

(19) DANMARK

(10) DK/EP 4097383 T3



(12)

## Oversættelse af europæisk patentskrift

Patent- og  
Varemærkestyrelsen

- 
- (51) Int.Cl.: **F 16 L 23/18 (2006.01)**                      **F 16 J 15/02 (2006.01)**                      **F 16 J 15/06 (2006.01)**  
**F 16 J 15/08 (2006.01)**                      **F 16 J 15/10 (2006.01)**                      **F 16 L 23/16 (2006.01)**
- (45) Oversættelsen bekendtgjort den: **2024-07-01**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2024-05-08**
- (86) Europæisk ansøgning nr.: **21707409.5**
- (86) Europæisk indleveringsdag: **2021-01-25**
- (87) Den europæiske ansøgnings publiceringsdag: **2022-12-07**
- (86) International ansøgning nr.: **NO2021050018**
- (87) Internationalt publikationsnr.: **WO2021154085**
- (30) Prioritet: **2020-01-28 NO 20200110**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
- (73) Patenthaver: **TP-Products AS, co Lunds gate 22, 3043 Drammen, Norge**
- (72) Opfinder: **UVERUD, Knut-erik, C O Lunds gate 24, 3043 Drammen, Norge**
- (74) Fuldmægtig i Danmark: **AWA Denmark A/S, Strandgade 56, 1401 København K, Danmark**
- (54) Benævnelse: **LEDNINGSFORBINDELSESINDRETNING**
- (56) Fremdragne publikationer:  
**WO-A1-93/18331**  
**GB-A- 2 552 698**



# DESCRIPTION

Description

## Field of Invention

[0001] The present invention regards a conduit connector with a seal ring having disconnected sealing portions.

## Background

[0002] In subsea pressure piping and equipment systems several methods exist for providing sufficient sealing for their conduit connections.

[0003] When connecting adjacent sections of fluid flow conduits or vessels, seal rings are typically interposed at the interface of adjacent connecting flanged conduits or vessel portions which are then bolted or clamped together. The seal ring is typically metallic, the seal being affected by elastic or plastic deformation of a sealing surface of the seal ring against sealing portions of the ranged portions.

[0004] These systems are intended to resist leakage in conduit connections from internal pressures, external pressures or both; bi-directional pressure. Typically, these annular sealing systems are inserted into pre-machined tapered grooves of which the conduit sealing function is accomplished as a combination of geometry, smooth surface finish and high contact stress between annular seal rings and conduit grooves.

[0005] Annular sealing systems as described above can be divided into two different sealing principles:

### ***Load controlled seals, often called gaskets***

[0006] The ring is permanently deformed due to high forces applied to the top and bottom of the ring transferred via the seal groove contact faces. The gasket material is softer than the ring groove material. This leads to a reliable metal to metal barrier, provided the force on the gasket is high enough to achieve the required contact pressure to seal for the fluid in question. However these seals have very little spring back and the sealing ability is hence quickly lost under separating loads. The load controlled gaskets are not suitable under dynamic loads

because they allow movement between the mating parts.

***Deformation controlled metal seals***

**[0007]** The deformation-controlled seals have their contact force with the seats defined by the given displacement of the seats, radially, axially or combined, and the stiffness of the seal defined by its geometry and material properties. The obtained seal contact force during the assembly of the connection under normal design conditions is not affected by the loads transmitted through the connection. Such seals are also often denoted "non-load bearing seals".

**[0008]** The geometry of such annular seals is of critical importance, as they are designed to provide sufficient contact force between the conduit seal groove and the annular seal to accomplish a reliable metal to metal seal. However, some annular seal designs, often referred to as "self-energized" or "pressure assisted" seals, make use of a specific annular seal geometry and the fluid or gas pressure from inside the conduit, the externally or both, from which the pressure(s) enhances the conduit connection's sealing capabilities.

**[0009]** A prior art for such a non-load bearing self-energized annular seal is exemplified by US20010045709A1, which demonstrates an H shaped seal in a groove like the one used in this invention, formed by a conduit joint. The seal consists of two pairs of seal lips connected through a web. The inner sealing portion, outer sealing portion and web are all made integrally from one homogenous material.

**[0010]** Current seal designs fail to provide sufficient bi-directional sealing in conduit joints, should there be pressure imbalance either internally or externally, where either an increased pressure from one side or the other may create a pressure breach either radially inside or outside the conduit joint, compromising the system's overall sealing capabilities. GB 2 552 698 A and WO 93/18331 A1 disclose conduit connectors of the prior art.

**Summary of the Invention**

**[0011]** The object of the present invention is to provide a non-load bearing self-energized metal to metal annular seal ring assembly for conduit connections that provides a barrier against leakage from both internal pressures, external pressures or combined, intended for use in, but not limited to, subsea environments.

**[0012]** Said objects are achieved in a conduit connector as defined in the appended claims.

**[0013]** The invention will require less bolt/clamp force to energize the annular sealing system during assembly than prior art. The annular sealing system comprising of at least two individual

annular portions designed as a system, and which under certain conditions the annular portions will work independently and under other conditions will work as one seal with interacting portions.

### **Brief Description of the Drawings**

**[0014]** Certain features and functions of the present invention will be described with reference to the following appended figures in which:

Fig. 1 is a cross section through a part of a prior art conduit connector with an annular seal ring,

Fig. 2 is a corresponding cross section through a conduit connector with an annular seal ring according to the present invention as unassembled,

Fig. 3 is a cross section through the inventive conduit connector as assembled,

Fig. 4 is a cross section through the inventive conduit connector as assembled when subject to an overly high differential pressure over the seal ring,

Fig. 5 is a cross section through a conduit connector holding another embodiment of the inventive seal ring, and

Fig. 6 is a perspective view of the seal ring.

### **Detailed Description of the Invention**

**[0015]** Fig. 1 is a cross section through a prior art non-load bearing self-energized conduit connector connecting a first hub 1 and a second hub 2. The conduit connector has axial symmetric geometry about the centerline A-A on the left hand side of the cross section. The left hand side is a mirror image of the right hand side. In the mating end surfaces of the hub there are machined grooves for accepting an H shaped seal ring 3. The grooves include truncated projections with tapered sidewalls 5a, b adapted to contact inner and outer seal lips 8a, b on the seal ring. The seal ring is homogenous consisting of outer and inner sealing portions 3a, b which are firmly connected to each other through a web 7. If the internal fluid pressure in the connector is substantially higher than the external pressure, the internal pressure will exert a force on the inner lips 8a that increases the contact pressure against the protrusions 4a, b. However, this force will be transferred to the outer lips 8b through the web 7 lowering the contact exerted by these lips against the opposite sidewalls 5b of the protrusions 4a, b. This means that the sealing ability of the internal seal portion is improved, while the sealing ability against the outside of the connector is compromised. Such a high difference in pressure as described above can cause more plastic deformation to the firm web, which will

further reduce the contact-pressure between the seal-lips and the grooves.

**[0016]** Fig. 2 illustrates a non-load bearing self-energized seal ring in a conduit connector according to the present invention connecting a first hub 1 and a second hub 2. In the mating end surfaces of the hub there are machined grooves for accepting an H-shaped annular seal ring 3a, b. The grooves include truncated projections with tapered sidewalls 5a, b adapted to contact inner and outer seal lips 8a, b on the seal ring. The seal ring 3a, b comprises an inner annular portion 3a and an outer annular portion 3b, which outer annular portion 3b is coaxially positioned relative to the inner annular portion 3a.

**[0017]** The annular seal ring consists of at least two independent annular sealing portions which are manufactured independently and joined together to a system prior to assembly. A possible assembly method is to shrink the inner annular seal portion 3a relative to the outer annular seal portion 3b.

**[0018]** When the seal ring is mounted into the conduit connector, the portions 3a, b become separated by the wedging action provided by tapered sidewalls 5a, b and act as independent sealing portions under normal load-conditions, as shown in Fig. 3.

**[0019]** Fig. 6 shows the seal ring as seen in perspective with an outer seal portion 3b and an inner seal portion 3a.

**[0020]** If the internal fluid pressure in the connector is substantially higher than the external pressure, the internal pressure will only affect the inner annular portion 3a. As the seal ring 3a, b is in two-part form the forces exerted on the inner annular portion 3a will not be transferred to the outer annular portion 3b.

**[0021]** Conversely, if the external fluid pressure in the connector is substantially higher than the internal pressure, the external pressure will only affect the outer annular portion 3b. As the seal ring 3a, b is in two-part form the forces exerted on the external annular portion 3b will not be transferred to the outer annular portion 3a.

**[0022]** The inner annular portion 3a and the outer annular portion 3b may be produced from different materials such as different metals or metal alloys, different polymers or combinations of the above. The use of different materials in the annular portions will give different properties and behaviour when exposed to pressure and temperature to accommodate the different conditions on the inside and the outside of the seal ring.

**[0023]** Fig. 3 also illustrates the presence of an outer support rib 10 projecting from inner annular portion 3a. On the corresponding outer annular portion 3b there is a mating inner groove 11. In an unstressed condition a slip distance exists between the outer circumference of the outer support rib 10 and the bottom of the inner groove 11. If the differential pressure over the seal ring 3 exceeds the maximum allowable value, the outer support rib 10 will contact the bottom of the inner groove 11. This will allow the inner annular portion 3a and the outer

annular portion 3b to support each other preventing the seal ring 3a, b from being damaged, as shown in Fig.4.

**[0024]** Alternatively, the rib 10 may be on the outer sealing portion 3b and the groove 11 may be on the inner sealing portion 3a as illustrated in Fig. 5.

**[0025]** Fig. 4 illustrates how the interaction between the inner sealing portion and the outer sealing portion in an assembled connector can be regained under certain combinations of designed stiffness, pressure and temperature. Specifically, here the fluid pressure inside the tubing is overly high and the inner sealing portion has yielded to the pressure. The support rib 10 is in contact with the bottom of the groove 11. This means that the inner sealing portion is supported by the outer sealing portion avoiding a collapse of the inner sealing portion.

**[0026]** Fig. 3 also illustrates how the hubs 1, 2 and seal ring 3a, b form a protected cavity. This cavity may be a convenient location for a pressure tapping test port 12, and for sensors for assessing the integrity of the conduit connector. There may be conducted a verification test of correct assembly without compromising the integrity of the conduit prior to start of production. Pressure and temperature sensors may be mounted in this protected cavity for monitoring pressure and temperature during operation without compromising the integrity of the conduit. Additional instrumentation may be mounted inside this cavity, such as sensors for measuring humidity. The signals from sensors and electronics inside the protected cavity may be transferred from the cavity adjacent to the production fluid.

**[0027]** The expression 'conduit connector', as used in this description, is not limited to mean only connectors connecting tubular elements. In addition the seal ring may find applications wherever two bodies are to be joined through a sealed connection, such as connecting different parts of a pressure vessel.

## **REFERENCES CITED IN THE DESCRIPTION**

### Cited references

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

### **Patent documents cited in the description**

- US20010045709A1 [0009]
- GB2552698A [0010]
- WO9318331A1 [0010]

## P A T E N T K R A V

## 1. Ledningsforbindelsesindretning indbefattende:

et første samlepunkt (1) med en første hulrumssektion,  
et andet samlepunkt (2) med en anden hulrumssektion,  
5 hvor nævnte første og anden hulrumssektion danner et hul-  
rum, når den første og anden hulrumssektion er forbundet,  
hvor den første hulrumssektion indbefatter et første frem-  
spring (4a) med indre og ydre skrå sidevægge (5a, b),  
hvor den anden hulrumssektion indbefatter et andet frem-  
10 spring (4b) med indre og ydre skrå sidevægge (5a, b),  
hvor det første fremspring (4a) vender mod det andet frem-  
spring (4b), når de to samlepunkter (1, 2) er forbundet,  
en tætningsring placeret i nævnte hulrum,  
**k e n d e t e g n e t v e d, a t** tætningsringen indbefatter en  
15 indre ringformet tætningsdel (3a) og en ydre ringformet  
tætningsdel (3b), hvor tætningsdelene (3a, b) er adskilt fra  
hinanden, hvilket tillader dem at bevæge sig fuldstændigt  
frit i forhold til hinanden under drift, hvor den indre tætningsdel (3a) omfatter et par indre ringformede tætnings-  
20 slæber (8a), hvor den ydre tætningsdel (3b) omfatter et par  
ydre ringformede tætningslæber (8b),  
hvor læberne (8a) af den indre tætningsdel (3a) går i ind-  
greb med indre sidevægge (5a) af det første og andet frem-  
spring (4a, b),  
25 hvor læberne af den ydre tætningsdel (3b) går i indgreb  
med ydre sidevægge (5b) af det første og andet fremspring  
(4a, b),  
hvor den indre ringformede tætningsdel (3a) er adskilt fra  
den ydre ringformede tætningsdel (3b) ved kilevirkning til-  
30 vejebragt af de skrå sidevægge (5a, 5b), og  
hvor fluidtryk inden i forbindelsesindretningen kun virker på

og påvirker den indre tætningsdel (3a), og fluidtrykket på ydersiden af forbindelsesindretningen kun virker på og påvirker den ydre tætningsdel (3b).

2. Ledningsforbindelsesindretning ifølge krav 1, indbefattende en  
5 teståbning (12) i hulrummet mellem den indre tætningsdel (3a) og den ydre tætningsdel (3b) til tryk- og/eller temperaturlæsninger.

3. Ledningsforbindelsesindretning ifølge krav 1, hvor den indre tætningsdel (3a) og den ydre tætningsdel (3b) er fremstillet af forskellige materialer, som giver forskellige egenskaber og opførsel, når de ud-  
10 sættes for tryk og temperatur, for at tage hensyn til de forskellige forhold på indersiden og ydersiden af tætningsringen.

4. Ledningsforbindelsesindretning ifølge krav 1 eller 3, hvor den indre tætningsdel (3a) omfatter en understøtningsribbe (10), og den ydre tætningsdel (3b) omfatter en tilsvarende rille (11), hvor understøt-  
15 ningsribben (10) er tilpasset til at interagere med rillen (11) under visse kombinationer af tryk og temperatur.

5. Ledningsforbindelsesindretning ifølge krav 1 eller 3, hvor den indre tætningsdel (3a) omfatter en rille (11), og den ydre tætningsdel (3b) omfatter en understøtningsribbe (10), hvor understøtningsribben  
20 (10) er tilpasset til at interagere med rillen (11) under visse kombinationer af tryk og temperatur.

# DRAWINGS

Drawing

FIGURE 1

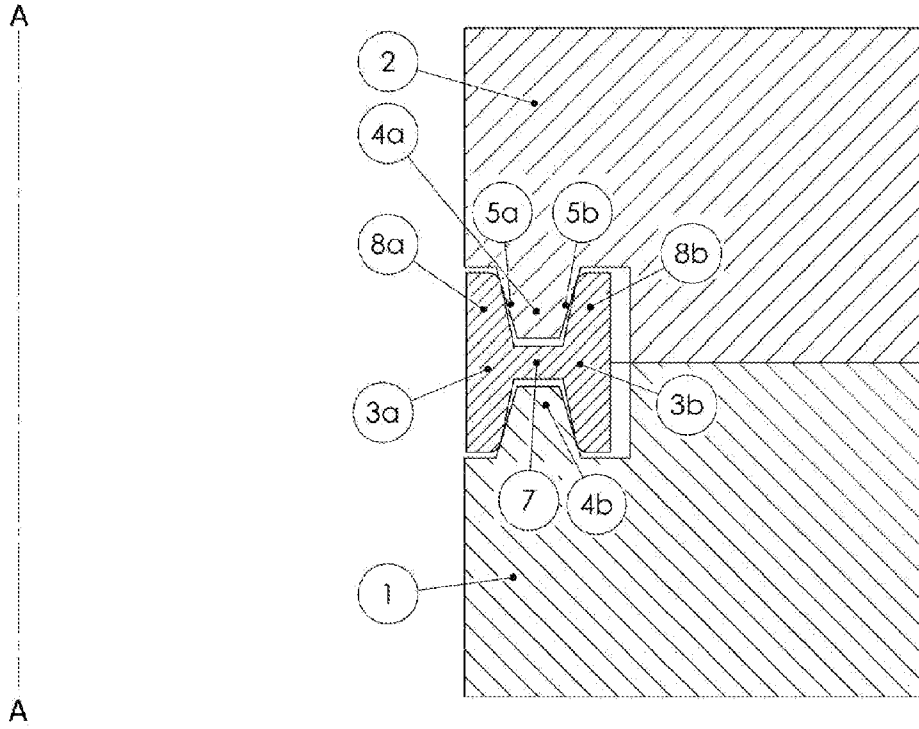




FIGURE 3

A  
-----  
A

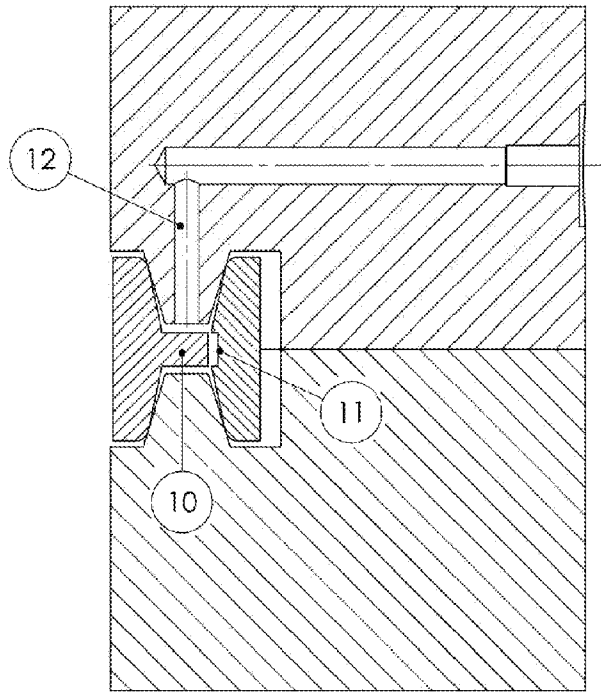


FIGURE 4

A  
-----  
A

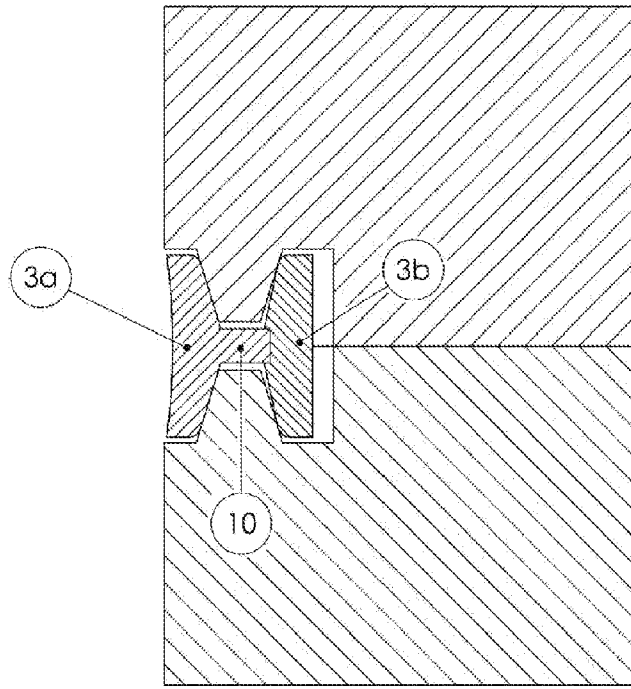


FIGURE 5

A  
A

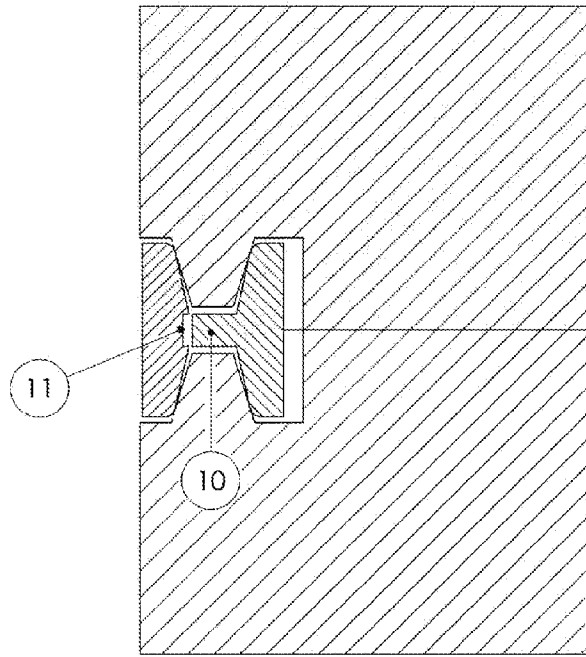


FIGURE 6

