

UNITED STATES PATENT OFFICE.

SAMUEL S. WALES, OF MUNHALL, PENNSYLVANIA. ASSIGNOR TO THE CARNEGIE STEEL COMPANY, OF PITTSBURG, PENNSYLVANIA. A CORPORATION OF NEW JERSEY.

STEEL ALLOY.

952,391.

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No Drawing.

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To all whom it may concern:

Be it known that I, SAMUEL S. WALES, of Munhall, Allegheny county, Pennsylvania, have invented a new and useful Improvement in Steel Alloys, of which the following is a full, clear, and exact description.

My invention relates to alloys of steel and particularly where nickel and chromium are used as alloying metals, and the object of the invention is to provide a new metal alloy, as is hereinafter described, which will give a metal of increased strength having great resistance to shocks and a high tensile strength.

In carrying out my invention, there is combined with the steel relatively small proportions of manganese, nickel, chromium and vanadium, and a small proportion of titanium. I have found the following proportions to be best suited for the purpose, it being understood that the proportions may vary within the limits usually had in carrying out metallurgical processes: carbon; manganese; nickel, below 4.00 per cent.; chromium, .50 per cent. to 2.00 per cent.; vanadium, .10 per cent. to .50 per cent.; titanium, .50 per cent. to 1.00 per cent.

The steel employed is preferably open hearth steel, and the nickel is preferably added to the furnace as part of the charge in a cold condition. The chromium is pre-heated and is added to the bath just before the tapping operation. The manganese is usually added either cold or pre-heated, and either to the bath or in the ladle and the vanadium and titanium are preferably added to the ladle. The charge is re-carburized in the usual manner. The sulfur, phos-

phorus and silicon content of the steel is kept within the usual low limit. After the steel has been cast into ingots it is rolled or forged to the desired dimensions and shape and when found necessary or desirable is subjected to heat treatment.

The advantages of my invention result from the addition of the titanium to the alloy steel in combination with the nickel, chromium and vanadium.

I claim:

1. An alloy steel containing manganese, from 1.00 per cent. to 4.00 per cent. nickel, from .50 per cent. to 2.00 per cent. chromium, from .10 per cent. to .50 per cent. vanadium and below 1.00 per cent. titanium.

2. A steel alloy containing manganese, below 4.00 per cent. nickel, chromium, not over .50 per cent. vanadium, and up to 1.00 per cent. titanium.

3. An alloy steel containing manganese, less than 4.00 per cent. nickel, less than 2.00 per cent. chromium, up to .50 per cent. vanadium and up to 1.00 per cent. titanium.

4. An alloy steel containing below 4.00 per cent. nickel, below 2.00 per cent. chromium, not over .50 per cent. vanadium and not over 1.00 per cent. titanium.

5. A chrome nickel steel alloy containing small proportions of titanium and vanadium.

In testimony whereof, I have hereunto set my hand.

SAMUEL S. WALES.

Witnesses:

R. D. LITTLE,
JAS. L. WELDON.