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(72) Inventor: **Sievers, Sabine**
47877 Willich (DE)

(74) Representative: **Beroud, Amandine**
L'AIR LIQUIDE S.A.
Direction de la Propriété Intellectuelle
75 Quai d'Orsay
75321 Paris Cedex 07 (FR)

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(71) Applicants:
• **L'AIR LIQUIDE, SOCIETE ANONYME POUR L'ETUDE ET L'EXPLOITATION DES PROCEDES GEORGES CLAUDE**
75007 Paris (FR)
Designated Contracting States:
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• **Air Liquide Deutschland GmbH**
40235 Düsseldorf (DE)
Designated Contracting States:
DE

(54) **Process for treating a line component**

(57) The present invention relates to a process for treating a component (1) for a line for conducting oxygen. A coating (3) of a coating material (4) is applied by electroplating at least to the surface (2) of the component (1) which is in contact with the oxygen during operation of the line.

The process according to the invention 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.

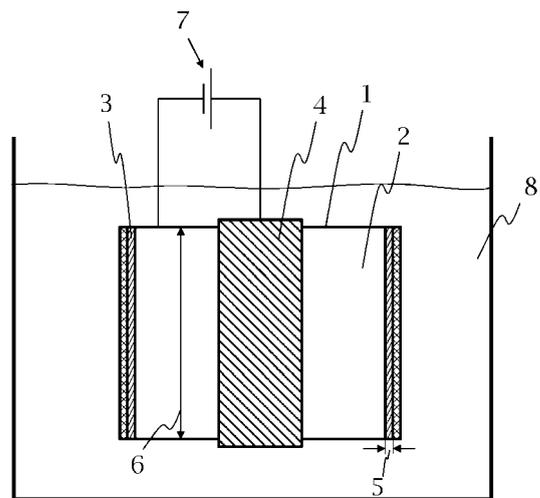


Fig. 1

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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.

[0005] 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 process with which components of a line for conducting oxygen can be coated with nickel, such that the nickel layer remains intact even in the event of mechanical loading.

[0006] These objects are achieved by a process according to the features of Patent Claim 1. Further advantageous configurations of the process 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.

[0007] In particular, the invention proposes a process for treating a component for a line for conducting oxygen, in which process a coating of a coating material is applied 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. Furthermore, the process can also be used for coating components for apparatuses in which use is made of a gas having an oxygen content of more than 23.5% by volume.

[0008] 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.

[0009] 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.

[0010] 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/dm² [ampere per square decimetre], particularly preferably of 1 to 4 A/dm², flows. In the case of these currents, the introduction of hydrogen, which could lead to hydrogen embrittlement of the component, is virtually avoided.

[0011] The process according to the invention 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 com-

ponents having geometries which cannot be coated by plasma spraying.

[0012] 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.

[0013] 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.

[0014] 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.

[0015] The coating material preferably has a nickel content of at least 99% by weight, particularly 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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 according to the invention.

[0020] The process according to the invention 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.

List of reference numerals

[0021]

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. Process for treating a component (1) for a line for conducting oxygen, in which a coating (3) of a coating material (4) is applied by electroplating at least to the surface (2) of the component (1) which is in contact with the oxygen during operation of the line. 5
2. Process according to Claim 1, wherein the component (1) comprises at least one of the following materials: 10
 - carbon steel,
 - austenitic steel,
 - ferritic steel, 15
 - cast iron,
 - malleable cast iron,
 - chromium-nickel alloy,
 - aluminium,
 - copper, 20
 - copper alloy,
 - non-metallic material,
 - glass,
 - plastic,
 - carbon fibre-reinforced plastic. 25
3. Process according to either of the preceding claims, wherein the coating (3) has a layer thickness (5) of at most 10 mm. 30
4. Process according to one of the preceding claims, wherein the coating material (3) has a nickel content of at least 99% by weight.
5. Process according to one of the preceding claims, wherein the component (1) has a length (6) of at least 2 m. 35

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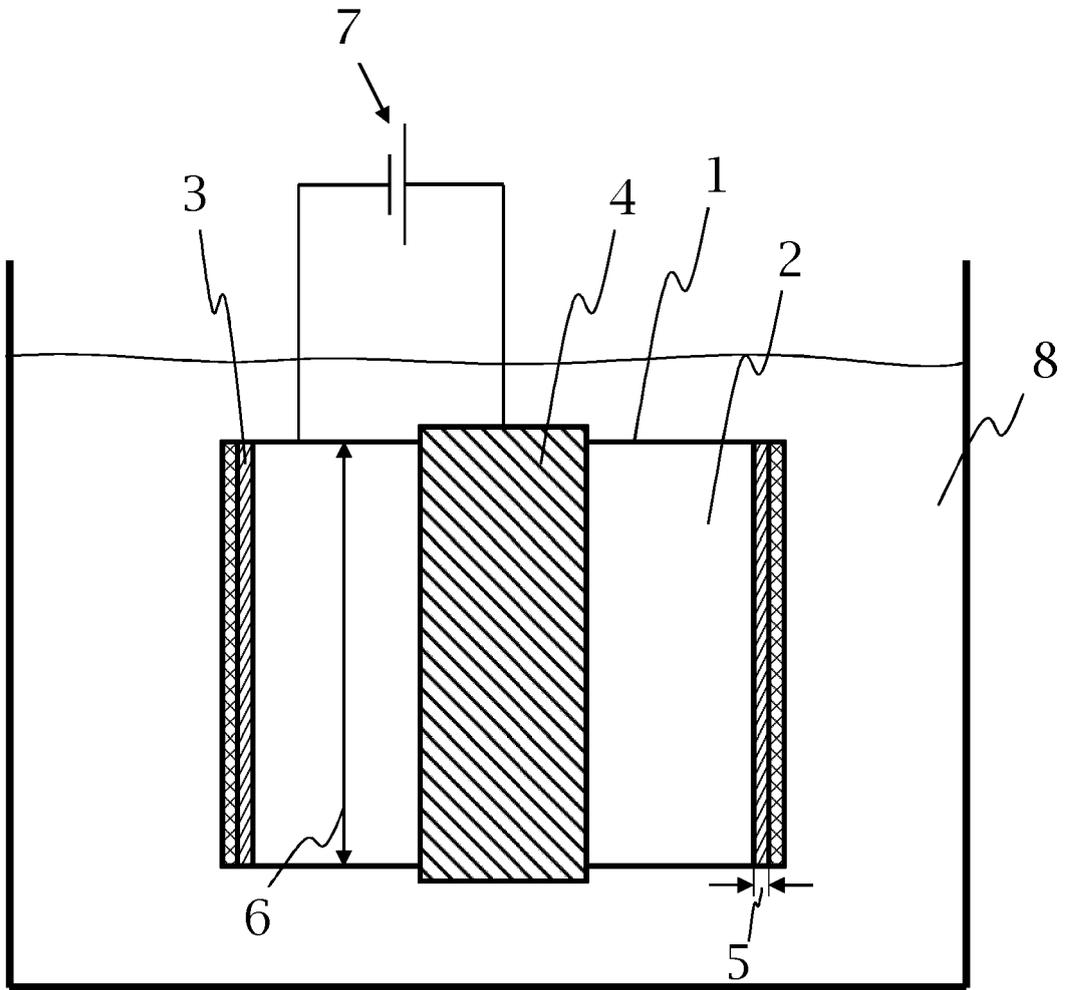


Fig. 1

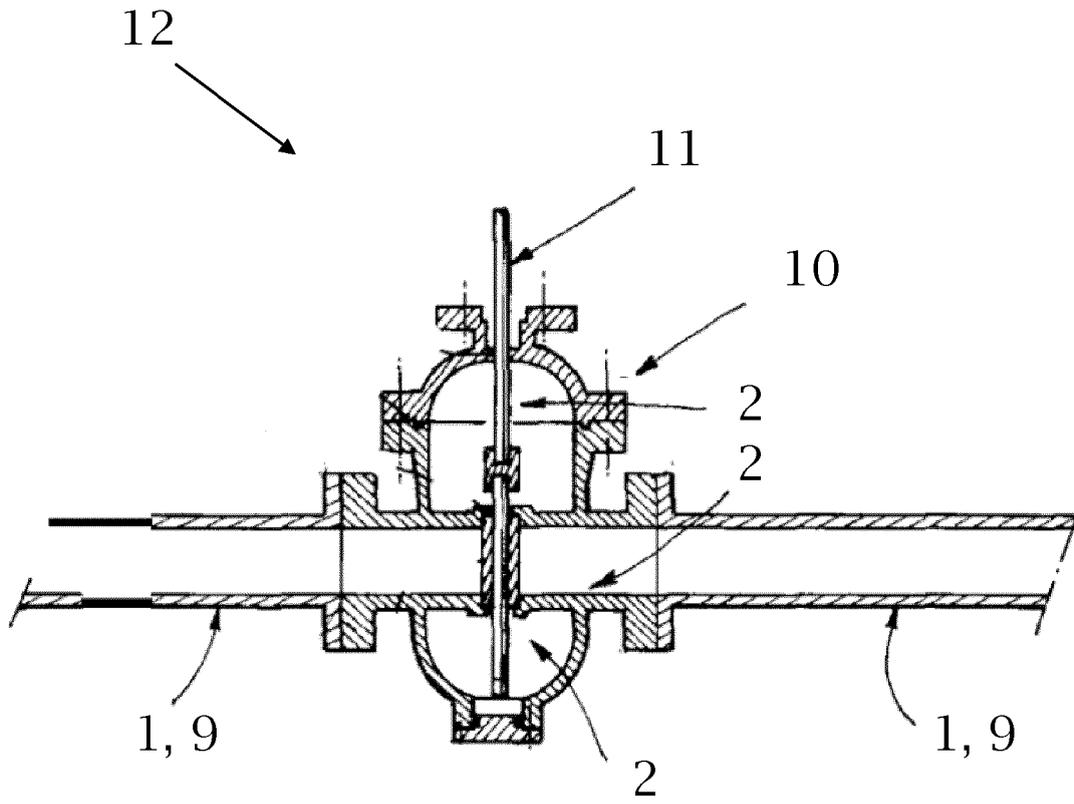


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 12 16 2802

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 849 084 A (VOUZELLAUD ALAIN [FR]) 18 July 1989 (1989-07-18) * column 1, line 17 - line 26 * * column 2, line 45 - column 4, line 66 * -----	1-5	INV. C25D7/04
X	US 2009/252883 A1 (KIM JOUNG SOO [KR] ET AL) 8 October 2009 (2009-10-08) * the whole document * -----	1-5	
A,D	US 2009/007967 A1 (FANO EMMANUEL [FR] ET AL) 8 January 2009 (2009-01-08) * the whole document * -----	1-5	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			C25D
Place of search		Date of completion of the search	Examiner
The Hague		28 August 2012	Le Hrevet, Morgan
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

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EPO FORM 1503 03/82 (P04/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 16 2802

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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28-08-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4849084 A	18-07-1989	DE 3861205 D1	17-01-1991
		EP 0291373 A1	17-11-1988
		FR 2615207 A1	18-11-1988
		US 4849084 A	18-07-1989
		ZA 8803106 A	25-01-1989

US 2009252883 A1	08-10-2009	KR 20090107341 A	13-10-2009
		US 2009252883 A1	08-10-2009

US 2009007967 A1	08-01-2009	CA 2599857 A1	08-09-2006
		CN 101133179 A	27-02-2008
		EP 1859068 A1	28-11-2007
		FR 2882764 A1	08-09-2006
		JP 4838269 B2	14-12-2011
		JP 2008531852 A	14-08-2008
		KR 20070111505 A	21-11-2007
		US 2009007967 A1	08-01-2009
		WO 2006092516 A1	08-09-2006

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20090007967 A1 [0004]