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(54) Benævnelse: **METALRØR TIL TRANSPORT AF OLIE OG GAS MED EN METALBELÆGNING I ET OVERGANGSOMRÅDE**

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METAL PIPE FOR CONVEYING OIL AND GAS, COMPRISING A METAL COATING IN A TRANSITION REGION

Description

Field:

[0001] The invention relates to a metal pipe, in particular a pipe for conveying oil and gas, comprising a metal coating in a transition region, to a system consisting pipes of this kind, and to a method for producing the pipe and the system of pipes.

Prior art:

[0002] Metal pipes, in particular pipes for conveying oil and gas, are welded together at the pipe joints when laid. In order to prevent corrosion or abrasion on the inner surface of the pipe body due to the oil or gas or the constituents thereof, the pipes are typically coated on the inner surfaces with a base coating made of plastics material or a metal material. Due to the heat effect when welding two metal pipes, in the region of the heat-affected zone this base coating can completely or partially detach or develop holes. This region is thus no longer protected against corrosion or abrasion.

[0003] If the pipe diameter is sufficiently large, these regions can be provided with this base coating again at a later point. However, this reduces the laying speed and leads to system costs and/or material costs. With small pipe diameters, the wear to these parts is taken into account when designing the material thickness and service life and leads to correspondingly higher part costs or lower service life.

[0004] CN 103008988 B discloses a metal pipe for conveying and gas.

Object of the invention:

[0005] The object of the invention is therefore to develop a metal pipe coated on the inner surface in such a way that a continuous wear-inhibiting layer is maintained in a welded connection of two such tubes, without post-coating.

Invention:

[0006] The object of the invention is achieved by a metal pipe having the features of claim 1, a system of at least two metal pipes according to the invention having the features of claim 8, a method for producing a metal pipe of this kind having the features of claim 10 and a method for producing a system of at least two metal pipes according to claim 15.

[0007] The transition region of a metal pipe, in particular a metal pipe made of a steel material, is coated on the inner surface of the pipe body with a metal, preferably weldable, material having anti-corrosion and/or anti-abrasion properties. The at least partial base coating covers, on the inside of the pipe body, the metal coating of the transition region at least in part. The transition region is arranged at the joint of the metal pipe and covers the heat-affected zone of a possible weld seam and an additional region of the pipe body to the extent that the heat introduced when connecting two pipes by welding can no longer damage the base coating of the pipe body or the base coating of the metal coating. As a result, a continuous protective layer is maintained on the inner surface of the pipe even in the case of a welded connection without additional work.

[0008] The metal coating of the transition region preferably consists of a metal material, preferably of a weldable, stainless material, more preferably of the material 2.4856, in particular weldable metal materials can be easily applied to a typical steel pipe. Stainless materials as a coating are very resistant to, for example, chemical attacks by the oils or gases, which are sometimes sulfuric.

[0009] Ideally, the metal coating has a variable thickness in the transition region, preferably a thickness that increases toward the pipe joint. For reasons of fluid dynamics, it is preferable if no edges remain on the inner surface of the pipe after coating. These edges can be reduced due to variable layer thicknesses.

[0010] The metal coating has, in the transition region, an average thickness of 0.1 mm to 2 mm, preferably an average thickness of 0.1 mm to 1 mm, even more preferably an average thickness of 0.2 mm to 0.4 mm. In the region of these thicknesses there is an optimum between the material used for coating and the protective effect with a typical service life of a pipe in use.

[0011] Preferably, the pipe joint has a coating that is at least partially made of metal, preferably of the same material as the coating of the transition region. As a result, the

pipe joint can be effectively protected from wear. Encompassing the pipe joint with an ideally continuous metal coating improves the connection between the pipe material and the metal coating.

[0012] The metal coating of the pipe joint has a variable thickness. This means that conceivable toothings and surface profiles which were previously formed by the pipe joint itself can also be formed by a coated pipe joint.

[0013] The metal coating of the pipe joint has an average thickness of 0.1 mm to 5 mm, preferably an average thickness of 0.1 mm to 1 mm, even more preferably an average thickness of 0.2 mm to 0.4 mm. These thicknesses are an optimum between the desired protective effect and material usage. Preferably, the length of the pipe body is greater than 10 m. Above this length, subsequent coating of a pipe connection is usually no longer feasible or economical. Moreover, the pipe body preferably has an inner diameter of more than 150 mm, preferably of more than 250 mm. These diameters are preferably used in pipeline construction. In this application, wear resistance in particular is of particular significance and laying speed dominates the investment costs. Both are improved by a design according to the invention of a metal pipe.

[0014] Ideally, an edge of the metal coating of the transition region and/or of the pipe joint is chamfered. The edge therefore no longer needs to be prepared before a welding process. The chamfer on the edge of the metal coating preferably forms part of a V- or J-groove. These grooves are common shapes when connecting two pipes by welding. The chamfer can also be protected from corrosion by a thermally unstable coating, so that it is not necessary to grind down the chamfer. This reduces the work steps when producing a pipeline at a construction site.

[0015] The object of the invention is also achieved by a system of at least two metal pipes according to any of claims 1 to 7 having the features of **claim** 8. The metal pipes are connected to one another by a weld seam and have, on the inner surface, a continuous coating with anti-corrosion and/or anti-abrasion properties. Such a system allows long pipelines with a continuous wear-inhibiting protective layer on the inner surface of the pipeline. Welding is an established method, in particular in pipeline construction, for connecting individual pipes to form a pipeline.

[0016] Preferably, the metal pipes are welded to one another by a weld seam made from the metal coating material. The protective layer is maintained on the inside in particular

when connecting using a welding process on the inner and outer surfaces or edges of the pipe joint.

[0017] The object of the invention is also achieved by a method for producing a metal pipe according to any of claims 1 to 7 having the features of **claim** 10.

[0018] The transition region of the pipe is coated with a metal material with anti-corrosion and/or anti-abrasion properties by means of build-up welding and a base coating is then applied to the inner surface of the pipe, the base coating covering the inner surface of the pipe body and partially covering the metal coating of the transition region. Within the meaning of the invention, build-up welding includes plasma spraying, laser build-up welding or applying a layer using an arc welding method.

[0019] Preferably, a metal material, more preferably a weldable, stainless material, most preferably the material 2.4856, is used for the metal coating of the transition region. Metal materials, in particular weldable metal materials, can be easily applied to a typical steel pipe. Stainless materials as a coating are very resistant to, for example, chemical attacks by the oils or gases, which are sometimes sulfuric.

[0020] Ideally, a metal coating is applied in the transition region with a variable thickness, preferably with a thickness that increases toward the pipe joint. By applying the metal coating with a thickness that increases toward the pipe joint, a continuous coating without edges can be produced by the subsequent coating. This reduces the pressure loss in the pipe when conveying oil or gas.

[0021] Preferably, the metal coating is applied in the transition region with an average thickness of 0.1 mm to 2 mm, preferably with an average thickness of 0.1 mm to 1 mm, even more preferably with an average thickness of 0.2 mm to 0.4 mm. These layer thicknesses can be applied reliably using known methods and are an optimum between material usage and wear protection.

[0022] The pipe joint is preferably coated at least in part with a metal coating, preferably with the same material as the coating of the transition region. A preferably continuous coating of the transition region and of the pipe joint improves the adhesion of the metal coating and improves the use properties when installing and operating the pipe.

[0023] A metal coating is applied to the pipe joint with a variable thickness. As a result, design-related surface contours are maintained or can be created. This simplifies handling when assembling the pipeline.

[0024] The metal coating of the pipe joint is applied with an average thickness of 0.1 mm to 2 mm, preferably with an average thickness of 0.1 mm to 1 mm, even more preferably with an average thickness of 0.2 mm to 0.4 mm. These thicknesses are an optimum between material use when coating and the desired wear protection.

[0025] Pipe bodies are preferably used which have a length greater than 10 m and/or an inner diameter of more than 150 mm, more preferably of more than 250 mm. Above these limit dimensions, subsequent coating of the inner surface is usually uneconomical.

[0026] An edge of the metal coating of the transition region and/or of the pipe joint, preferably in the region of a weld seam, is chamfered; ideally, part of a V- or J-groove is chamfered into the edge. This reduces the necessary steps when producing a pipeline at the construction site. Some of the preparation work is not necessary, because the weld seams are usually placed in V- or J-grooves when connecting two pipes. Preferably, a build-up weld is applied in the form of a ring, preferably in a recess of the pipe body, in the as yet uncoated pipe at the pipe ends on the inside and the build-up weld has anti-corrosion and/or anti-abrasion properties. The pipe is then provided with a base coating material from the inside, with part of the build-up weld also being provided with the base coating in an overlapping manner.

[0027] The object of the invention is also achieved by a method having the features of **claim** 15. The pipe joints are welded together, preferably with the material of the metal coating.

[0028] The description of the invention is accompanied by the following four drawings:

Fig. 1	is a section through a pipe with a coating
Fig. 2	is a section through a pipe with a coating of the pipe joint
Fig. 3	is a section through a pipe with a coating in a recess
Fig. 4	is a section through two connected pipes without a weld seam
Fig. 5	is a section through two connected pipes with a weld seam

[0029] The invention is described in detail in the following in the form of embodiments with reference to these drawings. In all the drawings, the same technical elements are denoted by the same reference signs.

[0030] *Fig. 1* is a section through a metal pipe not according to the invention for conveying oil or gas. The pipe body 1 consists, for example, of a carbon steel and forms

the structure of the metal pipe. A transition region 2 is arranged at the end of the pipe body 1, which transition region is provided with a metal coating 4. The metal coating 4 has a thickness d that increases toward the pipe joint 3. A base coating 5, here for example a plastics layer, is applied to the inner surface 6 of the pipe body 1, the plastics layer 5 partially covering the metal coating 4. Here, the offset in the metal coating 4 allows an almost edge-free inner surface 6 of the entire pipe.

[0031] *Fig. 2* is a section through a pipe having a metal coating 4 of the transition region 2 and an additional metal coating 4 of the pipe joint 3. The metal coating 4 is continuous, so that there is an L shape in sectional view. In the transition region 2, the metal coating 4 continuously rises upward to the pipe joint 3. The pipe joint 3 is coated with a constant thickness d. The inner edge 61 of the metal coating 4 is correspondingly chamfered to form a partial V-groove 8.

[0032] *Fig. 3* is a section through a pipe having a metal coating 4 of the transition region 2 in a recess 23 of the pipe body 1 and an additional metal coating 4 of the pipe joint 3. The metal coating 4 of the pipe joint and the transition region 2 is continuous, so that there is an L shape in sectional view. In the transition region 2, the base coating 5, a sprayed-on metal base coating according to the invention, partially covers the metal coating.

[0033] *Fig. 4* is a section through two pipes according to the invention arranged one next to the other. The two pipe joints 3 are in contact with one another, thus forming a continuous coating. The chamfered edges of the metal coating 4 thus form a V-groove on the inner and outer edges 61, 71. Moreover, the adjacent pipe joints 3 each have a complementary tongue and groove joint 11, with one part being coated or formed by the metal coating 4 of the pipe joint 3.

[0034] *Fig. 5* is the section of Fig. 3 with a corresponding weld seam 10 in the two V-grooves 8 on the inner and outer edges 61, 71 for connecting the two pipes to a pipeline.

Table 1: Reference signs

Number	Description
1	Pipe body
2	Transition region
21	Heat-affected zone
22	Cover region
23	Recess
3	Pipe joint
4	Metal coating
5	Base coating
6	Inner surface
61	Inner edge
7	Outer surface
71	Outer edge
8	V-groove part
9	J-groove part
10	Weld seam
11	Pipe body tongue and groove
d	Thickness
L	Length
D	Diameter

Patentkrav

1. Metalrør til transport af olie og gas, som omfatter et rørlegeme (1) med en indvendig og udvendig flade (6,7) og to rørsamlinger (3), hvor et overgangsområde (2) er arrangeret ved tilsvarende ende af rørlegemet (1), og den indvendige flade (6) på rørlegemet (1) omfatter mindst en delvis grundbelægning (5) mellem de to overgangsområder, hvor overgangsområdet (2) på den indvendige flade (6) af rørlegemet (1) er belagt med et metallisk, svejsbart materiale med korrosions- og/eller slidbeskyttende egenskaber; hvor den mindst delvise grundbelægning (5) på den indvendige side (6) af rørlegemet (1) dækker metalbelægningen (4) i overgangsområdet (2) mindst delvist,
kendetegnet ved, at
grundbelægningen (5) er en påsprøjtet metallisk grundbelægning (5).

2. Metalrøret ifølge krav 1, **kendetegnet ved, at** metalbelægningen (4) i overgangsområdet (2) består af et metalmateriale, fortrinsvis af et svejsbart, ikke-rustende materiale, mere fortrinsvis af materialet 2.4856.

3. Metalrøret ifølge ét af de foregående krav, **kendetegnet ved, at** metalbelægningen (4) har variabel tykkelse (d) i overgangsområdet (2), fortrinsvis en tykkelse (d), der forøges hen mod rørsamlingen (3).

4. Metalrøret ifølge ét af de foregående krav, **kendetegnet ved, at** metalbelægningen (4) i overgangsområdet (2) har en gennemsnitlig tykkelse (d) på 0,1 mm til 2 mm, fortrinsvis en gennemsnitlig tykkelse (d) på 0,1 mm til 1 mm, endnu mere fortrinsvis en gennemsnitlig tykkelse (d) på 0,2 mm til 0,4 mm.

5. Metalrøret ifølge ét af de foregående krav, **kendetegnet ved, at** rørsamlingen (3) har en mindst delvis metalbelægning (4), fortrinsvis af det samme materiale som metalbelægningen (4) i overgangsområdet (2).

6. Metalrøret ifølge ét af de foregående krav, **kendetegnet ved, at** længden (L) af rørlegemet (1) er større end 10 m.

7. Metalrøret ifølge ét af de foregående krav, **kendetegnet ved, at** rørlegemet (1) har en indvendig diameter (D) på mere end 150 mm, fortrinsvis på mere end 250 mm.

8. System af mindst to metalrør ifølge ét af kravene 1 til 7, **kendetegnet ved, at**

   – metalrørene er forbundet med hinanden ved hjælp af en svejsesøm (10);
   og
   – mindst to rør, der er svejset sammen med hinanden, har en gennemgående belægning (4,5) på den indvendige flade (6) med korrosions- og/eller slidbeskyttende egenskaber.

9. Systemet af mindst to metalrør ifølge krav 8, **kendetegnet ved, at** metalrørene er svejset sammen med hinanden med en svejsesøm (10) af det metalliske belægningsmateriale.

10. Fremgangsmåde til fremstilling af et metalrør ifølge ét af kravene 1 til 7, hvor en belægning er påført den indvendige flade (6) af rørlegemet flere gange, **kendetegnet ved, at**

– overgangsområdet (2) på rørlegemet (1) belægges med et metallisk materiale med korrosions- og/eller slidbeskyttende egenskaber ved hjælp af en pålægssvejsning; og
– en grundbelægning (5) påføres den indvendige flade (6) af rørlegemet (1), som dækker den indvendige flade (6) på rørlegemet (1) og delvist metalbelægningen (4) i overgangsområdet (2).

11. Fremgangsmåden til fremstilling af et metalrør ifølge krav 10, **kendetegnet ved, at** der til metalbelægningen (4) i overgangsområdet (2) anvendes et metallisk materiale, fortrinsvis et svejsbart, ikke-rustende materiale, mere fortrinsvis materialet 2.4856.

12. Fremgangsmåden til fremstilling af et metalrør ifølge ét af kravene 10 eller 11, **kendetegnet ved, at** der i overgangsområdet (2) påføres en metalbelægning (4) med en variabel tykkelse (d), fortrinsvis med en tykkelse (d), der forøges hen mod rørsamlingen (3).

13. Fremgangsmåden til fremstilling af et metalrør ifølge ét af kravene 10 til 12, **kendetegnet ved, at** metalbelægningen (4) i overgangsområdet (2) har en gennemsnitlig tykkelse (d) på 0,1 mm til 2 mm, fortrinsvis en gennemsnitlig tykkelse (d) på 0,1 mm til 1 mm, endnu mere fortrinsvis en gennemsnitlig tykkelse (d) på 0,2 mm til 0,4 mm.

14. Fremgangsmåden til fremstilling af et metalrør ifølge ét af kravene 10 til 13, **kendetegnet ved, at**

– der tilvejebringes en ringformet pålægssvejsning i det stadig ikke-belagte rør på den indvendige side; og
– pålægssvejsningen har korrosions- og slidbeskyttende egenskaber;
og
– røret indvendigt forsynes med grundbelægningsmaterialet, hvor også en del af pålægssvejsningen kommer til at overlappe grundbelægningslaget.

15. Fremgangsmåden til fremstilling af et system af mindst to metalrør ifølge ét af kravene 1 til 7, **kendetegnet ved, at** rørsamlingerne (3) svejses sammen med hinanden, fortrinsvis med samme materiale som metalbelægningen.

Fig. 1:

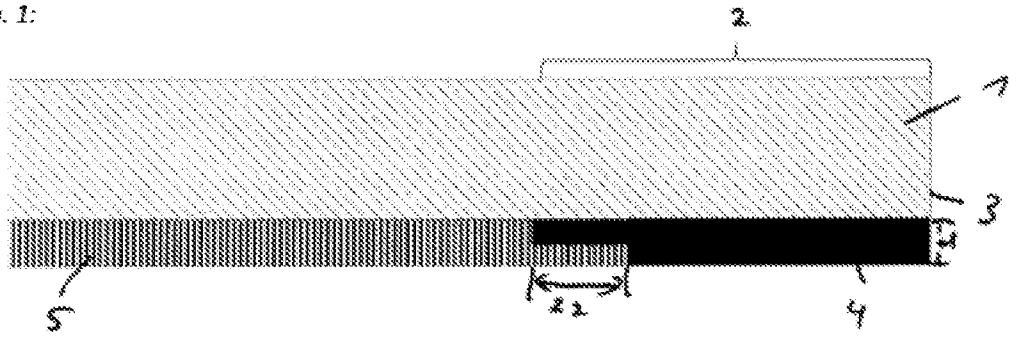

Fig. 2:

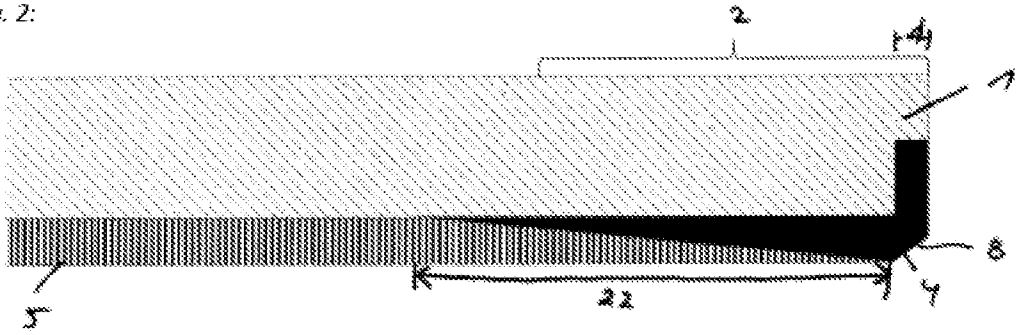

Fig. 3:

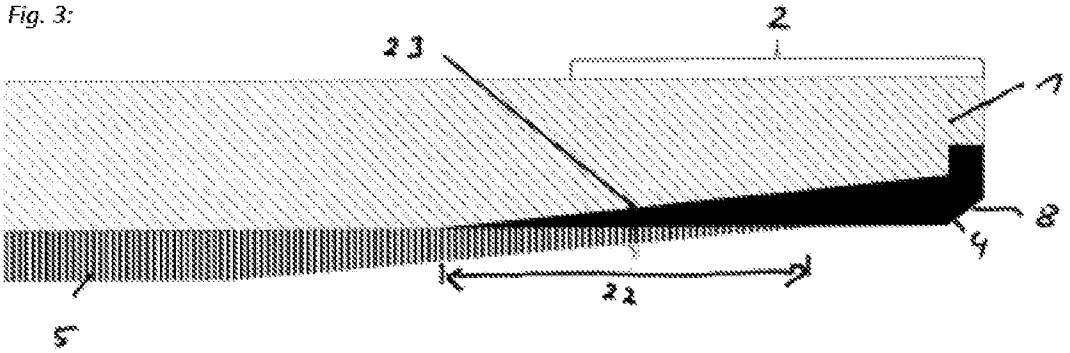

Fig. 4:

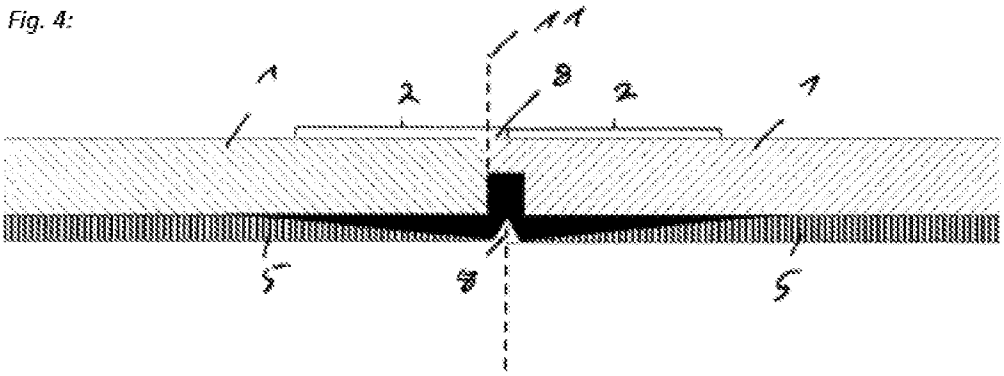

Fig. 5: