HU000034915T2

(19) **HU**

(11) Lajstromszám: **E 034 915** (13) **T2**

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SZÖVEGÉNEK FORDÍTÁSA

(21) Magyar ügyszám: **E 09 756944**
(22) A bejelentés napja: **2009. 05. 26.**

(51) Int. Cl.: ***E21B 17/042*** *(2006.01)*
F16L 15/06 *(2006.01)*

(96) Az európai bejelentés bejelentési száma:
EP 20090756944
(97) Az európai bejelentés közzétételi adatai:
EP 2283203 A1 **2009. 12. 10.**
(97) Az európai szabadalom megadásának meghirdetési adatai:
EP 2283203 B1 **2017. 07. 05.**

(86) A nemzetközi (PCT) bejelentési szám:
PCT/AT 09/000219
(87) A nemzetközi közzétételi szám:
WO 09146475

(30) Elsőbbségi adatok:
8942008 **2008. 06. 03.** **AT**

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EP2283203

PIPE CONNECTION

DESCRIPTION

The invention relates to a pipe connection, particularly a gas-tight pipe screw connection, in which the parts in the connecting region are connected by means of joining according to DIN 8593 by way of contact-pressing and insert-pressing, consisting of an inner pipe part and an outer pipe part or two inner pipe parts having an outer collar.

Pipes, mostly seamless pipes, which can be formed from different materials, are used for conducting oil field and/or gas field products vertically and horizontally even over great distances and require the high stress due to the high sealing quality of the connections in practical operation or use.

A pipe connection already used for a long time, which essentially constitutes the prior art in respect to the geometrical basic concept, is formed in such a manner that an inner pipe part and an outer pipe part has truncated cone-shaped sealing surfaces abutting against each other with an inclination relative to each other in the distal direction of the inner pipe part of approximately 1:10, which cooperate with the truncated cone-shaped stop surfaces oppositely directed in the direction of the axis. The sealing effect can thereby be achieved by a mutual, axial contact pressing on in each other (fully engaged setting) of the pipe ends, for example, by means of a threaded screw connection and the like.

In order to improve the tightness or the quality of the sealing of the pipe connection at the stresses on the pipe connections given in the field, but also in order to achieve a maintenance of the sealing quality of the pipe connections during a disassembly and reassembly of the pipe components, a plurality of geometrical embodiments were already proposed with special design of the sealing and stop surfaces of the connection. However, complex sealing surface formations are mostly associated with higher expenditures for the machining of the connection areas of the pipe ends and with reduced economic efficiency of the production.

US 7 334 821 B2 discloses a pipe connection with a barrel-shaped, convex in section, sealing surface of the pipe inner part and an adjoining, protruding extension with a distal stop surface. In this way, in the full engagement of the pipe connection the press surfaces of the pipe components should obtain an increased conicity and provide an improved sealing effect. The production cost for the creation of the complexly formed sealing areas, however, appears high.

Rounded stop surfaces, such as WO 2007/017082 A1 discloses these, should produce, if applicable, an axial pressurization of the frequently rounded press fit surfaces over the circumference when the threaded parts are brought together and screwed together. This embodiment of the stop surfaces can in a simple manner bring about an, if applicable, independent centering of the axis of the pipes during an assembly or screwing together even by inexperienced personnel.

According to US 4,692,988 it is proposed to protect the threaded parts also in the case of a sealing screwing-in, while a threaded part is treated with a dry lubricant made, for example, from molybdenum disulfide and the cooperating part with a liquid lubricant.

Based on the essentially, geometrical concept of a pipe connection according to the prior art the problem addressed by the invention is to indicate a novel pipe connection manufacturable with high cost-effectiveness, which produces improved use properties of the pipelines in practical field use and is conducive to a disassembly and reassembly of the lines.

The improved use properties of the pipelines relate in particular to the maintenance of the tightness of the respective pipe connection both in the case of high internal pressure as well as in the case of high external pressure as well as in the case of a superimposed tensile, compressive and bending stress of the pipe string, wherein so- called galling should be minimized in the connection area and a loosening and a renewed full engagement of the connection should be improved.

The problem addressed is solved according to the invention in the case of a pipe connection with the features of Claim 1.

The advantages achieved with the invention can be seen cooperatively essentially in an increase of the surface pressure on the press fit surfaces and an advantageous positioning of the same, spaced apart from the stop surfaces. Associated therewith are a general optimization of the size of the local, mechanical material stresses in the connection area and a prevention of the stress peaks in respect to an occurrence of plastic deformations and of crack initiation in the material.

By means of extensive investigations it was found that the sealing property of the pipe connection according to the present invention is completely maintained at pressures above the nominal value and in the case of superimposed tensile, compressive and bending stresses.

Calculations according to the finite element method as well as elasticity investigations have shown that in many cases advantages are provided by a geometry according to the invention in the connection area, specifically with a formation of a hollow space between press fit surfaces and stop surfaces.

For one thing, due to the hollow space in the case of a longitudinal extension similar to the prior art the connection of the press fit surfaces or sealing seat surfaces is shortened or reduced, which leads to higher sealing surface pressures.

The transition made without contact results due to kinetic stress in an increased, largely homogeneous, specific surface pressure and thus the sealing on the press fit surfaces, wherein due to an axial spacing to the stop surfaces in the case of a bending of the system only tolerable differences in the local surface pressure arise. Where applicable, superimposed tensile and compression stresses have only a slight impact on the tightness of the connection, because the press fit surfaces have a small inclination of approx. 1:10.

Advantageously the hollow space acts in the connection area of the pipe parts as a lubricant pocket and improves a distribution and reduces the pressure of the lubricant during the sealing assembly of a field pipeline.

According to the present invention the transition of the connection areas, press seat and stop, formed without contact between the pipe parts, is formed by a coaxial recess from the inner wall surface of the outer pipe part. Thus, both favorable mechanical material stresses as well as stress states promoting the tightness of the connection are achieved.

When the inner pipe part is pressed into the outer pipe part, in a fully engaged setting of the connection, high, essentially radially directed forces are formed in the area of the press fit surfaces, which in this area leads to a widening with a tangential extension of the material of the outer pipe wall.

Through a coaxial recess from the inner wall surface of the outer pipe part in the adjacent transition area and thus from a position of the pipe parts without contact in the area up to the stop surfaces, elastic extensions are no longer given in the tangential direction of the outer pipe wall, however, in the latter axially directed tensile forces act, which are formed by a pressing of the stop surfaces of the inner pipe onto that of the outer pipe and produce an elastic extension in the direction of the axis.

In the connection area such locally complex stress conditions according to the present invention are largely reduced, wherein according to the present invention the formation of a transition area secures larger elastic extension values and ensures the tightness of the connection even in the case of complex stresses of the pipe string.

Advantageously the recess in the transition area in the cross section has a corner-free profile, because the stress peaks on the inner surface of the outer pipe are thus largely prevented and a crack initiation and risk of fatigue fracture are eliminated.

If the inner pipe part in the area of the transition from the distally extended press fit surface to the stop surface has a rounded form, then local stress peaks with local plastic material deformations can be eliminated and the cooperation of the stop surfaces can be improved. Especially good results were achieved with an edge rounding with a radius of R = 0.9 to 15.

Advantageously, the coaxial recess in the outer pipe part in the cross section from the press fit surface to the recess profile is formed with a transition radius of 0.5 to 1.0 mm and is formed edge-free up to the stop surface. In the boundary region of press fit surface and recess, pressure stress peaks are thus avoided with certainty.

Extensive and targeted investigations have shown that the quotient from length of the transition made without contact to the length of the effective press fit according the present invention should have a value of 0.4 to 1.7, preferably of 0.6 to 1.5, in order to achieve optimal sealing conditions of a pipe connection according to the present invention.

This apparently broad value range resulted from an inclusion of all conventional pipe diameters.

Dimension-related evaluations disclosed that the quotient for pipes, so-called casing pipes or CASINGS, with an outer diameter of greater than 4 ½ inches (*corresponds to 0.1143 m*) is optimized at 0.4 to 1.2, preferably at 0.6 to 1.0.

On the other hand, for riser pipes or conveyor pipes, which have an outer diameter of less than 4 ½ inches (*corresponds to 0.1143 m*) up to 1.6 inches (*corresponds to 0.0402 m*) and lower, therefore, in the case of so-called TUBINGS, optimized quotients from length of the transition made without contact to the lengths of the press fit of 0.9 to 1.7, preferably of 1.1 to 1.5 were determined.

In order to achieve a low-cost and high-quality compact embodiment of the pipe connection with increased tightness, the outer pipe part according to the present invention has an inclination of the press fit surface of approximately 1:10 with respect to the diameter towards the stop surface and the stop surface has an oppositely directed angle beta of β = 10° to 20°, preferably of β = approximately 15° to the normal of the axis.

If, as has emerged from the tests, the press fit surfaces and/or the stop surfaces have a surface roughness of less than Ra = 3.2 µm, however, more than Ra = 0.4, measured as a mean roughness value according to DIN 4777 ISO/DN42871, then largely without a so-called galling of the press fit surfaces a highly specific pressure load can be applied and a largely unrestricted disassembly of the pipe connection is possible. It is assumed in this respect, that in the recesses of the rough surface profile in the above roughness limits an optimal amount of lubricant can be positioned in order to obtain the desired properties.

A pipe connection according to the invention can technically be brought into full engagement by different means, which press the pipe parts together axially. Advantageously, the known screw connections have proven successful.

By means of a schematic drawing merely one embodiment of the pipe connection according to the present invention shall be depicted below.

Figure 1 shows a pipe connection in axial section.

In Figure 1 a pipe connection of an inner pipe **I** and an outer pipe **A** is shown in axial section.

In the connection area of the pipes an inner pipe part I has a press fit surface **1I**, which is inclined distally in relation to the pipe diameter with a value of 1:10. A stop surface **2I**, which constitutes the connection area **3** with a front-side sealing surface and the inner pipe end, is formed distally subsequent to the press fit surface **1I** inclined oppositely directed toward a pipe longitudinal axis **x** with an angle **β** of 15°.

An outer pipe part **A** in the case of a fully engaged pipe part connection abuts in the connection area **12** proximally against the press fit surface **1I** of the inner pipe with the press fit surface **A1**.

A transition area **3** is provided between connection area **1**, which comprises the press fit surfaces **1I** and **1A**, and the area **2** with the stop surfaces of the pipe parts, in which a recess **RA** from the inner wall of the outer pipe **A** exists, forms a hollow space **R** between the pipe parts **I** and **A** and provides the parts in this zone without contact.

In the outer pipe part **A** the boundary region between press fit surface **1A** and recess profile **3A** is rounded with a radius of 0.8 mm, wherein as a result the entire inner wall surface **3A** of the coaxial recess **RA** is created rounded edge-free up to the stop surface **2A**.

CSŐCSATLAKOZÁS

SZABADALMI IGÉNYPONTOK

1. Csőcsatlakozás, különösen gáztömített csőcsatlakozás, amely belső és külső részekből (I,A) áll, ahol a belső és külső részek (I ,A) egy belső csődarab (I) és egy külső csődarab (A), vagy két belső csődarab (I) és egy külső muff (A), amely csőcsatlakozásnál a részek, a csatlakozási tartományban, illesztésekkel, besajtolás és rásajtolás útján vannak összekötve, ahol a csőcsatlakozás három csatlakozási tartománnyal áll elő, ahol a csőcsatlakozás a belső és külső részek (I,A) préselési illeszkedése (1) és felütközése (2) együttműködő, a belső csődarab (I) vége irányába, a csőtengelyhez (x) döntött illeszkedő felületekkel (1I, 1A), és homlok oldalon ezekhez az illeszkedő felületekhez (1I, 1A) döntött ütköző felületekkel (2I, 2A) rendelkeznek, ahol az illesztő felületek (1I,1A) és ütköző felületek (2I, 2A) szembe irányulóan döntött csonkakúp alakkal rendelkeznek, a külső rész (A) az illeszkedő felület (1I, 1A) a kb. 1:10 arányú dőlésével rendelkezik a csőátmérőre vonatkoztatva, és az ütközési felület (2I, 2A) előnyösen β=10°-20°, előnyösen kb.15° szögű a tengely merőlegeséhez képest, és ahol a kapcsolatban álló részek illesztésének (1) és ütközésének (2) átmenete (3) érintés mentesen képződik egy közbülső térrel, illetve üreges térrel (R) egy koaxiális kimunkálással (RA) a belső falfelületéből (3A) a külső térben (A), azzal a feltételtel, hogy az érintésmentesen előálló átmenet (3) tengelyirányú hosszából az illesztés (1) hosszához számított hányados 0,4-től 1,7-nek adódik.
2. Az 1. igénypont szerinti csőcsatlakozás, **azzal jellemezve, hogy** a kimunkált nyílás (RA) az átmeneti tartományban (3), a keresztmetszetben szögletmentes profillal rendelkezik.
3. Az 1 vagy 2. igénypontok egyike szerinti csőcsatlakozás, **azzal jellemezve, hogy** a belső csőrész (I), az átmenet (3) tartományában, disztálisan továbbvezetett préselt felfekvő felületként (1) és ütközőfelületként (2) lekerekítve van kiképezve.
4. Az 1.-3. igénypontok egyike szerinti csőcsatlakozás, **azzal jellemezve, hogy** a külső részben (A) levő kimunkált nyílás (RA), a préselt felfekvő felület (1, A) keresztmetszetében a kimunkált nyílás (RA) profil felé egy átmeneti rádiusszal (Ro) van kiképezve, amely 0,5-1,0 mm méretű, (Ro=0,5-1,0), és a ütközőfelületig (2A) perem nélkül van kiképezve.
5. Az 1.-4. igénypontok egyike szerinti csőcsatlakozás, **azzal jellemezve, hogy** az érintkezés mentesen előállított átmenet (3) és a préselt felfekvő felület (1) hosszának a hányadosa 0,6-1,5 értékűnek adódik.
6. Az 1. igénypont szerinti csőcsatlakozás, **azzal jellemezve, hogy** API 5CT szerinti CASING csövek számára, amik lényegében FUTTER csövek, nagyobb, mint 11,43 cm (4,5 coll) mérettel, a hányados a belső csődarabtól (1) érintés mentesen létrejött átmenettől (3), az illesztés (1) hosszához számított hányadosként 0,4-1,2, előnyösen 0,6-1,0 érték adódik.
7. Az 1. igénypont szerinti csőcsatlakozás, **azzal jellemezve, hogy** GPI 5 CP szerinti TUBING csövek számára, amik lényegében nyomó, vagy szállító csövek, 11,43 cm (4,5 coll), és kisebb, például 4,02 cm (1,66 coll) átmérővel, a belső csődarab érintésmentesen előállt átmenet (3) hosszából és az illesztés (1) hosszából számított átmenet hányadosa 0,9-1,7, előnyösen 1,1-1,5 értéknek adódik.
8. Az 1.-7. igénypontok egyike szerinti csőcsatlakozás, **azzal jellemezve, hogy** a belső és külső részek olyan csőanyaggal rendelkeznek, amely legalább a csatlakozási tartományban termikusan javított, hőkezelt anyag, és emelt szerszámanyag szilárdságú.
9. Az 1.-8. igénypontok egyike szerinti csőcsatlakozás, **azzal jellemezve, hogy** a préselt felfekvő felületek (1I, 1A), és/vagy az ütközőfelületek (2I, 2A) E szabvány szerinti felületi érdességgel rendelkeznek, ami kisebb, mint Ra=0,4µm, de több, mint Ra=0,4µm, megfelel a DIN ISO /DIN4287/1 szerinti közepes felületi érdességnek.

10. Az 1.-9. igénypontok egyike szerinti csőcsatlakozás, **azzal jellemezve, hogy** a csődarabok összeeresztései csavarkötéssel vannak kialakítva.

PIPE CONNECTION

FIGURES

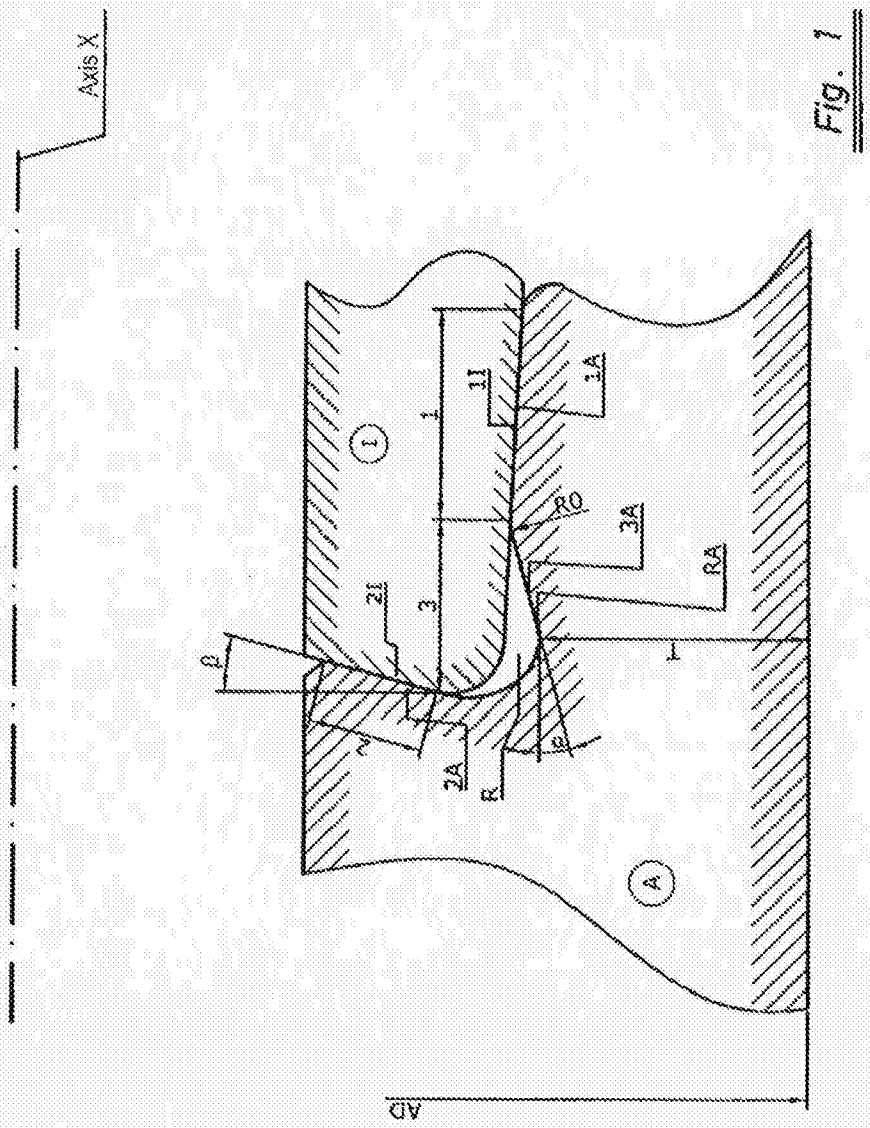

Fig. 1