

UNITED STATES PATENT OFFICE.

BENNO STRAUSS, OF BREDENEY, GERMANY.

HEAT TREATMENT OF NICKEL-CHROME STEEL.

1,404,907.

Specification of Letters Patent. Patented Jan. 31, 1922.

No Drawing.

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(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

To all whom it may concern:

Be it known that I, Prof. Dr. BENNO STRAUSS, a citizen of the German Empire, residing at Bredeney, Germany, have invented certain new and useful Improvements in Heat Treatment of Nickel-Chrome Steel, of which the following is a specification.

This invention relates to a method of producing steel alloys suitable for objects such as gun barrels, turbine buckets and the like, which require a high resistance against corrosion, and it consists in the use of steel alloys for producing such objects, which contain from 6% to 25% chromium and from 20% to $\frac{1}{2}$ % nickel and not over 1% carbon, and it also relates to articles produced by such a method.

In the production of such objects it has up to now been recommended to use nickel steel containing about 10% nickel or from 25% to 30% nickel.

It has now been proved by experiments that alloys of the above named composition possess considerably higher power of resistance to corrosion than the previously used nickel steel alloys.

The great power of resistance of these alloys will be evident from the following.

A bar from an alloy of 20% chromium and 2% nickel shows still entirely shiny surfaces after it has been exposed for months to the influence of damp air, whilst bars of ordinary steel and bars of nickel steel containing 10% nickel show considerably corroded surfaces when exposed to damp air for the same length of time, and even nickel steel with 25% nickel show corroded surfaces.

Taking the loss in weight of mild steel as 100, a corroding test in sea water gave the following losses in weight for:

Nickel steel with 10% nickel	66
Nickel steel with 25% nickel	44
Steel with 10% chromium and 3% nickel	16
Steel with 20% chromium and 2% nickel	9

At the same time the described alloy nickel-chrome-steel possesses better qualities of strength than nickel steel containing 25% nickel which has hitherto generally been considered as mostly rust proof.

The above steel alloys may be divided into

two groups namely, alloys which in the forged state possess a hardness over 380 (in accordance with Brinnell;) and such alloys which possess a hardness below 350 (also in accordance with Brinnell).

To the first group belong alloys containing—

6% chromium and 12% to 4% nickel.

or 12% chromium and 7% to $\frac{1}{2}$ % nickel.

or 18% chromium and 4% to $\frac{1}{2}$ % nickel.

Alloys of the first group which are difficult or almost impossible to work in the forged state can be made soft and easy to work if they are heated to a temperature situated between 500° C. and the critical point, and thereupon cooled quickly or slowly. The critical point is situated in accordance with the composition of the alloy, between 720° C. and 780° C.

If this heating treatment be preceded by a heating up to 800° C. to 1000° C. with a subsequent quick or slow cooling, the alloys will obtain in addition a great strength and toughness. By small additions of tungsten or vanadium the quality of strength of the alloys may be still more improved.

By means of a subsequent heating to from 800° C. to 900° C. and subsequent quick or slow cooling, the alloys will again become hard and be difficult or impossible to work. This heating treatment forms consequently a means for hardening after working of objects produced from these alloys. These alloys may therefore be employed for the production of ball bearings as well as for the production of the balls therefor, which objects are exposed to rust or to the action of sea water.

I claim:—

1. Method of making soft and easy to work steel alloys containing 6% to 25% chromium, 20% to $\frac{1}{2}$ % nickel and not over 1% carbon and having in the forged state, a hardness over 380 (in accordance with Brinnell), said method consisting in heating the alloys to a temperature between 500° C. and the critical point and in subsequently cooling them.

2. Method of making steel alloys soft and easy to work and simultaneously tough;

namely; steel alloys containing 6% to 25% chromium, 20% to $\frac{1}{2}$ % nickel and not over 1% carbon and having in the forged state, a hardness over 380 (in accordance with 5 Brinnell), said method consisting in heating the alloys to a temperature between 800° C. and 1000° C. and thereupon cooling them, in reheating the alloys to a temperature between 500° C. and the critical point and in subsequently cooling them. 10

In testimony whereof I have affixed my signature in presence of two witnesses.

BENNO STRAUSS. [L. s.]

Witnesses:

HELEN NUFER,
ALBERT NUFER.