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(54) Process for treating a line component

Verfahren zur Behandlung einer Leitungskomponente

Procédé de traitement d'un composant de ligne

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Description

[0001] The present invention relates to a process for treating a component for a line for conducting oxygen. In particular, the invention relates to a process in which a coating is applied to a surface of the component which is in contact with oxygen during operation of the line.

[0002] For transporting gaseous oxygen at pressures of up to several 10s of bars, use is made of components such as, for example, pipelines, bends, T-pieces and/or fittings made of carbon steel or high-grade steel. Carbon steel and high-grade steel are not recommended for pressure ranges in the case of flowing oxygen above, for example, 1 bar and 11 bar, respectively, depending on the flow rate (see EIGA/CGA). At pressures or rates above these limit values, it is possible to use components made of expensive substitute materials which, however, are difficult to obtain, for example Monel 400, a nickel-copper alloy. However, in Germany, for example, special reports or permits are required for the use of materials other than carbon steel and high-grade steel for pipelines for conducting oxygen.

[0003] Alternatively, in this pressure range carbon steel and high-grade steel are proposed as components for conducting the gaseous oxygen if personnel are prevented from accessing the lines at the installation site of the components by, for example, barriers. These barriers, however, are not always approvable or permissible and access during operation of the pipelines for monitoring, maintenance or repair measures is not possible or not permitted.

[0004] In addition, it is clear from the guidelines/recommendations (EIGA/CGA) that components of the line made of high-grade steel or carbon steel having a coating of pure nickel are preferred for conducting gaseous oxygen up to 207 bar. In this context, it is known from US 2009/0007967 A1 to apply a nickel layer to carbon steel or high-grade steel pipes by means of plasma spraying. In the case of pipes having a 90° bend, for example, plasma spraying can however only be used with difficulty, and in addition plasma spraying can only be used for components having an overall length of up to 1.8 m. In addition, it has been found that the nickel layer applied by plasma spraying can spall and be completely destroyed during tensile and bending tests and also during separating operations.

It is therefore an object of the invention to at least partially solve the problems outlined with reference to the prior art and, in particular, to specify a use of components in a line for conducting oxygen coated with nickel, such that the nickel layer remains intact even in the event of mechanical loading.

[0005] These objects are achieved by a use according to the features of Patent Claim 1. Further advantageous configurations of the use are specified in the dependent patent claims. The features given individually in the patent claims may be combined with one another in any desired, technologically feasible way and may be supplemented with explanatory information from the description, in which case further alternative embodiments of the invention are presented.

In particular, the invention proposes an use for a component in a line for conducting a gas, wherein said component was treated by applying a coating of nickel by electroplating at least to the surface of the component which is in contact with the oxygen during operation of the line, preferably also the entire surface. The gas has an oxygen content of more than 23.5% by volume. The gas has an oxygen content of more than 23.5% by volume.

[0006] In the line, oxygen is conducted in particular at a pressure of greater than 1 bar or even greater than 11 bar. The component for a line for conducting oxygen is, in particular, a pipe, a flange, a valve, a trap, a slide, a bend, a T-piece, a filter, a compressor and/or a piston.

According to the invention, the coating is applied to the component by electroplating. For this purpose, the component is provided, after chemical pretreatment for cleaning the surface of the component, in a liquid bath, in particular an electrolytic liquid bath.

The component is connected to the negative terminal of a voltage source and thus forms the cathode. The coating material is likewise provided in the liquid bath and is connected to the positive terminal of the voltage source, as a result of which the coating material forms the anode. On application of a DC voltage, a current is produced between the coating material and the component, as a result of which ions of the coating material are released from the anode. These ions of the coating material flow to the component, where they form a coating on the surface of the component by cathodic deposition. In particular, a bond is established between the component and the coating material by reduction. On account of an appropriate arrangement and/or coverage of the component or arrangement of the coating material in the liquid bath, only specific surface regions of the component can be coated. It is preferable to apply a voltage such that a current having a current density of 0.5 to 10 A/dm^2 [ampere per square decimetre], particularly preferably of 1 to 4 A/dm^2, flows. In the case of these currents, the introduction of hydrogen, which could lead to hydrogen embrittlement of the component, is virtually avoided.

[0007] The process makes it possible to produce components for gaseous oxygen at high pressure very cost-effectively, and therefore no barriers during operation of the pipeline or expensive substitute materials are required. The electroplating establishes a bond between the component and the coating which prevents the nickel layer from becoming detached even under tensile and bending test loading and during separation, as a result of which the coated components also have very good mechanical properties. On account of the mechanical properties, no particles of the coating pass into the line even when the line is being processed. In addition, the surface of the component is depicted exactly by the electroplating. It is also possible to coat components having geometries which cannot be coated by plasma spraying.

[0008] The component preferably comprises at least one of the following materials:

- carbon steel,
- austenitic steel,
- ferritic steel,
- cast iron,
- malleable cast iron,
- chromium-nickel alloy,
- aluminium,
- copper,
- copper alloy,
- non-metallic material,
- glass,
- plastic,
- carbon fibre-reinforced plastic.

[0009] In particular, the surface which is in contact with the oxygen during operation of the line is therefore produced from one of these materials. In this case, the material preferably has a thickness of at least 0.1 mm [millimetre] or even of at least 20 mm.

[0010] It is advantageous if the coating has a layer thickness of at most 10 mm, particularly preferably of at most 5 mm. In particular, a coating having a layer thickness of at least 0.5 μm [micrometre], preferably of at least 2 μm, or even at least 10 μm should be applied. This also achieves a high resistance to wear.

[0011] The coating material has a nickel content of at least 99% by weight, preferably of at least 99.2% by weight, very preferably of at least 99.9% by weight. Nickel is suitable and permitted in particular for use in lines for conducting oxygen.

Components having a length of at least 2 m [metre], particularly preferably of at least 5 m and up to 10 m, are preferably also treated by the electroplating. The electroplating is therefore also suitable for coating components having large dimensions.

The invention and the technical context will be explained below in more detail with reference to the figure. It should be pointed out that the figure shows a particularly preferred alternative embodiment of the invention, but the invention is not limited thereto. Schematically:

Figure 1: shows the electroplating of a component, and

Figure 2: shows a line for conducting oxygen.

Figure 1 schematically shows a cross section through a liquid bath 8 for electroplating a component 1. In the exemplary embodiment shown here, the component 1 is a pipe having a length 6 and has a surface 2 on the inner side. The component 1 is connected to the negative terminal of a voltage source 7. The positive terminal of the voltage source 7 is connected to a coating material 4, which is arranged in the pipe and thus forms the anode. In order to apply a coating 3 to the surface 2 of the component 1, a voltage is applied between the component 1 as electrode and the coating material 4 as anode. The current induced by the voltage between the coating material 4 and the component 1 through the liquid bath 8 releases ions of the coating material 4, which flow through the electrical field to the component 1. The ions of the coating material 4 arrive at the surface 2 of the component 1, where they form a coating 3 by reduction. The coating 3 has a layer thickness 5 which, in this case, is applied uniformly on the surface 2 of the component 1. The layer thickness 5 is at most 10 mm. The electroplating is ended when a predefinable layer thickness has been reached. The coating material is made of high-purity nickel, with a nickel content of at least 99.2% by weight.

Figure 2 shows a line 12 for conducting oxygen. The line 12 comprises pipes 9 and a valve 10 with a spindle 11 including a closing plate. The surfaces 2 of the pipes 9 and of the valve 10 which are in contact with oxygen during operation of the line 12 have a nickel coating, which was applied by the process of electroplating.

[0012] The process establishes a bond between the coating 3 and the component 1 which withstands even the greatest mechanical demands and therefore makes reliable operation of a line for gaseous oxygen possible.

[0013] List of reference numerals

1	Component
2	Surface
3	Coating
4	Coating material
5	Layer thickness
6	Length
7	Voltage source
8	Liquid bath
9	Pipe
10	Valve
11	Spindle with closing plate
12	Line

Claims

1. Use of a component (1) in a line conducting a gas having an oxygen content of more than 23,5% by volume, wherein said component (1) was treated by applying a coating (3) of a coating material (4)having a nickel content of at least 99% by weight, by electroplating at least to the surface (2) of the component (1) which is in contact with the oxygen during operation of the line.

2. Use according to Claim 1, wherein the component (1) comprises at least one of the following materials:

   - carbon steel,
   - austenitic steel,

- ferritic steel,
- cast iron,
- malleable cast iron,
- chromium-nickel alloy,
- aluminium,
- copper,
- copper alloy,
- non-metallic material,
- glass,
- plastic,
- carbon fibre-reinforced plastic.

3. Use according to either of the preceding claims, wherein the coating (3) has a layer thickness (5) of at most 10 mm.

4. Use according to one of the preceding claims, wherein the component (1) has a length (6) of at least 2 m.

Patentansprüche

1. Verwendung einer Komponente (1) in einer Leitung, die ein Gas mit einem Sauerstoffgehalt von mehr als 23,5 Vol.-% führt, wobei die Komponente (1) durch Auftragen einer Beschichtung (3) eines Beschichtungsmaterials (4), das einen Nickelgehalt von mindestens 99 Gew.-% aufweist, durch Galvanotechnik auf mindestens die während des Betriebs der Leitung mit dem Sauerstoff in Kontakt stehende Oberfläche (2) der Komponente (1) behandelt wurde.

2. Verwendung nach Anspruch 1, wobei die Komponente (1) mindestens eines der nachstehenden Materialien umfasst:

- Kohlenstoffstahl,
- Austenitstahl,
- Ferritstahl,
- Gusseisen,
- Temperguss,
- Chrom-Nickel-Legierung,
- Aluminium,
- Kupfer,
- Kupferlegierung,
- nicht-metallisches Material,
- Glas,
- Kunststoff,
- kohlefaserverstärkten Kunststoff.

3. Verwendung nach einem der vorangehenden Ansprüche, wobei die Beschichtung (3) eine Schichtdicke (5) von maximal 10 mm aufweist.

4. Verwendung nach einem der vorangehenden Ansprüche, wobei die Komponente (1) eine Länge (6) von mindestens 2 m aufweist.

Revendications

1. Utilisation d'un composant (1) dans un gazoduc ayant une teneur en oxygène supérieure à 23,5% en volume, dans laquelle ledit composant (1) a été traité par l'application d'un revêtement (3) sur un matériau de revêtement (4) présentant une teneur en nickel d'au moins 99% en poids, par électrodéposition au moins sur la surface (2) du composant (1) qui est en contact avec l'oxygène pendant le fonctionnement du gazoduc.

2. Utilisation selon la revendication 1, dans laquelle le composant (1) comprend au moins l'un des matériaux suivants :

- acier au carbone,
- acier austénitique,
- acier ferritique,
- fonte,
- fonte malléable,
- alliage chrome-nickel,
- aluminium,
- cuivre,
- alliage de cuivre,
- matériau non métallique,
- verre,
- matière plastique,
- matière plastique renforcée par des fibres de carbone.

3. Utilisation selon l'une quelconque des revendications précédentes, dans laquelle le revêtement (3) présente une épaisseur de couche (5) d'au plus 10 mm.

4. Utilisation selon l'une quelconque des revendications précédentes, dans laquelle le composant (1) a une longueur (6) d'au moins 2 m.

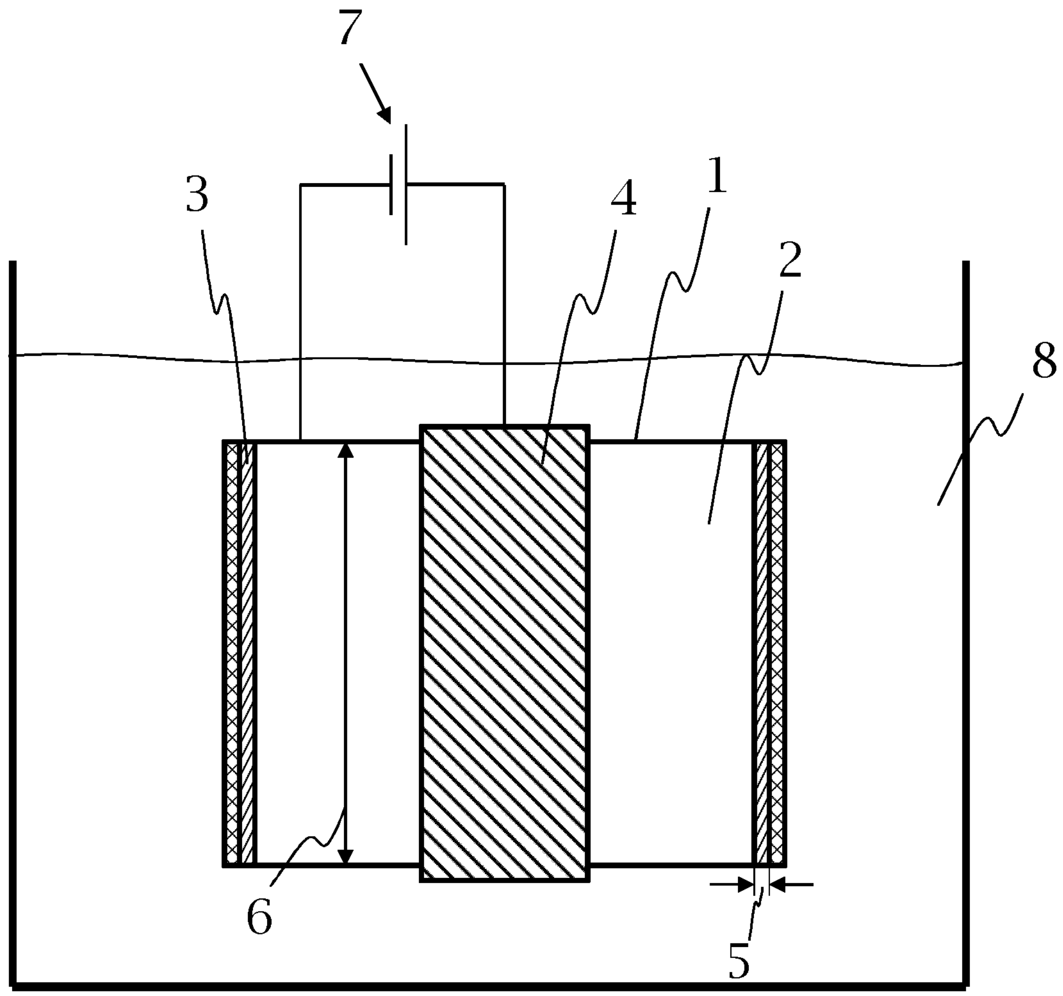

Fig. 1

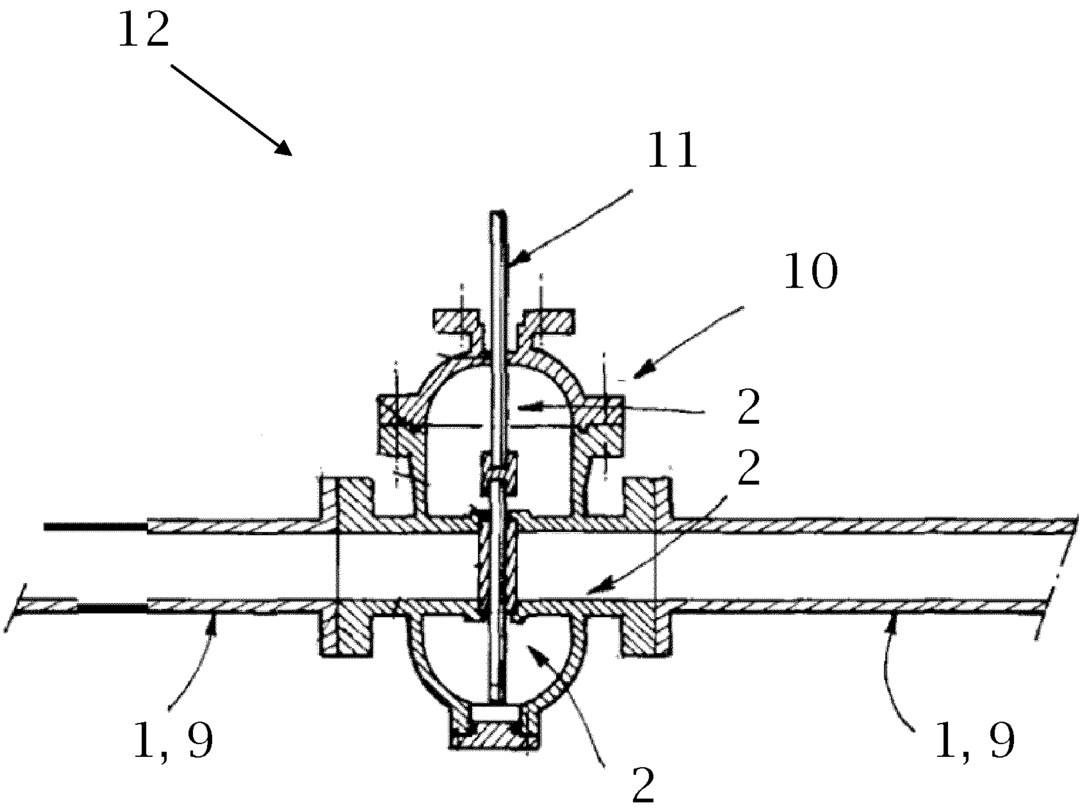

Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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