Patented May 26, 1931 1,807,554

UNITED STATES PATENT OFFICE

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ALLOY FOR TURBINE BLADES AND MACHINE PARTS EXPOSED TO SIMILAR CONDITIONS

No Drawing. Application filed December 16, 1926, Serial No. 155,345, and in Germany December 28, 1925.

It has been proposed by various persons to use chromium nickel alloys for the manufacture of gas and steam turbine blades and of machine parts exposed to similar mechanical, thermic and chemical conditions. According to the proposals, such alloys contained 40% to 80% nickel, 12%–25% chromium and 0–30% iron. Besides the main ingredients, in certain cases there was also used an addition of 2%–5% molybdenum or tungsten. It has also been proposed to replace part of the nickel by cobalt.

The reason for not adopting in practice such alloys for the above-mentioned purposes, is probably that these alloys produced by the processes of manufacture hitherto employed, and with the composition hitherto usual, failed to comply with all the conditions which have to be fulfilled by gas and steam turbine blades and by machine parts exposed to similar mechanical, thermic and chemical conditions.

It has been found that the chief reason for the non-adoption was that, according to the usual processes of manufacture, the alloys contained 0.2% and more per cent. of carbon, and that the alloys become much more suitable for the purposes mentioned if they are made completely free from carbon. The absence of carbon reduces in the first place the brittleness of such alloys, so that their toughness or tenacity in the region of the notch is considerably increased at the temperatures to be considered. In the second place, the resistance to corrosion of alloys free from carbon is very much greater than that of carbon-containing alloys. For instance an alloy consisting of 62% nickel, 15% chromium, 22% iron and 1% manganese, has four times smaller resistance to corrosion by dilute sulphuric acid, and 400 times smaller resistance to corrosion by diluted nitric acid, than when it contains 0.9% carbon. In the third place, chromium nickel alloys free from carbon, are completely non-sensitive in heat treatment, so that for instance when soldering on the bands which extend around the outer ends of the turbine blades, and binding wires, there is no need to pay any particular attention to the cooling conditions or to effect a subsequent annealing with definite conditions of cooling. The toughness at the region of the notch does not change at all, whether they be slowly cooled from the annealing temperature, or cooled suddenly.

In order to ensure a sufficiently high yielding point, to the alloys may be added up to 15% tungsten, up to 12% molybdenum or up to 20% cobalt. It has been found that the same result may be obtained by an addition of up to 6% aluminum.

The manufacture of such alloys free from carbon could be effected by the so-called vacuum smelting process.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

A turbine blade which is non-corrodible and non-sensitive by heat treatment to the thermal, mechanical and physical conditions of use, consisting of an alloy comprising 10 to 40% of chromium, 40 to 85% of a nickel-like metal, 10 to 40% of iron, and up to 15% of a toughening metal having the characteristics of tungsten, the alloy being substantially free from carbon.

In testimony whereof I have affixed my signature.

WILHELM ROHN.