FLUID OR DRINKING WATER DUCTING SYSTEMS

Inventors: Peter Arens, Attendorf (DE);
           Christian Rischen, Eslohe (DE);
           Frank Kasperkowiak, Attendorf (DE);
           Patrik Zeiter, Riken (CH)

Correspondence Address:
PROSKAUER ROSE LLP
ONE INTERNATIONAL PLACE
BOSTON, MA 02110

Appl. No.: 11/941,496
Filed: Nov. 16, 2007

Foreign Application Priority Data
Nov. 16, 2006 (EP) .............................. 06 124 248.3

Publication Classification
Int. Cl. C22C 38/44 (2006.01)
U.S. Cl. 420/66; 420/65; 420/67; 420/68

ABSTRACT
The use of a steel alloy for the production of fittings, particularly screw- or push-fit fitting, valves or compression joints as well as corresponding fittings, particularly screw- or push-fit fittings, valves or compression joints for fluid or drinking water ducting systems is described. Low-cost production of fittings, valves and compression joints at the same time with improved corrosion resistance is achieved by the use of a steel alloy, which beside iron has the following content of alloying constituents in weight percent:

C≤0.05%,
11%≤Cr≤15%,
Ni≤5%,
Mn≤2%,
N≤0.25%.
FLUID OR DRINKING WATER DUCTING SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to and the benefit of European patent application no. 06 124 248.3, filed Nov. 16, 2006, which is owned by the assignee of the instant application. The disclosure of this application is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The invention relates to the use of a steel alloy for the production of fittings, particularly screw- or push-fit fittings, valves or compression joints for fluid or drinking water ducting systems as well as fittings, particularly screw- or push-fit fittings, valves or compression joints.

BACKGROUND OF THE INVENTION

[0003] Usually nowadays highly cupferiferous non-ferrous metal alloys, such as bronze or red brass, are used for the production of fluid conducting components of gas or drinking water ducting systems, for example. The non-ferrous metal alloys used, particularly in the case of systems intended for drinking water supply, are subject to stringent requirements. On the one hand the non-ferrous metal alloys must have particularly high corrosion resistance, since the components in contact with drinking water for example should not corrode even when in use over many years. Apart from a slight tendency of metal ions to migrate into the fluid, the components should also be easy-to-produce and able to be worked on satisfactorily by machine. Due to the rising price of copper, the main constituent of the non-ferrous metal alloys used up till now, alternatives are being increasingly sought which, apart from ensuring satisfactory machining properties, ensure equally good corrosion resistance at low-cost. As stainless steel alloy austenitic steel, for example 1.4301 or 1.4401 steel, has been used hitherto which, although distinguished by good formability, so that fittings, valves or compression joints can be produced at low-cost, has a corrosion resistance, particularly in the case of thick-walled parts, which are in constant contact with drinking water for example, which has room for improvement. Although ferritic steel, which in principle has equivalent corrosion resistance, is well-known, so far it has not been used for the production of fittings, valves and compression joints, since on the one hand these have a tendency to coarse grain formation when welded, which leads to reduced corrosion resistance. On the other hand the production of thick-walled parts, such as valves for example, is problematic due to the reduced formability of the ferritic steel alloys.

BACKGROUND OF THE INVENTION

[0004] The invention, in one embodiment, features a steel alloy that can be used in the low-cost production of fittings, valves and compression joints with improved corrosion resistance.

[0005] In one aspect, the invention features the use of a steel alloy, which beside iron has the following content of alloying constituents in weight percent:

<table>
<thead>
<tr>
<th>Element</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>≤0.05%</td>
</tr>
<tr>
<td>11%≤Cr≤25%</td>
<td></td>
</tr>
<tr>
<td>Ni</td>
<td>≤5%</td>
</tr>
<tr>
<td>Mn</td>
<td>≤2%</td>
</tr>
<tr>
<td>N</td>
<td>≤0.25%</td>
</tr>
</tbody>
</table>

[0006] Surprisingly it has been shown that by using the steel alloy with the composition indicated fittings, valves or compression joints can be produced at low-cost. Until now it was assumed that corresponding ferritic or austenitic-ferritic steel alloys were not suitable for the production of corresponding components, since on one hand these presented problems as regards formability and on the other hand have a tendency to coarse grain formation when welded, so that corrosion resistance is no longer assured in these cases. Due to the advance in welding methods, as with laser welding for example, heat ingress during welding could be reduced to such an extent that any reduction in corrosion resistance virtually no longer arises. Furthermore progress in the field of forming processes, which enable the metal to flow, have led to the fact that fittings, valves or compression joints, despite their wall thickness and the high strains needed for their production, can be made at low-cost. With the inventive use of a steel alloy, due to the low carbon content of 0.05 by wt-% maximum, intercrystalline corrosion of the ferritic or ferritic-austenitic steel alloy is substantially reduced. The chrome ratio of 11-25 by wt-% likewise leads to an improvement in corrosion resistance. Higher chrome content does in principle increase corrosion resistance. However with increasing chrome content, conversion of the steel alloy into fittings, valves and compression joints becomes more difficult. Nickel is considered to be an austenite former and to this extent determines the amount of the austenitic microstructure in the steel alloy. With a ratio of less than 5% the austenitic amount is about 50% of the steel alloy. The lower the nickel content, the higher the ferritic amount of the microstructure. The formability of the steel alloy can be improved by adding 2% manganese maximum. A higher manganese amount on the other hand would reduce the corrosion resistance of the steel alloy. With a nitrogen content of Ni≤0.25 wt-% on the one hand, as the result of nitrogen being present, it is possible to improve resistance of the steel alloy to pitting corrosion. On the other hand as a result of the nitrogen content being limited to the value mentioned, the formability of the steel alloy is not negatively influenced.

[0007] In a next embodiment of the inventive use, the steel alloy has a Cr content of 10%≤Cr≤23% in weight percent. In particular corrosion resistance can be substantially improved by the higher chrome content of the steel alloy.

[0008] In order, even with heavier wall thickness, to achieve sufficient resistance of the steel alloy to intercrystalline corrosion, the steel alloy has a titanium content of 0.15-0.8 by wt-%.

[0009] Limitation of the molybdenum content to less than or equal to 0.5 by wt-% lowers the cost when using the steel alloy for the production of fittings, valves or compression joints.

[0010] A substantial improvement in corrosion resistance however can be attained by the alternative addition of molybdenum, so that the Mo-content in the steel alloy is limited to 1.0%≤Mo≤2.5%, preferably 1.5%≤Mo≤2.5% in weight percent.
Preferably the nitrogen content of the steel alloy is limited to

\[ N \leq 0.03\% \], preferably \( N \leq 0.015\% \)

in weight percent, in order to improve the formability of the steel.

In a next refined embodiment of the invention a steel alloy, which has a nickel content of

\[ 1\% \leq Ni \leq 3\% \]

in weight percent, is used. The ratio between the ferritic and austenitic microstructure is adjusted by means of the Ni-content. Preferably the amount of the austenitic microstructure is 50% maximum. With corrosion resistance as good as that of ferritic steel having a much lower Ni-content, the austenitic ferritic steel alloy has improved tensile strength values and fatigue limit characteristics in corrosive fluid compared to austenitic steel and improved formability compared to the ferritic steel alloys.

As a result of using the steel alloy for the production of fittings, in particular screw- or push-fit fittings, valves or compression joints for compressed air or fire-extinguishing circuits, drinking water supply systems or gas pipes, highly corrosion resistant systems can be provided at low-cost.

In another aspect, the invention features fittings, particularly screw- or push-fit fittings, valves or compression joints, due to the fact that these were produced by the inventive use of a steel alloy. With regard to the advantages of the fittings, valves and compression joints produced in this way, reference is therefore made to the previous remarks on the inventive use of the steel alloy.

There is now a variety of possibilities for configuring and refining the inventive use as well as the inventive components. In this respect reference is made to the claims subordinate to patent claim 1 as well as to the description of exemplary embodiments in conjunction with the drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawing shows in:

Fig. 1a-d perspective views of four exemplary embodiments of inventive fittings, valves and compression joints.

An exemplary embodiment of the inventive fittings is the valve housing 1 shown in Fig. 1a) for example. The valve housing 1, ranked among the fittings, has fairly thick walls in some parts and can be produced from solid metal by machining for example, but also by drop forging the ferritic or ferritic-austenitic steel alloys containing the alloying constituents indicated above.

In particular a titanium content of 0.15-0.8 by wt-% ensures good resistance of the valve housing 1 to intercrystalline corrosion, despite the heavy wall thickness. When welding the valve housing 1 according to the invention, attention must be paid to ensure that heat ingress is as little as possible, since otherwise the steel alloy has a tendency to heavy grain growth and intercrystalline corrosion. Preferably welding is therefore performed with laser methods, which are optimized for as little heat ingress as possible. By adding up to 2.5 by wt-% molybdenum the valve housing 1 can be additionally protected against intercrystalline corrosion.

Although the ferritic or ferritic-austenitic steel alloy according to the invention is limited in its formability, compared to deep drawing steel, the formability permits the production of end caps 2 (Fig. 1b)), which were made by deep-drawing from a strip of corresponding steel alloy, provided the metal is able to flow during transformation. In a further cold forming step an O-ring groove 3 can be made in the end cap 2 for example. Fig. 1c) shows a compression joint 4. The compression joint 4 consists of a pipe with an over bend 5 and connection pieces 6 at both ends. The over bend 5 is produced by bending, whereas the connecting pieces 6 are fitted to the compression joint 4 by flattening and mushrooming over for example, but also by using an internal high pressure forming process. The connecting pieces 6 can be pushed onto a corresponding connecting piece, a pipe for example, and compressed with this, so that a tight connection is obtained.

The T-piece 7 shown in Fig. 1d) has O-ring grooves 3 at the two opposite connection ends, which are intended for the connection to compression joints for example. The T-piece 7 for example can be made by internal high pressure forming of a longitudinally welded pipe, the thread 8 being produced by machining for example. However the thread 8 can also be produced by roller-burning. As forming processes upsetting, crimping, necking out and widening can be mentioned. The inventive use of the ferritic or ferritic-austenitic steel alloy not only permits the use of conventional forming techniques, but results in the production of particularly corrosion resistant and low-cost fittings, valves or compression joints for fluid or drinking water ducting systems.

1. Use of a steel alloy for the production of fittings, particularly screw- or push-fit fittings, valves or compression joints for fluid or drinking water ducting systems, characterized in that the steel alloy, beside iron, has the following content of alloying constituents in weight percent:

\[ C \leq 0.05\% \],

\[ 1\% \leq Cr \leq 25\% \],

\[ 1\% \leq Ni \leq 3\% \],

\[ 1.0 \leq Mo \leq 2.5\% \],

\[ Mn \leq 2\% \], and

\[ N \leq 0.25\% \].

2. Use according to claim 1, characterized in that the steel alloy has a Cr content of 16% \( \leq Cr \leq 23\% \) in weight percent.

3. Use according to claim 1, characterized in that the steel alloy has a Ti-content of 0.15% \( \leq Ti \leq 0.8\% \) in weight percent.

4. Use according to claim 1, characterized in that alternatively the steel alloy has a Mo-content of 1.8% \( \leq Mo \leq 2.5\% \) in weight percent.

5. Use according to claim 1, characterized in that the steel alloy has a N content of N \( \leq 0.03\% \), preferably N \( \leq 0.015\% \) in weight percent.

6. Use according to claim 1, characterized in that the steel alloy is used for the production of fittings, particularly screw- or push-fit fitting, valves or compression joints for compressed air or fire-extinguishing circuits, drinking water supply systems or gas pipes.

7. A fitting, particularly a screw- or push-fit fitting, valve or compression joint, comprising:

- a steel alloy, beside iron, having the following content of alloying constituents in weight percent:

  \[ C \leq 0.05\% \],

  \[ 11\% \leq Cr \leq 25\% \].
10. The fitting of claim 7 wherein the steel alloy includes a Mo-content of 1.8% ≤ Mo ≤ 2.5% in weight percent.

11. The fitting of claim 7 wherein the steel alloy includes a N content of N ≤ 0.03%, preferably N ≤ 0.015% in weight percent.

12. The fitting of claim 7 wherein the fitting is adapted for compressed an air or fire-extinguishing circuit, drinking water supply system or gas pipe.

* * * * *