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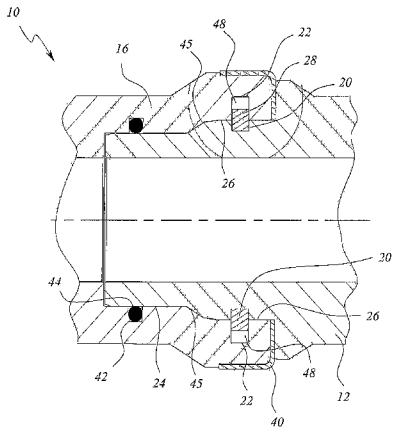
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(54) **Title:** A FLUID COUPLING



(57) **Abstract:** A fluid coupling (10) for connecting pressurised conduits. The coupling includes a spigot (12) for connection to a first conduit (14) and a socket (16) for connection to a second conduit (18). The spigot incorporates a first circumferential groove (20) disposed on its outer surface (24) and the socket incorporates a second circumferential groove (22) disposed on its inner surface (26). The spigot and the socket are adapted for axial engagement whereby the conduits are sealingly connected for fluid communication through the coupling and whereby the circumferential grooves are substantially in radial alignment. A releasable retaining member (28) is selectively moveable between a locked configuration, wherein the retaining member extends radially into both grooves to prevent axial disengagement of the spigot and the socket, and a release configuration wherein the retaining member is disposed substantially within one of the grooves and is substantially clear of the other to permit axial disengagement. The coupling further including a release means for moving the retaining member from the locked configuration to the release configuration, the release means including an opening (38) in a peripheral sidewall of the socket to provide radial access to the releasable retaining member.

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TITLE: A FLUID COUPLING

FIELD OF THE INVENTION

The present invention relates to fluid couplings.

The invention has been developed primarily as a high-pressure hydraulic fluid coupling for use in the mining industry and will be described hereinafter with reference to this application. However, it will be appreciated that the invention is not limited to this particular field of use.

BACKGROUND OF THE INVENTION

The following discussion of the prior art is intended to place the invention in an appropriate technical context and enable the associated advantages to be fully understood. However, any discussion of the prior art throughout the specification should not be considered as an admission that such art is widely known or forms part of the common general knowledge in the field.

Fluid couplings are typically comprised of male and female members connected in fluid-tight relationship by some form of retention mechanism to provide sealed fluid communication between adjoining sections of hose or pipe. Known retention mechanisms include threaded fasteners, nuts and sleeves, bolted retaining flanges, ball detents, ring clamps, and the like. The type of coupling, the operating pressure, the expected frequency of decoupling and the access conditions, often determine the required form of retention mechanism in any particular application. However, most known couplings are subject to problems or limitations.

For example, some retention mechanisms, once engaged, do not permit relative rotation between the hose or pipe sections connected to the respective male and female coupling members. This can induce additional stress and strain in both the adjoining pipe sections and the coupling, leading to accelerated wear, kinking, skiving and even premature failure. Some retention mechanisms such as those involving spring-loaded detent mechanisms function effectively at relatively low pressures, but cannot be readily modified to operate safely, consistently and reliably in high-pressure applications. Other forms of retention mechanism such as those involving complementary threaded formations on the respective coupling members are

adaptable to both low and high-pressure applications, but the processes of coupling and decoupling are relatively time-consuming. In hydraulic applications, particularly where a plurality of couplings are mounted side-by-side, access is often restricted, which further limits the applicability or efficacy of a number of conventional forms of retention mechanism. For example, threaded couplings require sufficient access for suitable spanners or wrenches, which become awkward and inefficient to use when subject to tight spatial constraints, particularly in high pressure and large scale applications where relatively heavy couplings and high torques are involved.

In an attempt to address some of these limitations, couplings utilising other forms of retention mechanism such as staple locks have been developed. Such couplings typically employ a generally U-shaped locking staple adapted for insertion transversely with respect to the coupling axis through complementary slots, apertures or grooves formed in the respective coupling members, to prevent decoupling. Such couplings are often used in the mining industry. They provide a relatively quick release mechanism, simply requiring withdrawal of the locking staple, while typically permitting relative rotation between the male and female members. Such couplings are disclosed more specifically, for example, in US Patent No. 4,260,184 in the name of Greenawalt et al and US Patent No. 4,923,350 in the name of Hinksman et al.

Greenawalt et al. describes a fluid coupling assembly in the form of male and female coupling members interconnected by a U-shaped locking staple. The staple is inserted into the assembly after the coupling members are connected to ensure that a fluid-tight seal is maintained. Greenawalt suggests that the particular cross-sectional configuration of the staple as described, provides optimum resistance to fatigue failure as well as improved tensile strength and consistent retention under normal operating conditions.

Whilst Greenawalt's fluid coupling is an improvement over the prior art, it has several inherent limitations. First, since the staple protrudes past the external periphery of the coupling, it is susceptible to catching on adjacent couplings or other nearby equipment, which can result in inadvertent ejection of the staple and consequential disengagement of the coupling. Staple locks are also susceptible to "walk-out" under cyclic loading. If this occurs while the fluid line is pressurised, a dangerous release of the pressurised fluid may result. This has been the source of

fatalities in the past, particularly in the mining industry where high hydraulic pressures are used in confined spaces. Additionally, this design is inherently inefficient because the effective area of overlap between the staple and the slots or grooves on the respective coupling members is relatively small, and therefore only a relatively small portion of the total volume of the staple acts to resist the axial separation load induced by the fluid pressure in the lines. As a consequence of the resultant stress concentrations, relatively large staples and associated fittings are required for a given pressure rating, and the staples are more susceptible to failure as a result of localised material weaknesses or manufacturing flaws.

Hinksman et al. teaches an improved type of fluid coupling staple to be used in a similar configuration to that described by Greenawalt. In contrast to Greenawalt, the staple used in Hinksman's coupling is composed of two fixedly connected half portions. Hinksman teaches that this construction provides a higher resistance to dynamic loading than that of a solid staple.

By current standards, both the above types of staple lock coupling were designed for relatively low hydraulic pressures. Presently in the mining industry, staple type couplings are being increasingly subjected to and used with higher system pressures to achieve increased production rates in more demanding circumstances with equipment of the same or reduced size. In higher pressure applications, the inherent flaws of these designs become increasingly evident and problematic. Accordingly, there exists a need for a more efficient and robust coupling design, which will accommodate further increases in hydraulic pressure without compromising the physical size or reliability of the coupling itself.

It is an object of the present invention to overcome or ameliorate one or more of the disadvantages of the prior art, or at least to provide a useful alternative.

SUMMARY OF THE INVENTION

According to the invention, there is provided a fluid coupling for connecting pressurised conduits, the coupling including:

a spigot adapted for connection to a first conduit, the spigot having a first circumferential groove disposed on an outer surface thereof;

a socket adapted for connection to a second conduit, the socket having a second circumferential groove disposed on an inner surface thereof;

the spigot and the socket being adapted for axial engagement whereby the first and second conduits are sealingly connected for fluid communication through the coupling and whereby the first and second circumferential grooves are substantially in radial alignment;

a releasable retaining member being selectively moveable between a locked configuration wherein the retaining member extends radially into both of the grooves to prevent axial disengagement of the spigot and the socket, and a release configuration wherein the retaining member is disposed substantially within one of the grooves and clear of the other of the grooves thereby to permit the axial disengagement; and

release means adapted to permit movement of the retaining member from the locked configuration to the release configuration, said release means including an opening disposed in a peripheral sidewall of said socket to provide radial access to said releasable retaining member.

Preferably, in the release configuration, the retaining member is disposed substantially within the first circumferential groove and substantially clear of the second groove thereby to permit axial disengagement of the coupling. Alternatively, in another preferred form, the retaining member in the release configuration is disposed substantially within the second circumferential groove and substantially clear of the first groove. It is preferred that the spigot, socket and grooves are substantially annular in transverse cross-sectional profile.

The retaining member preferably includes a generally arcuate body portion and two circumferentially spaced end portions extending generally outwardly from the body to define respective release lugs. More preferably, the retaining member is substantially Ω-(omega)-shaped. The body portion of the retaining member preferably has a substantially square, rectangular, oval or round cross-sectional profile.

The outer surface of the spigot and the inner surface of the socket preferably have substantially complementary profiles.

The coupling preferably also includes bias means to bias the retaining member towards the locked configuration. More preferably, the retaining member is formed from a resilient material, the resilient material constituting the bias means. The resilient material is preferably spring steel.

Preferably, the opening in the socket is adapted to provide access to the release lugs of the retaining member. The coupling may also include a removable cover to selectively close and seal the opening. The cover is preferably formed from an elastomeric material.

An expansion tool is preferably adapted for insertion through the opening to circumferentially spread the release lugs and resiliently expand the retaining member fully into the second groove, and into the release configuration. This preferably provides a temporarily unobstructed path permitting the spigot to be inserted into or withdrawn from the socket.

The socket preferably includes a circumferential sealing groove disposed on the inner surface, the sealing groove being adapted to house a circumferential sealing member adapted for sealing engagement with the adjacent outer surface of the spigot thereby to provide a fluid seal between the spigot and socket in the locked configuration. In an alternative embodiment, the sealing groove is formed on the outer surface of the spigot. Preferably, the sealing member is formed from an elastomeric material. In one preferred embodiment, the sealing member takes the form of an O-ring. Multiple seals may also be provided, if required.

Preferably, the coupling is configured to permit relative rotation between the spigot and socket in the locked configuration. Alternatively, however, the coupling may be configured to prevent relative rotation between the spigot and socket in the locked configuration.

Preferably, the retaining member does not extend past the outer periphery of the socket in the locked configuration. Preferably, the retaining member is laminated.

The coupling is preferably adapted to operate in a pressure range of 2,000 to 20,000psi, more preferably in a range of 5,000 to 20,000psi, and even more preferably in a range of 10,000 to 20,000psi. Most preferably, the coupling is adapted to operate in these respective pressure ranges with a safety factor of at least 3:1, and ideally 4:1.

The coupling is preferably adapted to join conduits with an internal diameter of between 5mm and 100mm, and more preferably between 10mm and 80mm.

The internal diameters of the spigot and socket at their narrowest points are preferably no less than the nominal diameter of the respective conduits to which they are connected. The bore of the coupling is preferably consistent between the spigot and socket to minimise turbulence and pressure drop across the coupling.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a partly cut-away plan view of a fluid coupling according to the invention;

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

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

Figures 4a to 4e show five preferred embodiments of a retaining member to be used with the fluid coupling of Figure 1; and

Figure 5 is a cross-sectional view taken along line 3-3 of Figure 1, showing a alternative form of release tool.

PREFERRED EMBODIMENT OF THE INVENTION

Referring to the drawings, the invention provides a fluid coupling 10 including a spigot 12 adapted for connection to a first conduit 14 and a complementary socket 16 adapted for connection to a second conduit 18. The spigot incorporates a first circumferential groove 20 disposed on an outer surface 24 and the socket incorporates a second circumferential groove 22 disposed on inner surface 26. As shown in Figure 2, the spigot and socket are adapted for axial engagement in a coupled configuration whereby the first and second conduits are sealingly connected for fluid communication and the first and second grooves are disposed in substantial radial alignment, in the sense of providing at least some degree of relative overlap therebetween.

A releasable retaining member 28 is selectively movable between a locked configuration wherein the retaining member extends radially into both grooves to

prevent axial disengagement of the spigot and socket, and a release configuration wherein the retaining member is disposed substantially within one of the grooves and clear of the other groove, to permit axial disengagement of the coupling. In the illustrated embodiment, the release configuration is defined by the retaining member being disposed substantially within the first or outer circumferential groove 20 in the socket and clear of the second or inner groove 22 on the spigot. Conversely, in an alternative embodiment (not shown), the release configuration is defined by the retaining member being disposed substantially within the second (inner) groove and clear of the first (outer) groove.

The fluid coupling also includes release means to permit movement of the retaining member from the locked configuration to the release configuration.

As best shown in Figure 3, the spigot 12, socket 16, and grooves 20 & 22 have substantially annular transverse cross-sectional profiles such that in the coupled configuration, a high-pressure fluid is permitted to flow freely between the adjoining conduits through a central region 30 of the coupling, which is substantially circular in cross-section.

Referring now to Figures 4a to 4e, the retaining member 28 is generally Ω-(omega)-shaped, including a generally arcuate body portion 32 and two circumferentially spaced end portions extending radially outwardly to define respective release lugs 34. The arcuate body of the retaining member preferably extends angularly for more than 180°, more preferably for more than 270°, and ideally for more than 300°. In this regard, it will be appreciated that the first and second circumferential grooves on the respective coupling members may be substantially co-extensive with the body of the retaining member or may extend for 360° (as shown), subject to relevant design constraints.

The retaining member is formed from a resilient material such as spring or stainless steel, thereby providing inherent bias means disposed to bias the retaining member towards the locked configuration. It will be appreciated, however, that other forms of bias means such as mechanical or pneumatic spring mechanisms, or electromagnetic biasing systems may alternatively be used.

The retaining member 28 may have a square, rectangular, circular or oval cross-sectional profile as depicted by Figures 4a to 4d respectively. Other suitable cross-

sectional profiles may also be used. In addition, Figure 4b shows a retaining member that is laminated, comprising two fixedly connected half-sections 28a and 28a. As a variation on this embodiment, the retaining member may be formed primarily as a unitary component, but may include a slit or slits 36 to confer the characteristics of a partially or semi-laminated construction. In this regard, lamination or partial lamination of the retaining member may provide a higher resistance to dynamic loading than that of a solid or unitary construction.

Figure 4e shows a further embodiment of the retaining member 28, having a plurality of segments 32a secured to the arcuate body portion 32 by pins 52 or other suitable attachment means such as screws, bolts, rivets, adhesives, welds, crimps, brackets, clips, interference fittings, or the like. This multi-segment design provides additional flexibility in terms of the annular bearing surface area, the threshold force required to separate the release lugs, and the use of composite materials in construction.

The release means is defined by an opening in the form of an elongate access slot 38 disposed in the socket. The slot allows access to the release lugs 34 of the retaining member thereby to permit movement of the retaining member from the locked to release configuration. A removable elastomeric boot 40, which is mechanically retained between the spigot and the socket, is used to cover and seal the access slot, thereby restricting the ingress of extraneous debris in use. The boot is sufficiently flexible to allow for its displacement during assembly and disassembly of the coupling, yet has sufficient shape memory to return to act as a seal for the access slot.

The socket further includes a circumferential sealing groove 42 disposed on the inner surface 26. The sealing groove houses an elastomeric circumferential fluid seal, in the form of an O-ring 44, for sealing engagement with the outer surface 24 of the spigot to provide a fluid seal between the spigot and socket in the locked configuration. Further sealing is provided by the outer surface of the spigot and the corresponding inner surface of the socket having complementary profiles adapted for close-fitting engagement in the coupled configuration. These profiles also include corresponding tapered sections 45 to facilitate initial alignment.

To connect the spigot to the socket, the retaining member 28 is first placed within the socket such that it rests within the second or outer circumferential groove. As best shown in Figure 3, a suitable release tool such as clamp 46 incorporating an extraction wedge 47, is then inserted through the access slot 38 and engaged to circumferentially spread the release lugs, thereby resiliently expanding the retaining member fully into the second groove 22, into the release configuration. The radial expansion of the retaining member is accommodated by a void region 48 in the second groove. This expansion in turn provides a temporarily unobstructed path permitting the spigot to be inserted axially into the socket.

Figure 5 shows an alternative release tool in the form of a caliper 50, which may be used to spread the release lugs 34 when using the segmented retaining member of Figure 4e, which may be designed to require a relatively lower separation force.

Once the spigot is fully inserted into the socket in the coupled configuration, the release tool is removed, whereupon the retaining member resiliently contracts so as to extend into the first circumferential groove 20 on the socket. Since the retaining member now extends radially into both grooves, the locked configuration is established in which the spigot is prevented from being axially withdrawn from the socket. In this configuration, the O-ring provides a static seal between the spigot and socket so as to maintain a leak free joint.

It will be noted that the illustrated coupling 10 allows relative rotation between the spigot and socket in the locked configuration. However, in other embodiments (not shown), the coupling may be configured to prevent relative rotation between the spigot and socket in the locked configuration, if desired. This will depend in part upon the angular extent of the respective inner and outer grooves, as previously discussed.

To disassemble the coupling, the release tool is re-engaged with the release lugs and the retaining member is expanded again into the release configuration, wherein the body of the retaining member is contained substantially within the second circumferential groove, clear the first groove. This allows the spigot to be freely withdrawn.

It will be appreciated that the body of the retaining member extends simultaneously into both grooves for substantially all of its length in the locked

configuration, and hence shear forces resulting from axial loads on the coupling are distributed over substantially the entire effective length of the retaining member. Consequently, a fluid coupling of given size is able to support significantly higher axial separation loads relative to previously known designs, particularly those using staples. More specifically, the retaining member of the present invention presents a circumferential area in shear corresponding to at least 66% of the circumference of the spigot, representing an effective increase of more than 100% over comparable U-shaped staples. This allows operating pressures in the range of 10,000 to 20,000psi, with a safety factor of 4:1, in a comparably compact assembly. At the same time, the coupling and decoupling processes are substantially faster and more reliable than those of threaded fittings, which can be damaged by debris, are susceptible to operator error through thread-stripping or incorrect torque setting, and are time-consuming to decouple and reconnect.

Advantageously also, the retaining member of the present invention is fully contained, and does not extend past the outer periphery of the socket in the locked configuration. It is therefore less vulnerable to inadvertent release or damage, and is less likely to cause injury to people or damage adjacent componentry than is the case with previously known staple designs. It is also not susceptible to inadvertent "walk-out" in response to cyclic loading.

These characteristics make the present invention particularly applicable to high-pressure applications, such as those in the mining industry, where cost, maximum pressure rating, size and weight of equipment, ease of use, consistency and reliability of performance and conservative safety factors are all significant considerations. In these respects, the invention represents a practical and commercially significant improvement over the prior art.

Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms. In particular, it should be appreciated that the retaining member, the associated bias means, the release tool and the corresponding release lugs, as well as the socket and spigot themselves may take a variety of shapes and configurations, other than those specifically illustrated.

CLAIMS

1. A fluid coupling for connecting pressurised conduits, said coupling including:

a spigot adapted for connection to a first conduit, said spigot having a first circumferential groove disposed on an outer surface thereof;

a socket adapted for connection to a second conduit, said socket having a second circumferential groove disposed on an inner surface thereof;

said spigot and said socket being adapted for axial engagement whereby said first and second conduits are sealingly connected for fluid communication through the coupling and whereby said first and second circumferential grooves are substantially in radial alignment;

a releasable retaining member being selectively moveable between a locked configuration wherein the retaining member extends radially into both of said grooves to prevent axial disengagement of said spigot and said socket, and a release configuration wherein the retaining member is disposed substantially within one of said grooves and is substantially clear of the other of said grooves thereby to permit said axial disengagement; and

release means adapted to permit movement of the retaining member from the locked configuration to the release configuration, said release means including an opening disposed in a peripheral sidewall of said socket to provide radial access to said releasable retaining member.

2. A fluid coupling according to claim 1, wherein in said release configuration, said retaining member is disposed substantially within said first circumferential groove and is substantially clear of said second groove thereby to permit axial disengagement of said coupling.

3. A fluid coupling according to claim 1, wherein in said release configuration, said retaining member is disposed substantially within said second circumferential groove and is substantially clear of said first groove thereby to permit axial disengagement of said coupling.

4. A fluid coupling according to any one of claims 1 to 3, wherein said spigot, said socket and said grooves are substantially annular in transverse cross-sectional profile.

5. A fluid coupling according to any one of the preceding claims, wherein said retaining member includes a generally arcuate body portion and two circumferentially

spaced end portions extending generally outwardly from said body portion to define respective release lugs.

6. A fluid coupling according to claim 5, wherein said retaining member is substantially Ω-(omega)-shaped.

7. A fluid coupling according to claim 5 or claim 6, wherein said body portion of the retaining member has a substantially square, rectangular, oval or round cross-sectional profile.

8. A fluid coupling according to any one of the preceding claims, wherein the outer surface of said spigot and the inner surface of said socket have substantially complementary profiles.

9. A fluid coupling according to any one of the preceding claims, including bias means to bias said retaining member towards said locked configuration.

10. A fluid coupling according to claim 9, wherein said retaining member is formed from a resilient material, said resilient material constituting said bias means.

11. A fluid coupling according to claim 10, wherein said resilient material is spring steel.

12. A fluid coupling according to any one of claims 5 to 11, wherein said opening is adapted to provide access to said release lugs of said retaining member.

13. A fluid coupling according to claim 12, including a removable cover to selectively close and seal said opening.

14. A fluid coupling according to claim 13, wherein said removable cover is formed from an elastomeric material.

15. A fluid coupling according to any one of claims 12 to 14, wherein said release means further include a release tool, adapted for insertion through the opening to engage the release lugs and move the retaining member into the release configuration.

16. A fluid coupling according to claim 15, wherein said insertion provides an unobstructed path permitting said spigot to be axially engaged with or disengaged from said socket.

17. A fluid coupling according to any one of the preceding claims, wherein said socket includes a circumferential sealing groove disposed on its inner surface, said sealing groove being adapted to house a circumferential sealing member adapted for

sealing engagement with the outer surface of said spigot thereby to provide a fluid seal between said spigot and said socket in said locked configuration.

18. A fluid coupling according to any one of claims 1 to 16, wherein said spigot includes a circumferential sealing groove disposed on its outer surface, said sealing groove being adapted to house a circumferential sealing member adapted for sealing engagement with the inner surface of said socket thereby to provide a fluid seal between said spigot and said socket in said locked configuration.

19. A fluid coupling according to claim 17 or claim 18, wherein said sealing member is formed from a flexible elastomeric material.

20. A fluid coupling according to any one of claims 17 to 19, wherein said sealing member takes the form of an O-ring.

21. A fluid coupling according to any one of claims 17 to 20, wherein multiple seals are provided.

22. A fluid coupling according to any one of the preceding claims, wherein said coupling is configured to permit relative rotation between said spigot and socket in said locked configuration.

23. A fluid coupling according to any one of claims 1 to 21, wherein said coupling is configured to prevent relative rotation between said spigot and socket in said locked configuration.

24. A fluid coupling according to any one of the preceding claims, wherein said retaining member does not extend radially beyond an outer periphery of said socket in said locked configuration.

25. A fluid coupling according to any one of the preceding claims, wherein said retaining member is laminated.

26. A fluid coupling according to any one of the preceding claims, wherein said coupling is adapted to operate in a pressure range of between 13.8 and around 138 MPa (2,000 to 20,000 psi).

27. A fluid coupling according to any one of the preceding claims, wherein said coupling is adapted to operate in a pressure range of between 34.5 and around 138 MPa (5,000 to 20,000 psi).

28. A fluid coupling according to claim 26 or claim 27, wherein said coupling is adapted to operate in said pressure range with a safety factor of at least 3:1.

29. A fluid coupling according to claims 26 or claim 27, wherein said coupling is adapted to operate in said pressure range with a safety factor of at least 4:1.

30. A fluid coupling according to any one of the preceding claims, wherein said coupling is adapted to join conduits with an internal diameter of between 5mm and around 100mm.

31. A fluid coupling according to any one of the preceding claims, wherein said coupling is adapted to join conduits with an internal diameter of between 10mm and around 80mm.

32. A fluid coupling according to any one of the preceding claims, wherein internal diameters of said spigot and said socket at their narrowest points are no less than nominal internal diameters of the respective conduits to which they are connected.

33. A fluid coupling according to any one of the preceding claims, wherein the coupling has an internal bore that is substantially constant when the spigot and socket are engaged, thereby in use to minimise turbulence and pressure loss across the coupling.

34. A fluid coupling substantially as herein described with reference to any one of the embodiments of the invention illustrated or described in the accompanying drawings and/or examples.

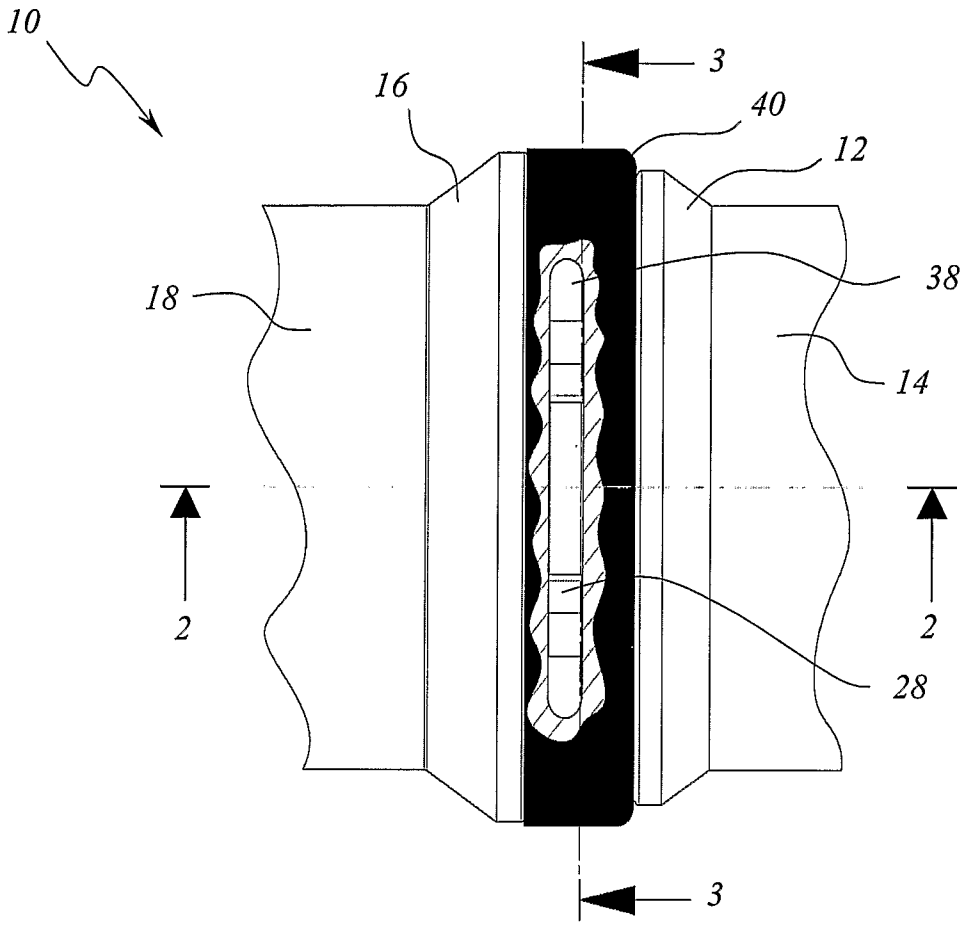


Fig. 1

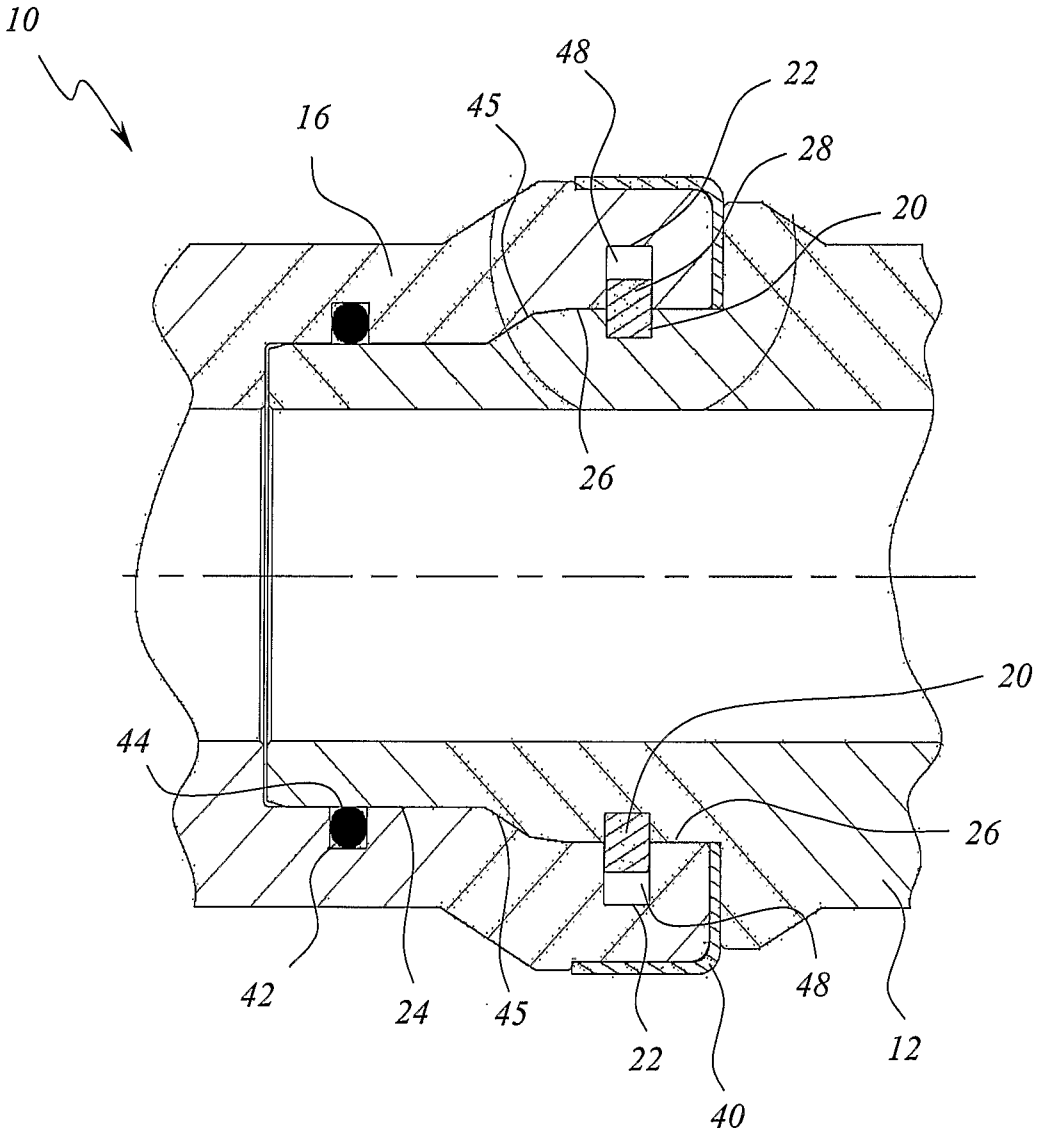


Fig. 2

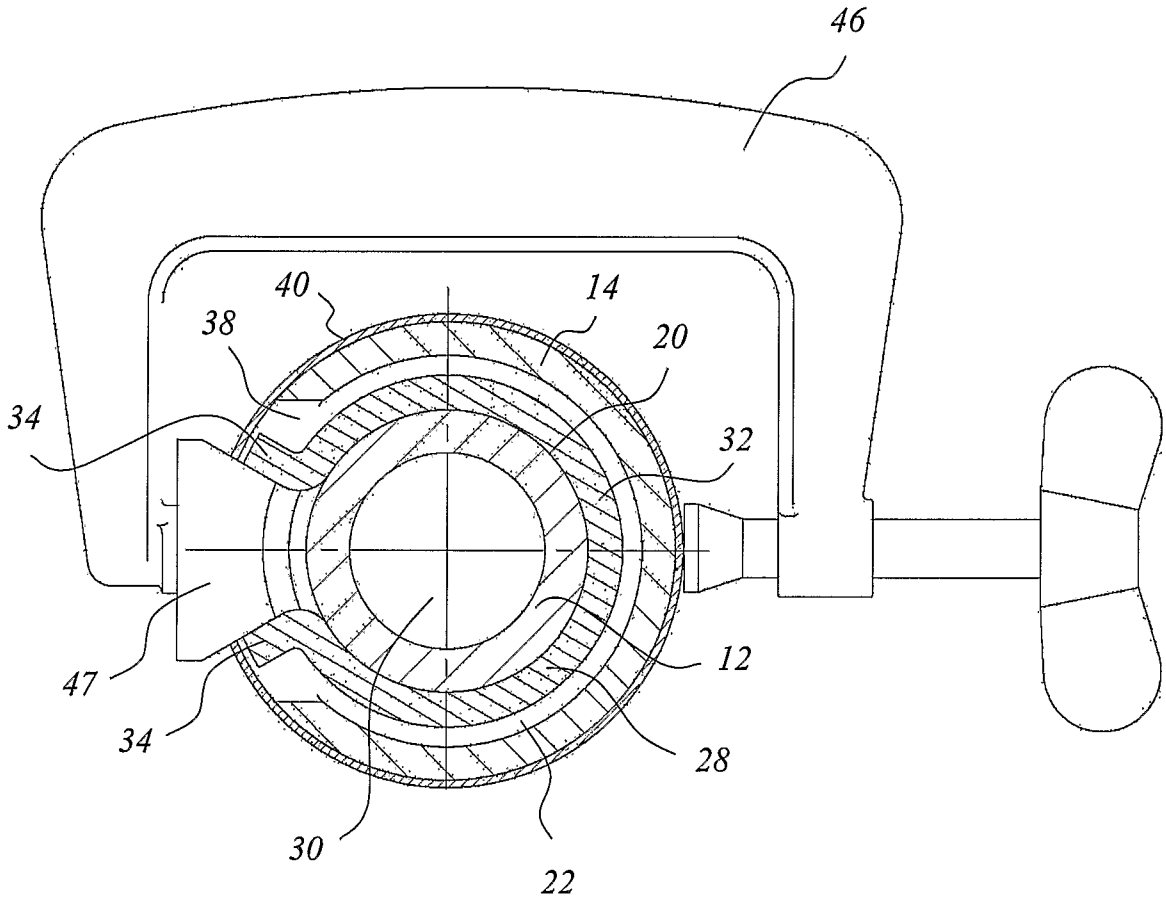


Fig. 3

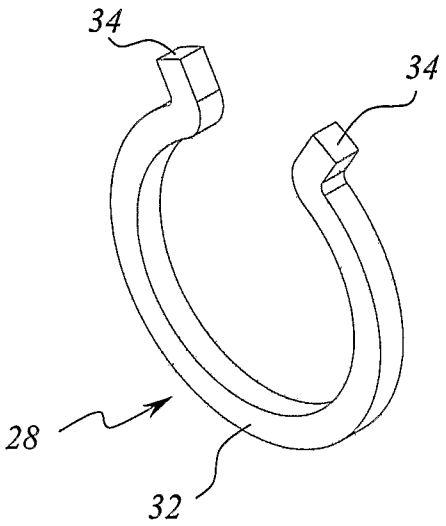


Fig. 4a

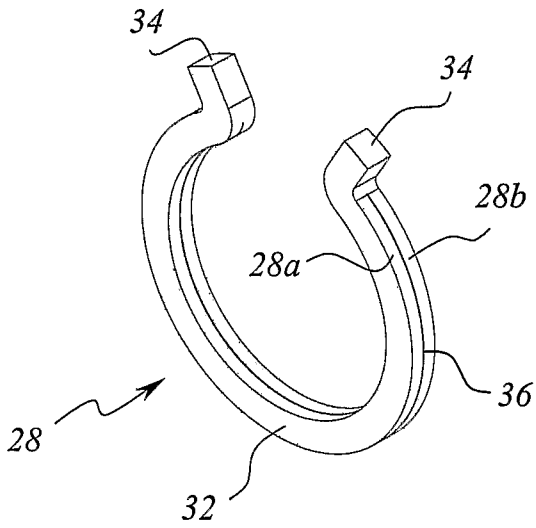


Fig. 4b

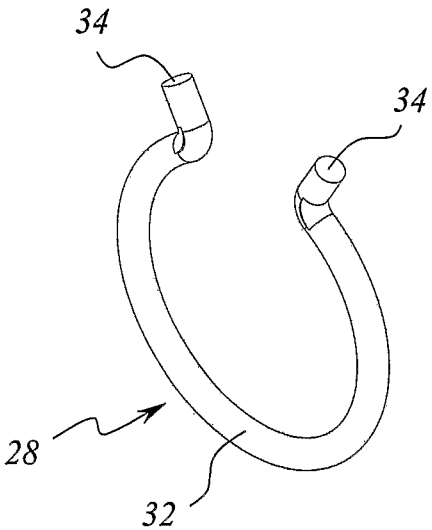


Fig. 4c

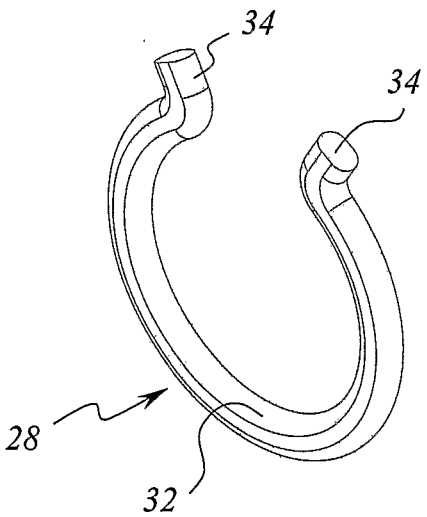


Fig. 4d

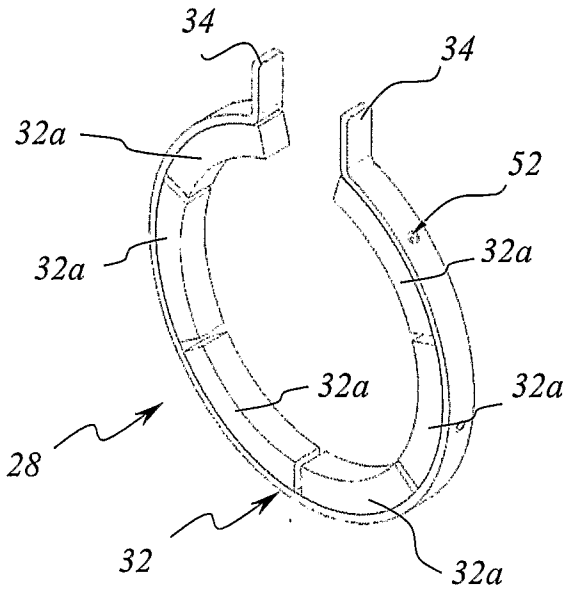


Fig. 4e

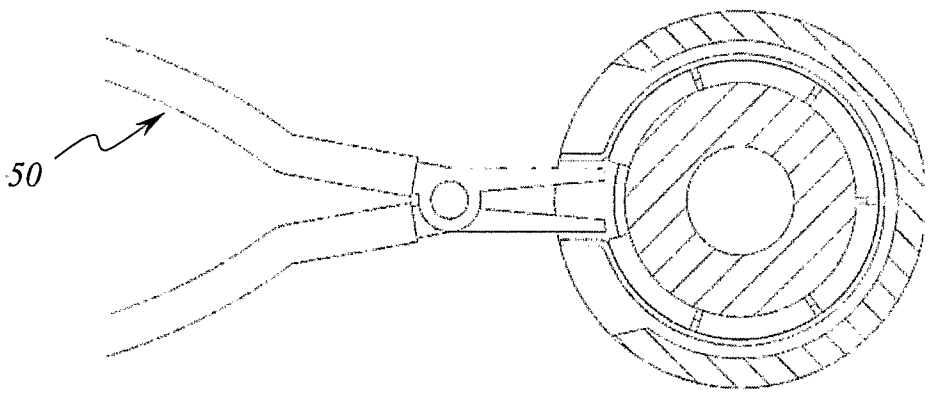


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2006/000902

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

F16L 21/08 (2006.01) ***F16L 25/00*** (2006.01) ***F16L 37/00*** (2006.01)

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)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent DWPI - F16L with keywords pipe, tube, coupling, joint, connection, groove, key, channel, retaining, spigot, clip, radial, annular, circumferential, release, remove, access, window, aperture, hole, opening and the like

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5498042 A (DOLE) 12 March 1996 Full description, All figures	1-29, 32-33
Y	Full description, All figures	30, 31
Y	US 5172941 A (PAWELZIK et al.) 22 December 1992 Full description, Figs 1 & 2	30, 31
A	EP 1336790 A1 (ESSEF CORPORATION) 20 August 2003 Full description, All figures	1-33

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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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
11 August 2006	31 AUG 2006
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **JAGDISH BOKIL** Telephone No : (02) 6283 2371

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2006/000902

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 1995/006221 A1 (H A PRINCE BEHEER BERGEN OP ZOOM B.V.) 2 March 1995 Full description, All figures	1-33
A	WO 1997/048937 A1 (VICTAULIC COMPANY OF AMERICA) 24 December 1997 Full description, All figures	1 - 33

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2006/000902

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5498042	AU	40871/96	CA	2166760	EP	0784183
		JP	9196272	SG	43714		
US	5172941	DE	4034088				
EP	1336790	AU	2003200453	CA	2418844	JP	2004003607
		MX	PA03001475	US	6932391	US	2003168854
WO	9506221	AU	77104/94	NL	9301453		
WO	9748937	AU	32987/97	ID	18498	US	5813705
		US	6179347	ZA	9705250		

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX