# United States Patent [19]

**Skoglund et al.**

[11] **3,890,143**

[45] **June 17, 1975**


[54] **WELDED CONSTRUCTIONS OF STAINLESS STEELS**


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[21] Appl. No.: **350,655**

[52] **U.S. Cl.** ..... **75/125;** 75/126 C; 75/126 D; 75/128 T; 75/128 W

[51] **Int. Cl.** ..... **C22c 39/20**

[58] **Field of Search** .. 75/125, 126 C, 126 D, 128 T, 75/128 W; 29/196.1



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[57] **ABSTRACT**

Tubes and vessels intended for use in handling or housing hot water are formed by welding together sheets of stainless chromium steel having high corrosion resistance, good workability and completely stabilized structure.


**7 Claims, No Drawings**

# WELDED CONSTRUCTIONS OF STAINLESS STEELS

At constructions exposed to contact with warm or hot water, for example heat exchangers, particularly water heaters and hot-water containers as well as conduits or the like for hot or warm water, the corrosion resistance of the material is a decisive factor for the service life of the installation. In consideration thereof, such installations heretofore were constructed of copper, of sheet steel with inside copper coat, of enamel-coated sheet steel and of high-quality stainless chromium-nickel steel. The welding operations normally required in the manufacture of, for example, containers or conduits give rise in most steels to structural procedures, which deteriorate the resistance of the steels to hot and warm water. Therefore, either the steel is covered with a protective coat or a particularly high-alloyed stable steel is used.

Since recently also heat exchangers have become available which consist of pure chromium steel, to which titanium is added in order to stabilize the structure, i.e. bind carbon and nitrogen in the form of phases capable of being precipitated. Titanium is added either according to the rules of stoichiometry or in a definite ratio to carbon and nitrogen, whereby complete stabilization is assumed obtained. It was found that these chromium steels which per se are cheap, do not show the necessary corrosion resistance, particularly not in places where welding is carried out, i.e. in the weld fillet or its immediate vicinity. It is here where in most cases corrosion attacks occur extremely rapidly and thereby cause operation break-downs in the installation.

The present invention shows the way and proposes the means for rendering it possible to manufacture heat exchangers and the like as described above also of chromium steel and to meet the requirement of a longest possible service life. According to the invention a heat exchanger or the like referred to above is made of sheet metal, of a material having the general chemical composition as follows:

Chromium steel with low carbon and nitrogen contents, which improves the working properties. For obtaining weldability, the material is stabilized with titanium, which improves the corrosion resistance. The chromium steel further includes molybdenum, which in combination with the low carbon and nitrogen contents eliminates the disadvantages of conventional chromium steels, such as brittleness and corrosion. Welded installations in contact with hot or warm water according to above, for example water heaters or heat exchangers, according to the invention are characterized in that they consist of sheets of chromium steel having the analysis as follows:

| | | |
|---|---|---|
| C | at max. | 0.03% |
| $N_2$ | at max. | 0.03% |
| Cr | | 17–25%, particularly 18.75–19.75% |
| Ni | at max. | 0.5% |

Cu at maxi. 0.2 %
Si at max. 0.3 – 0.6 %
Mn at max. 0.3 – 0.6 % and



Mo from 1 – 4 %, particularly 1.5 – 3 % and contents of elements which bind carbon and nitrogen, such as Ti - Nb/Ta, Al, Zr and the like, the Ti-content exceeding or being equal to 0.3 % if titanium alone is added, but at least 0.2 % in combination with other stabilizing elements.

Further examples of chromium steel for welded constructions according to the invention appear from the following:

| Test heat | 6-3806 | Test heat | 6-0933 |
|---|---|---|---|
| C — 0.029 | 0.027 | 0.028 | 0.028 |
| Si — 0.34 | 0.32 | 0.38 | 0.44 |
| Mn — 0.48 | 0.48 | 0.45 | 0.38 |
| Cr — 19.2 | 18.6 | 21.5 | 20.20 |
| Ni — 0.31 | 0.26 | 0.31 | 0.19 |
| Mo — 2.24 | 2.23 | 2.18 | 2.98 |
| N — 0.019 | 0.018 | 0.017 | 0.015 |
| Ti — 0.64 | 0.57 | 0.61 | 0.66 |

As an example of a heat exchanger according to the invention the following may be stated:

A heat exchanger of usual construction was manufactured by welding cold-rolled sheets of 2 mm thickness with the steel analysis as follows: Carbon — 0.028 %, nitrogen — 0.025 %, chromium — 18.95 %, nickel — 0.35 %, copper — 0.06 %, silicon — 0.5 %, manganese — 0.48 % and molybdenum — 2.44 %, and titanium — 0.64 %.

These heat exchangers were easy to work and to weld, and they did not show any corrosion attacks, not even after a long operation time.

This example was mentioned only for explaining the invention, but not for restricting the same.

What we claim is:

**1.** An article comprising at least one welded sheet of stainless chromium steel consisting essentially of

| | | |
|---|---|---|
| C | not more than | 0.03% |
| $N_2$ | not more than | 0.03% |
| Cr | | 17 to 25% |
| Ni | not more than | 0.5% |
| Cu | not more than | 0.2% |
| Si | | 0.3 to 0.6% |
| Mn | | 0.3 to 0.6% |
| Mo | | 1 to 4% |
| Ti | | 0.2 to 0.66% |

the balance being iron and incidential impurities, percentages being by weight.

**2.** An article as claimed in claim **1**, wherein the chromium content is 18.75 to 19.75% by weight.

**3.** An article as claimed in claim **1**, wherein the chromium content is 20.5 to 21.5% by weight.

**4.** An article as claimed in claim **1**, wherein the molybdenum content is 1.5 to 3% by weight.

**5.** An article as claimed in claim **4**, wherein the molybdenum content is 2 to 3% by weight.

**6.** An article as claimed in claim **1**, wherein the alloy steel composition includes also a significant amount of a carbon- and nitrogen-binding stabilizing element selected from the group consisting of niobium, tantalum, aluminum and zirconium.

**7.** An article as claimed in claim **1**, wherein the titanium content is at least 0.3% by weight.

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# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

PATENT NO. : 3,890,143

DATED : June 17, 1975

INVENTOR(S) : ERIC SKOGLUND, and OLLE JARLEBORG

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

[30] Foreign application Priority Data

Germany - No. G 72 14 126.5 - April 14, 1972

Signed and Sealed this

eleventh Day of November 1975

[SEAL]

*Attest:*

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