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Buehler et al.

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[54] **QUICK-DISCONNECT INFLATABLE SEAL ASSEMBLY**

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[51] **Int. Cl.**[4] **F16L 17/02**

[52] **U.S. Cl.** **285/39**; 285/97; 285/107; 285/108; 285/109; 285/133.1; 285/351; 285/421; 285/904; 277/34

[58] **Field of Search** 285/97, 351, 107, 904, 285/109, 421, 108, 39, 133.1; 277/34, 34.3, 34.6; 138/93; 166/187

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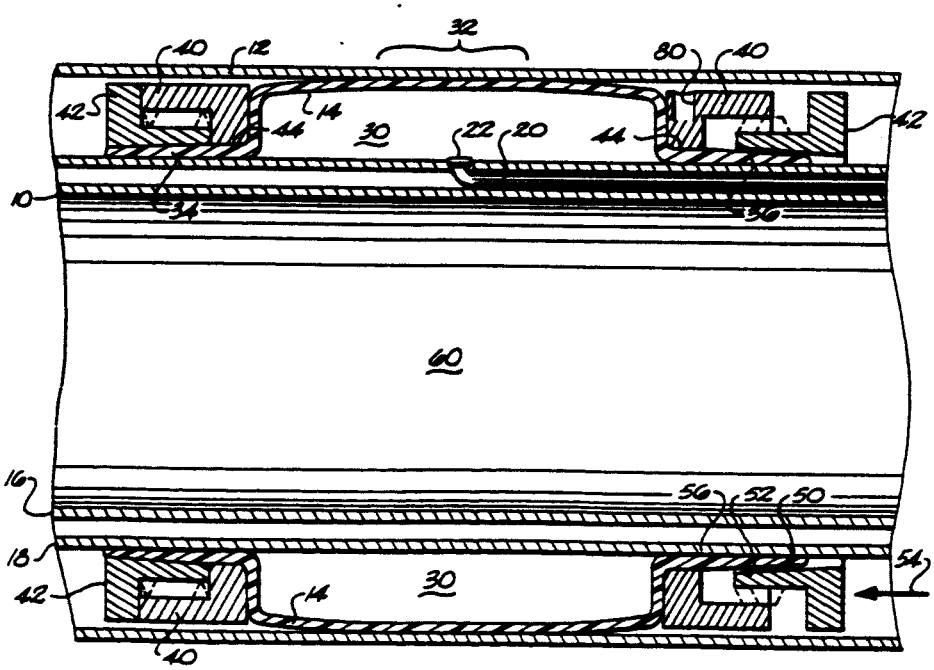
[57] **ABSTRACT**

A zero-leak cryogenic coupling includes a polymeric seal clamped to a male bayonet member with two pairs of tightening rings. The tightening rings threadably engage each other in respective pairs around tapered ends of the inflatable seal member so that a wedging action tightens the seal member about the male bayonet. Once in place, the seal may be inflated via an inflation port so that its expansion provides a pressure contact with the inside surface of a coaxial female member.

17 Claims, 3 Drawing Sheets



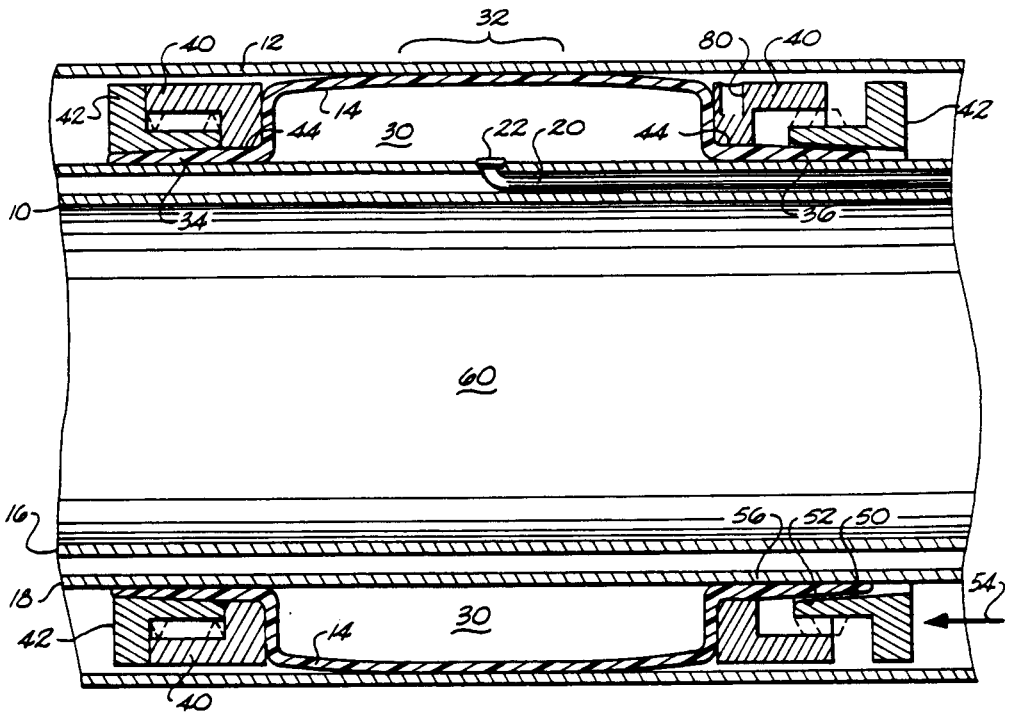

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Fig. 1

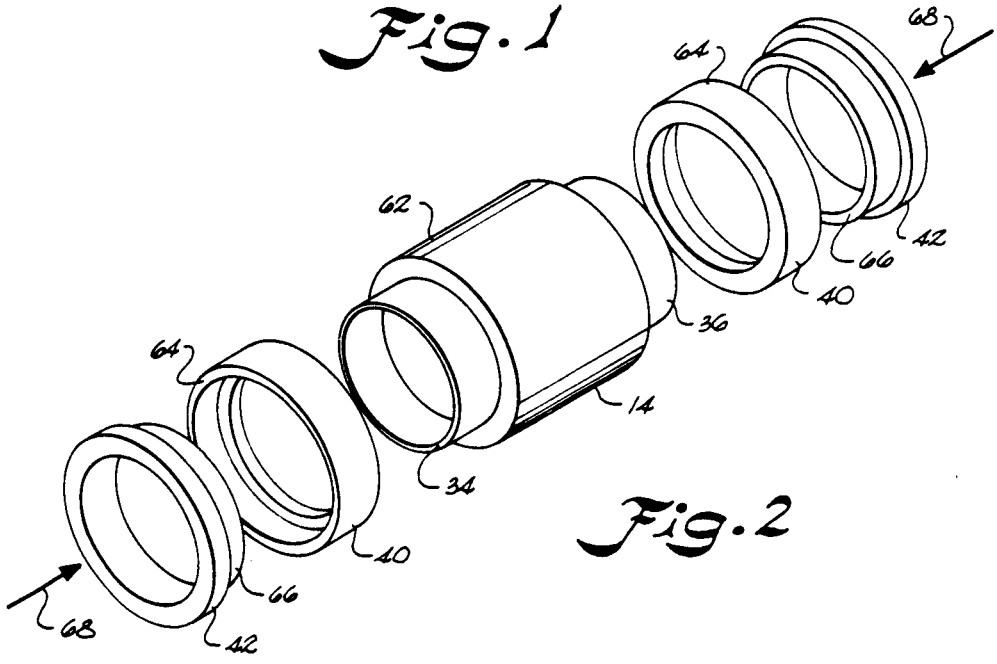
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Fig. 2

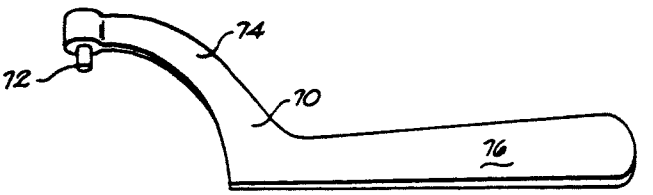

Fig. 3

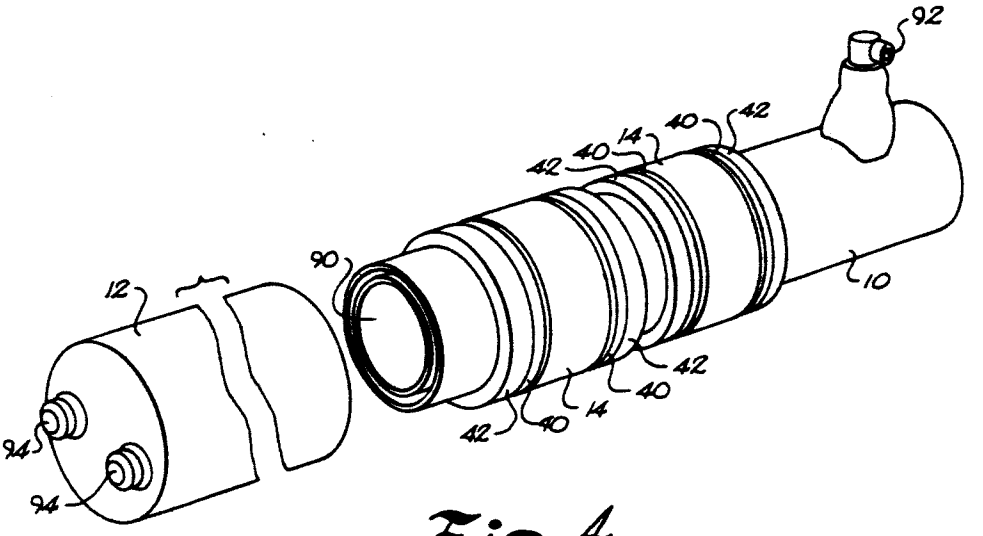

Fig. 4

While specific features of a construction in accordance with the present invention have been set forth in an exemplary embodiment thereof, the spirit and scope of this invention should not be strictly limited to such examples. For example, the dimensions of various apparatuses in accordance with the present invention may be adapted for use in particular applications. For example, the diameter of the male bayonet member may in general vary between 2 and 4 inches, with the resulting size of the inflatable seal member and tightening rings for use therewith varying accordingly. The pressurization line is preferably at least about a ⅛ inch stainless steel tube, but maybe larger such as ¼ inch whenever a 4 inch quick-disconnect male bayonet member is used. Also, the size and nature of the fluid inlet to the male bayonet member may vary, with an approximately two inch screw-on type line being typical.

Various modifications to the present invention may be practiced by those of ordinary skill in the art, all of which modifications are intended to come within the spirit and scope of the present invention. Furthermore, the present exemplary embodiment and the description thereof is intended for purposes of disclosure only, and not for purposes of limiting the present invention, which limitations are set forth only in the appended claims.

What is claimed is:

1. A seal assembly, comprising:

a first tube having an opening in at least one axial end thereof, and defining an interior channel axial therein and intersecting with said opening, said first tube adapted for being received within a second tube of larger diameter;

an inflatable seal member received about said first tube and having a central body with tapered ends on each axial end thereof, each such end forming an inclined plane relative said first tube; and

securement means, received about said tapered ends, for securing said seal member to said first tube, said securement means including respective pairs of mutually threadable tightening rings situated about said tapered ends such that threaded tightening of the respective pairs of rings causes at least one ring of each such pair to be axially advanced against the inclined plane of its corresponding tapered end for securing said inflatable seal member to said first tube by compressing and sealing such tapered end between such one ring and said first tube; wherein

said inflatable seal member may be controllably inflated when said first tube is received within a second tube so that said seal member is pressed into contact with the inside surface of the second tube, whereby said first tube is sealed with respect to the second tube so as to permit fluid to be passed to the second tube through said channel and said opening of said first tube.

2. A seal assembly as in claim 1, wherein said seal member further includes annular shoulder portions adjacent to and axially inward from said tapered ends thereof.

3. A seal assembly as in claim 2, wherein:

said inflatable seal member comprises a semi-rigid polymeric material which is relatively impermeable to gasses introduced thereto.

4. A seal assembly as in claim 3, wherein

said seal member is comprised of an injection-moldable FEP polymeric resin, which results in a relatively stiff but deformable seal member;

said tightening rings are comprised of seamless stainless steel and have Acme threads for applying adequate force to said seal member during tightening of said rings for sealing said seal member about said first tube;

said fluid comprises cryogenic material such as one of liquid hydrogen, liquid oxygen, liquid nitrogen, and liquid argon; and

gas for pressurizing said inflatable seal member comprises one of gaseous helium and gaseous nitrogen, selected in accordance with the particular cryogenic material used.

5. A seal assembly as in claim 3, wherein said tightening rings define wrench-interface openings around the periphery thereof adapted for receipt of a spanner wrench for rotatably driving said rings selectively in and out of threaded engagement with one another.

6. A seal assembly as in claim 1, wherein:

said first tube comprises a male bayonet member having a double wall construction, with an inflation tube disposed between the double walls thereof, and defines an inflation port in a side wall thereof connected to said inflation tube; and further wherein

said inflatable seal member is received about said first tube in an axial position which overlays said inflation port thereof, so that said seal member may be inflated by gas introduced into said inflation tube.

7. A seal assembly as in claim 1, wherein:

said inflatable seal member includes a relatively flat end portion thereof between said central body thereof and said tapered ends.

8. A seal assembly as in claim 1, further comprising a second inflatable seal member received about said first tube and axially displaced from the first-mentioned inflatable seal member, said second inflatable seal member including additional securement means thereabout for securing same to said first tube, whereby the reliability of said seal assembly is thereby increased.

9. A seal assembly, comprising:

a first tube having an opening in at least one axial end thereof, and defining an interior channel axial therein and intersecting with said opening, said first tube adapted for being received within a second tube of larger diameter;

an inflatable seal member received about said first tube and having tapered ends; and

securement means, received about said tapered ends, for securing said seal member to said first tube; wherein

said inflatable seal member may be controllably inflated when said first tube is received within a second tube so that said seal member is pressed into contact with the inside surface of the second tube, whereby said first tube is sealed with respect to the second tube so as to permit fluid to be passed to the second tube through said channel and said opening of said first tube;

said first tube comprises a male bayonet member having a double wall construction, with an inflation tube disposed between the double walls thereof, and defines an inflation port in a side wall thereof connected to said inflation tube;

said inflatable seal member is received about said first tube in an axial position which overlaps said inflation port thereof, so that said seal member may be inflated by gas introduced into said inflation tube; and further wherein

said first tube has a diameter in the range of from about 2 to about 4 inches, and said inflation tube received within the double wall construction of said first tube has a diameter of from about $\frac{1}{8}$ to $\frac{1}{4}$ of an inch, said double walls being radially separated from one another adequate to accept said inflation tube therebetween.

10. A quick-disconnect inflatable seal assembly, for leak-proof transfer of fluids, comprising:

an inner tube having a passage therein adapted for the passage of fluids therethrough;

an inflatable seal member, received about said inner tube, and having tapered edges on each axial end thereof;

clamping rings received about said tapered edges adequate to secure said seal member about said inner tube; and

an outer tube, having an inside diameter larger than the outside diameter of said inner tube with said seal member and said clamping rings disposed thereabout; wherein

with said inner tube received within said outer tube, said seal member may be inflated to project radially outward an amount adequate to sealingly contact said outer tube inside diameter, so as to permit the leak-proof transfer of fluids between said tubes; and

said inner tube comprises a male bayonet member having a double wall construction for the insulated passage of cryogenic fluids therethrough, and further includes a pressurization line disposed within such double wall construction, said line terminating at one end thereof in an inflation port defined in the outer surface of said inner tube so that gas introduced into said pressurization line enters said inflatable seal member through said inflation port for controllably inflating said seal member.

11. An inflatable seal assembly as in claim 10, wherein said inflatable seal member comprises semi-rigid polymeric material, and projects during its inflation radially outward beyond the outside diameter of said inner tube with said clamping rings secured thereabout so as to engage the inside diameter of said outer tube, and immediately recovers from such outwardly projected position upon release of pressurization to said seal member, said seal member at all times being relatively impermeable to gaseous materials admitted thereto for inflating same.

12. An inflatable seal assembly as in claim 10, wherein said clamping rings comprise respective pairs of threadably engageable inner and outer tightening rings, with said inner ring being received on a relatively flat circumferential area of said seal member, and projecting therefrom with an overhung portion for defining an annular space about said seal member, and with said outer tightening rings comprising rings for threadably engaging said inner tightening rings while received within said annular space defined thereby, said outer tightening rings further defining tapered inside diameters for engaging the tapered edges of said inflatable seal member, wherein said outer tightening rings are drawn towards said inner tightening rings with increased threadable engagement therebetween so as to be wedged into said annular space between said overhung portion and said tapered edges.

13. An inflatable seal assembly as in claim 10, wherein:

said seal member comprises polymeric material, and said clamping rings comprise pairs of threadably matable stainless steel rings which tighten around said seal member adequate to slightly deform said tapered edges thereof, whereby outer of said rings are drawn further onto said tapered edges as same are rotatably engaged with inner rings of said pairs, so as to seal said inflatable seal member about said inner tube adequate to receive and retain gas therein.

14. A beyonet-type quick-disconnect cryogenic coupling for the zero-leakage transfer of cryogenic fluids, comprising:

a male bayonet member adapted for receipt in a female receptable member, and for the passage of cryogenic fluid therethrough into said female member;

at least one inflatable seal received about the circumference of said bayonet member in a fixed axial portion thereof, said seal member having axial ends including tapered portions inclined away from the body of said seal member;

a pair of interacting tightening rings disposed about each axial end of said seal for securing same to said bayonet member;

a female member adapted for receipt for said bayonet member therein with said seal and said pairs of rings disposed about said bayonet member; and

means for selectively inflating said seal with a gas, while said bayonet member is received in said female member, adequate to sealingly engage the interior of said female member, whereby cryogenic fluids may be passed from said bayonet member to said female member without leakage therebetween; wherein

said seal includes annular shoulder portions at the top of the inclines of said tapered portions; and

axially inward rings of said ring pairs reside about said seal shoulder portions so that their respective axially outward rings are drawn inward against said inclines as the respective ring pairs are threadably engaged.

15. A cryogenic coupling as in claim 14, wherein:

said male bayonet member includes a double wall construction tube; and

said means for selectively inflating said seal includes a pressurization line received within said double wall construction of said bayonet member, and an inflation port defined therebetween and the outside diameter of said male bayonet member; and further wherein

said inflatable seal is received about said bayonet member positioned over said inflation port so that gas introduced through said pressurization line to said inflatable seal via said inflation port selectively inflates such seal.

16. A cryogenic coupling as in claim 15, further comprising:

an additional inflatable seal axially displaced along said male bayonet member from said at least one inflatable seal thereof; and

a separate pressurization line and inflation port operatively associated with said additional inflatable seal, whereby the reliability of said cryogenic coupling is increased.

17. A cryogenic coupling as in claim 14, wherein:

said inflatable seal comprises polymeric material;

said tightening rings comprise stainless steel material; and

said male bayonet member includes a sealable inlet port for the introduction of cryogenic fluids into the interior thereof, which fluids are transferred to said female member during operation of said cryogenic coupling.

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