing surface portions, said first surface portion being angularly oriented relatively to said second surface portion, said first surface portion subtending an angle of about 35° to about 60° measured with respect to said central axis;

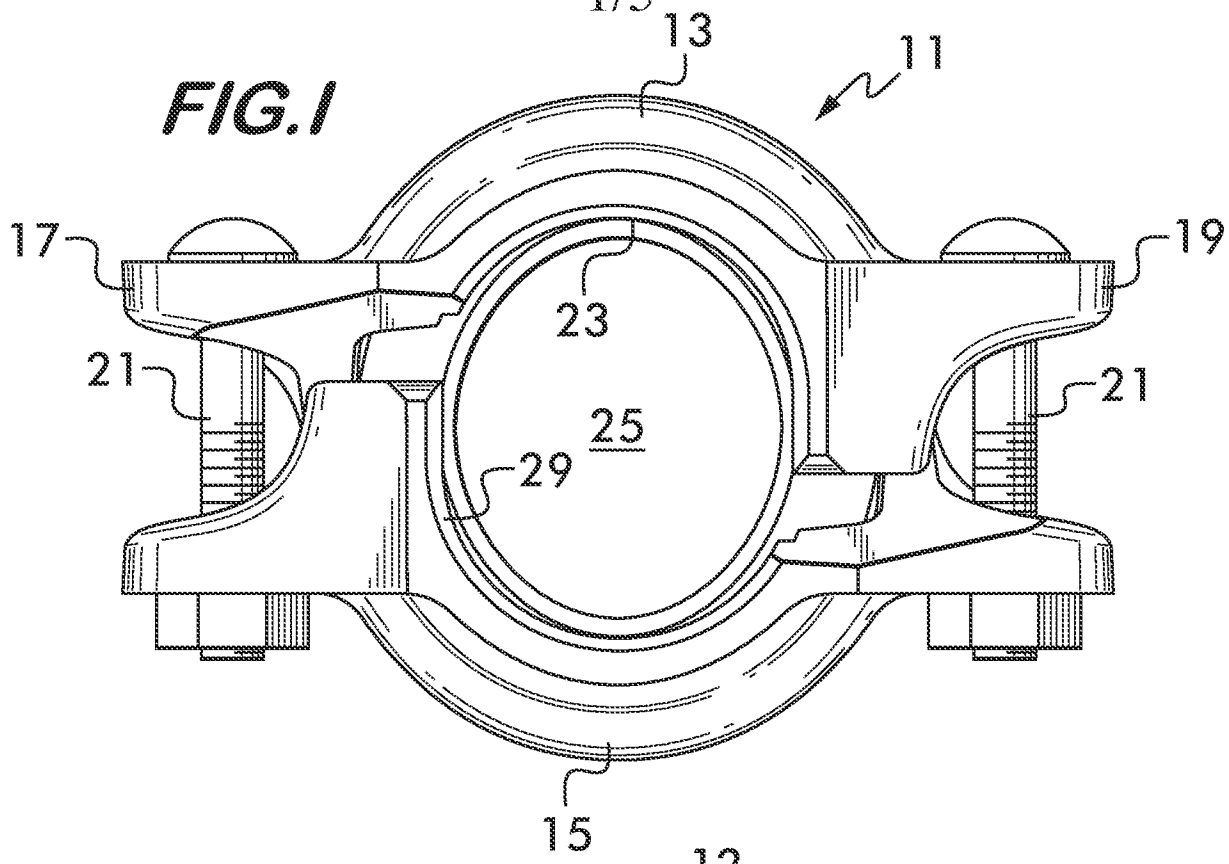
inserting said first pipe element into said central space from one side of said pipe coupling, said first pipe element engaging and thereby rotating said coupling segments relatively to one another about an axis passing through said connection members to provide clearance for inserting said first pipe element;

inserting said second pipe element into said central space from an opposite side of said pipe coupling; and

tightening said connection members and thereby drawing said coupling segments toward one another and into engagement with said first and second pipe elements to couple them in end to end relation.

28. The method according to claim 27, wherein said step of inserting said second pipe element into said central space from an opposite side of said pipe coupling comprises engaging said coupling segments with said second pipe element and thereby rotating said coupling segments relatively to one another about said axis passing through said connection members to provide clearance for inserting said second pipe element.

FIG.1



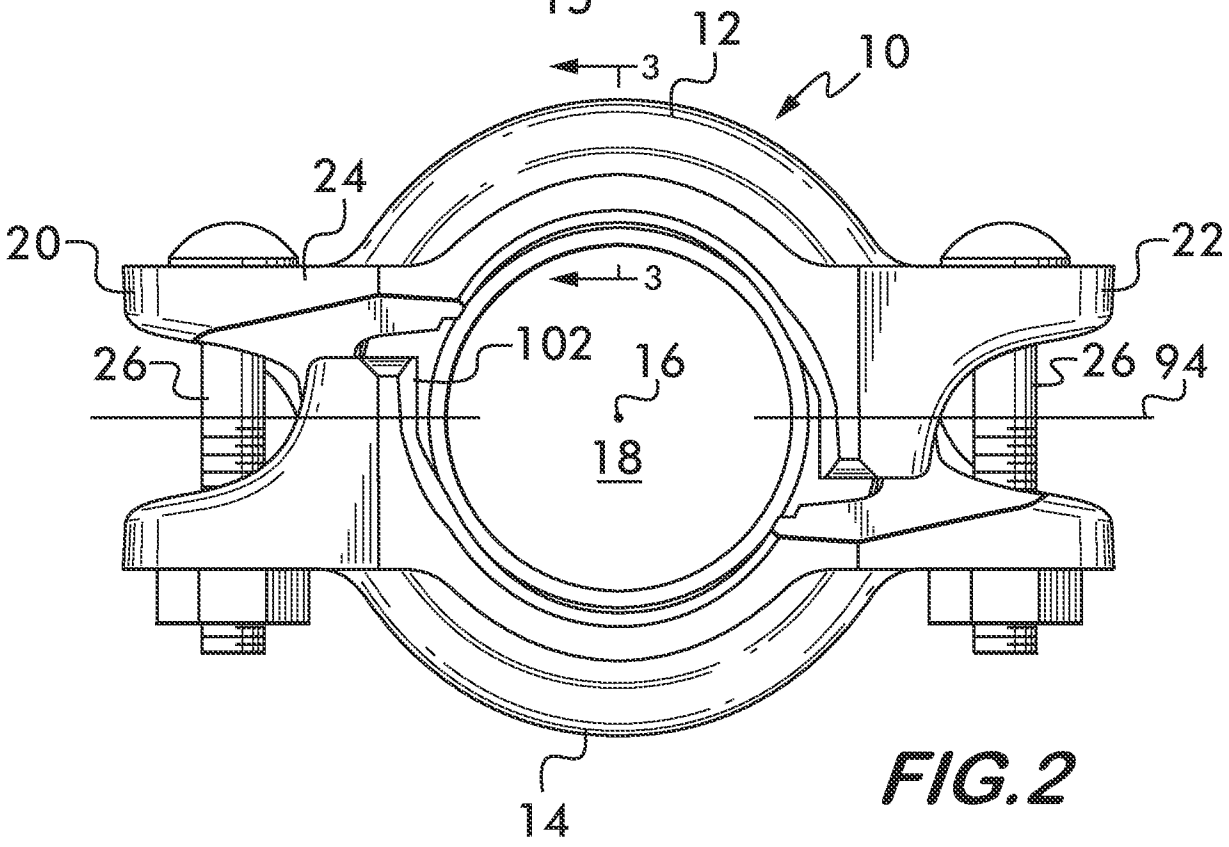


FIG.2

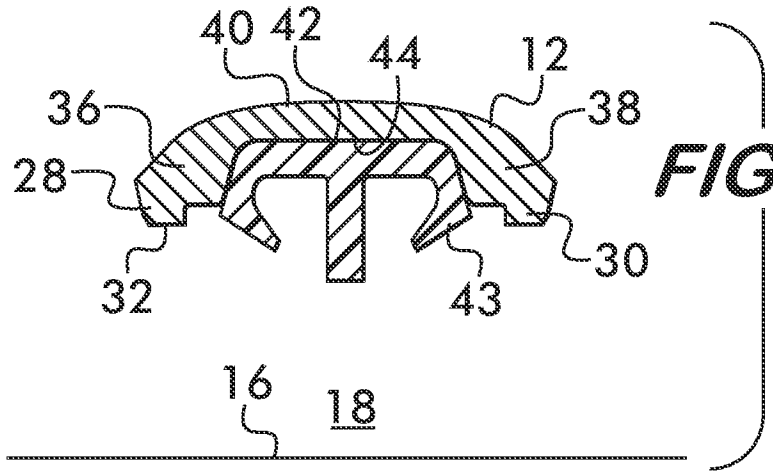


FIG.3

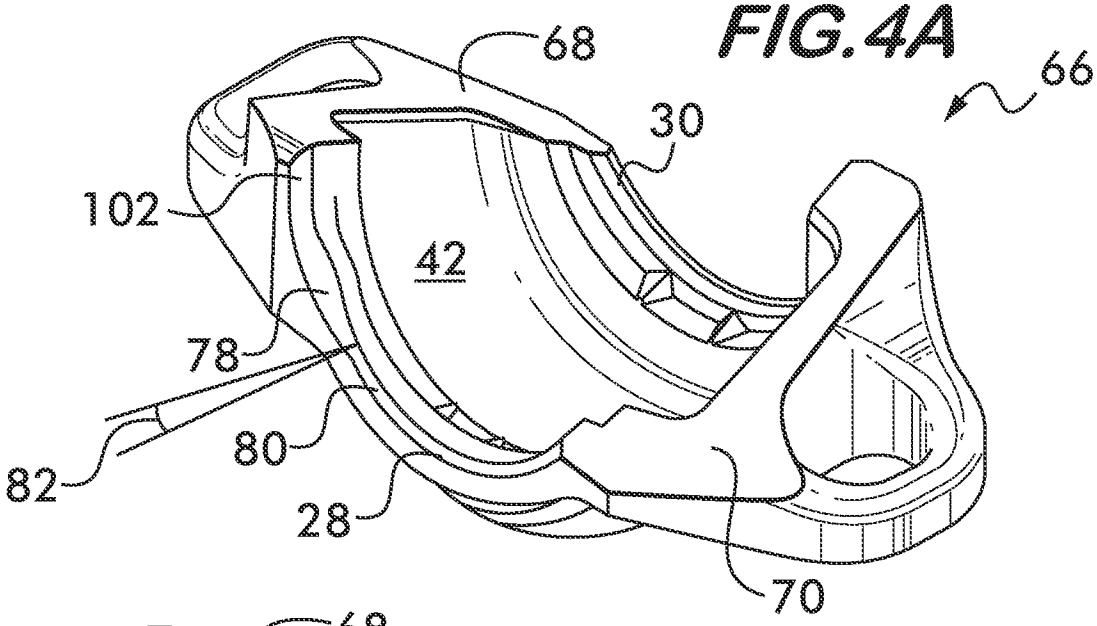


FIG.4A

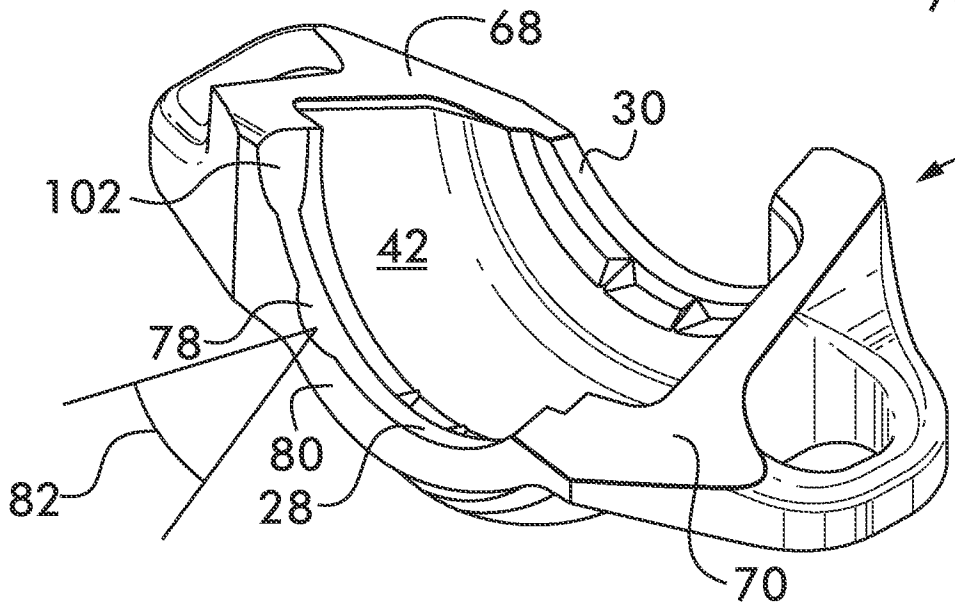


FIG.4B

FIG.5A

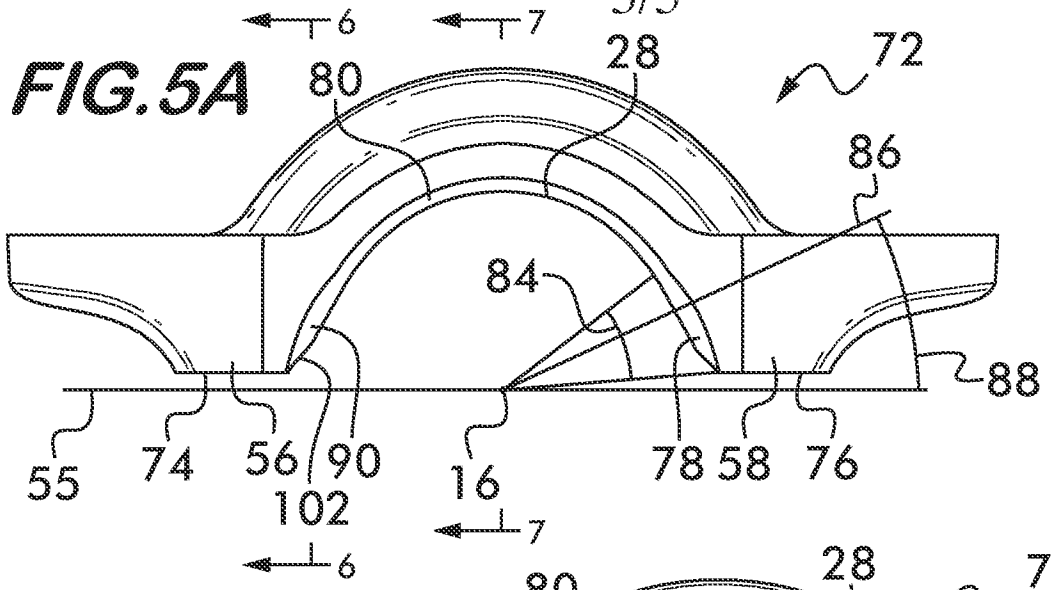
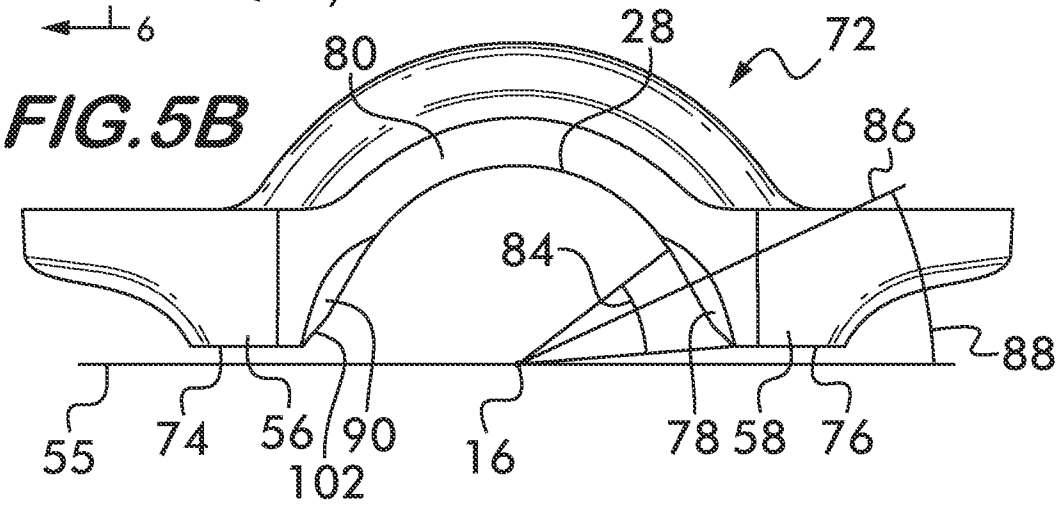


FIG.5B



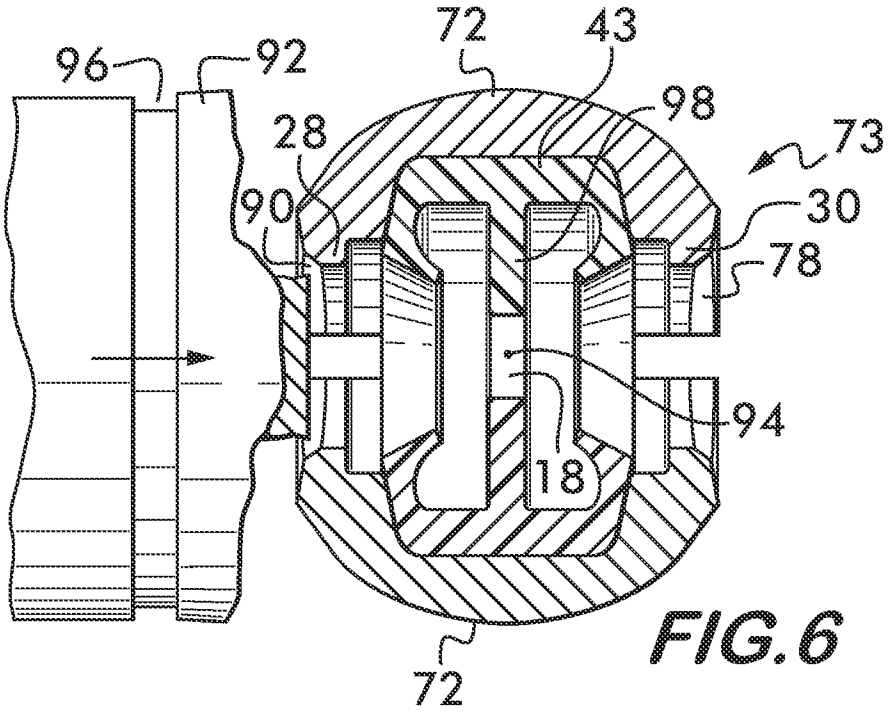


FIG.6

FIG. 7

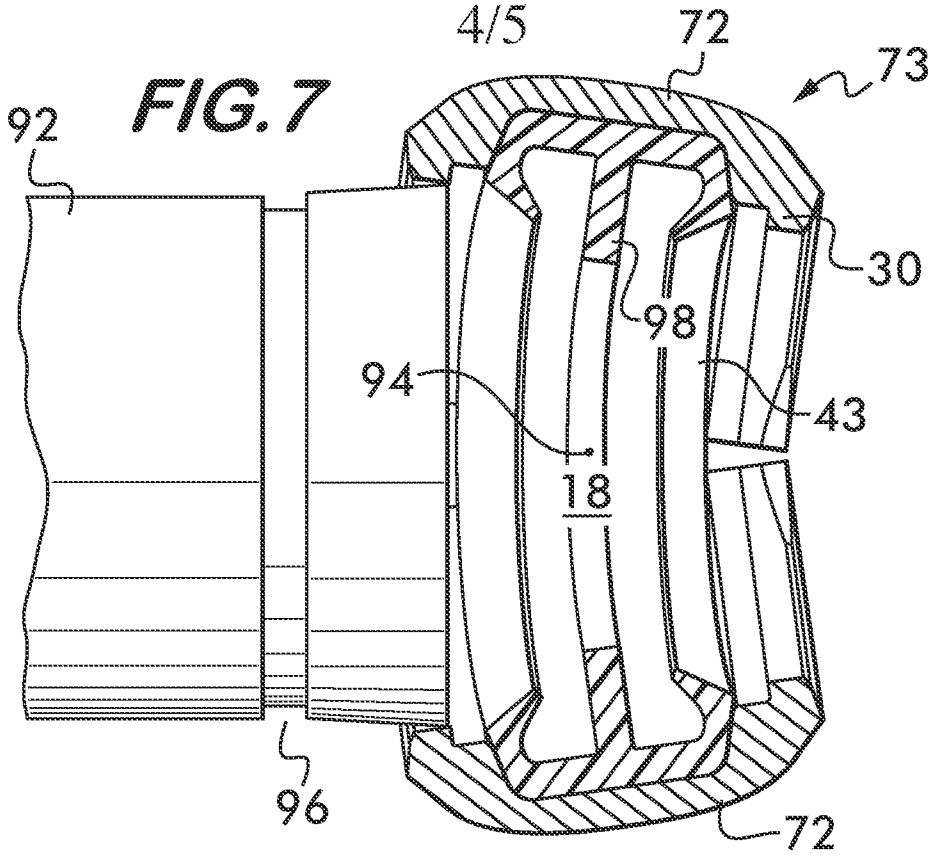


FIG. 8

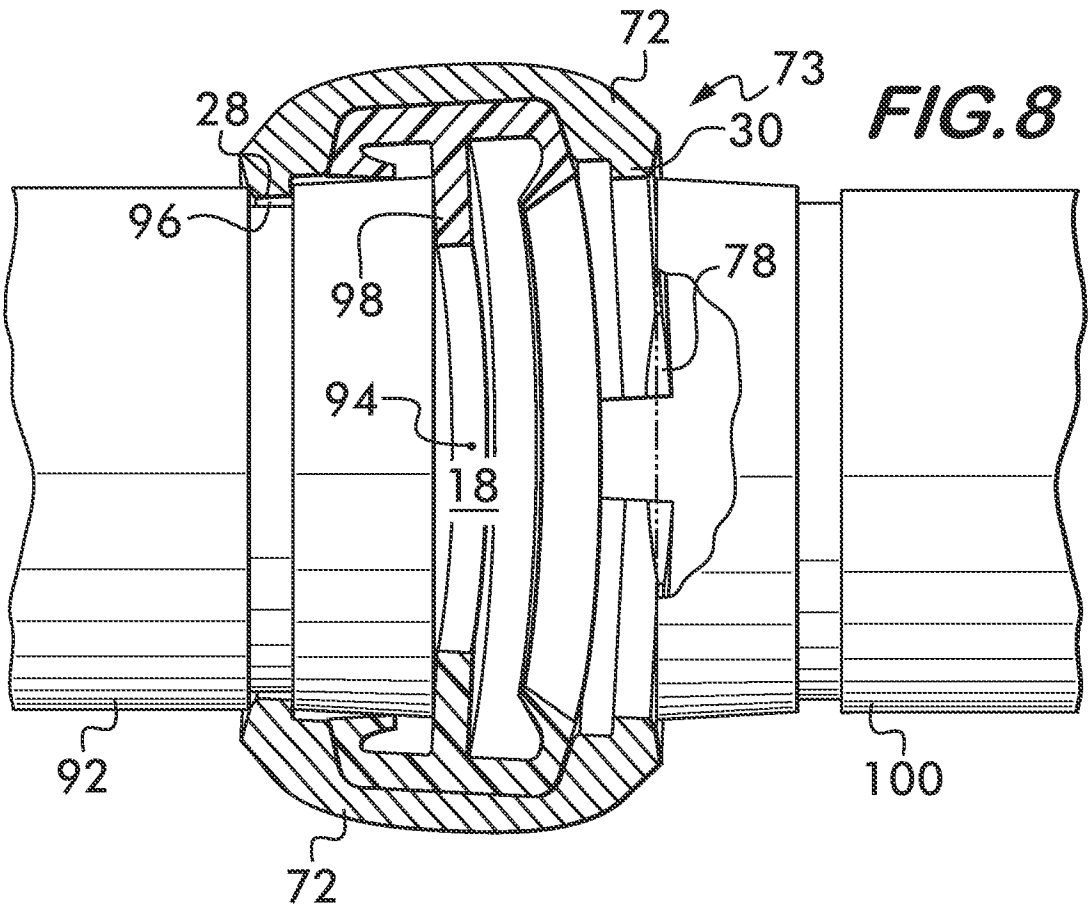
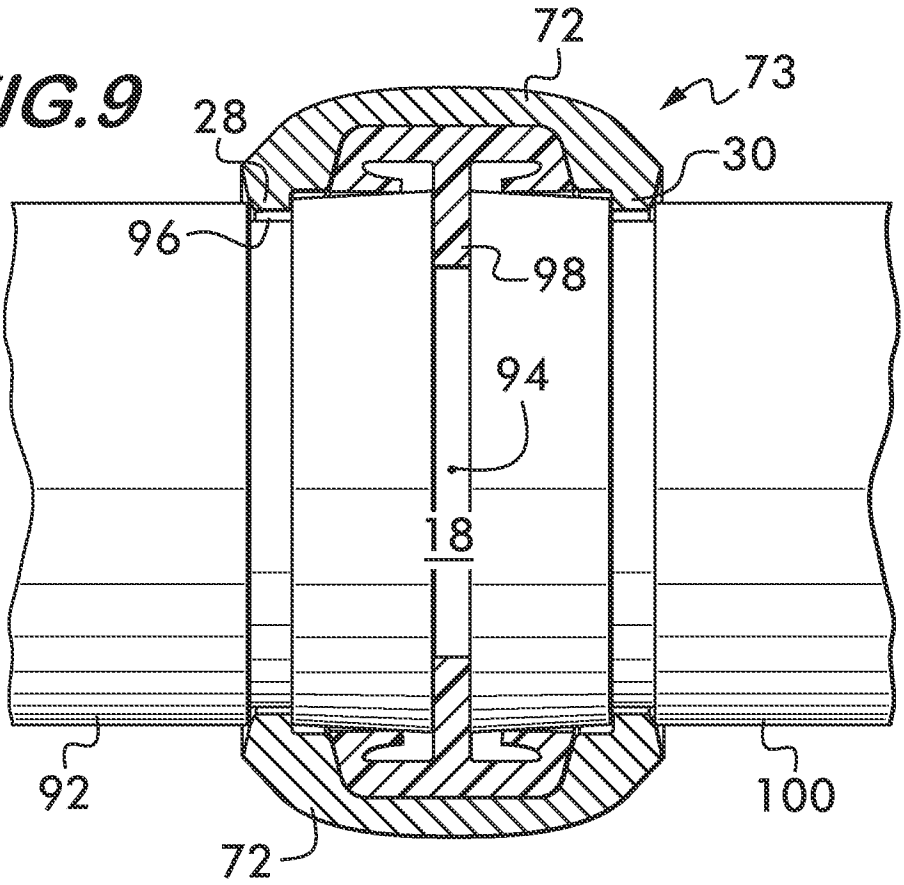


FIG.9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 12/64474

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - F16L 23/18 (2012.01)
USPC - 285/367
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
USPC: 285/367
IPC(8): F16L 23/18 (2012.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 285/110,252,253,335,337,362,367,369,372,373,400,405,406,412,417,419,420 (keyword limited; terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase; Google Patent; Google Scholar; Google; PubWEST (PGPB,USPT,USOC,EPAB,JPAB) Search terms used: pipe coupling segments arcuate angled surfaces coupler third surface chamfer ring gasket pocket fasteners projection extension tab ear connect joint circle washer tube channel plane edge wall well clasp nut closing adjust variable victaulic etc.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US 2003/0062718 A1 (RADZIK); 03 April 2003 (03.04.2003); entire document, especially Fig 3; para [0015]-[0021], [0023]	1, 7-11, 17-21, 27-28 ----- 2-6, 12-16, 22-26
Y	US 7,722,087 B2 (DOLE et al.); 25 May 2010 (25.05.2010); col 4, ln 10-34	2-6, 12-16, 22-26
A	US 6,105,972 A (GUZOWSKI); 22 August 2000 (22.08.2000); Fig. 1; col 4, ln 10-23	1-6
A	US 5,505,499 A (WALLBANK); 09 April 1996 (09.04.1996); Fig 2; col 2, ln 41-56	1-6
A	US 2011/0210546 A1 (GEESE et al.); 01 September 2011 (01.09.2011); Fig 1-2; para [0022]-[0023]	7-8
A	US 7,086,131 B2 (GIBB et al.); 08 August 2006 (08.08.2006); entire document	1-28

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 January 2013 (17.01.2013)	20 FEB 2013
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)