Patented Sept. 3, 1929. 1,727,282

UNITED STATES PATENT OFFICE.

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ALLOY STEEL.

No Drawing. Application filed March 22, 1928. Serial No. 263,974.

The object which I have in view is the production of a steel of the high-carbon, high-chromium type which will possess better machining qualities, and will harden more readily and to a greater degree of hardness and with less distortion or movement than steels of this general type which are now known.

For the accomplishment of these objects I have invented an alloy steel of the high-carbon high-chromium type including as ingredients cobalt and vanadium.

Both of these ingredients have been hitherto employed as ingredients of alloy steel but not in the manner hereinafter described or in combination with each other.

Thus cobalt has been used as an ingredient in tungsten and molybdenum high-speed steels to increase the cutting efficiency of the latter, and cobalt has also been added to high-carbon high-chromium steels in a proportion of more than 1%, usually about 3.50% to produce "red-hard" properties.

My present object, however, is not the production of "red-hard" properties, but to obtain the improved qualities above mentioned.

Moreover vanadium has been employed as an ingredient in many types of high-speed and tool steels with results which are well understood but are not the same as those which I have in view in connection with the present invention.

High-carbon high-chromium steels are recognized as superior materials for dies owing to their wearing qualities compared to other die-steels, but their use has hitherto been restricted owing to relative poor machinability.

I have discovered that the addition of cobalt and vanadium to such steels greatly improves their machinability due to the better distribution of the segregate which results.

Because of their basic composition high-carbon high-chromium steels are heavily segregated with a chromium carbide segregate, and the uniform distribution of this segregate, which I effect, causes the steel to harden in a more uniform manner than could occur if the cobalt and vanadium were not present as ingredients.

Again I have discovered that by adding cobalt and vanadium as ingredients high-carbon high-chromium steels will attain a more intensive hardness than is possible in the absence of such ingredients.

Moreover high-carbon high-chromium steels are by nature relatively non-deforming and non-warping during hardening, but, owing to the presence of the chromium carbide segregates such steels will deform and warp to a limited degree during the hardening processes.

This tendency I am able to reduce to a minimum by the inclusion in the steels of cobalt and vanadium as ingredients. Their inclusion acts to break up the segregates and to distribute them more uniformly throughout the steel, thus causing an easier and more complete solution of the chromium carbide when the steel is heated to above its critical range.

My improved alloy steel which possesses the improved qualities above referred to contains in weight substantially from .50% to 1% of cobalt; from .50% to 1.25% of vanadium; from 1.5% to 2.50% of carbon; from 8% to 18% of chromium, with the remainder of iron together with whatever silicon, manganese, phosphorous and sulphur which is normally present in steels of this type.

These limits are approximate only and a reasonable range of variation may be observed without materially impairing the beneficial results in view.

I have obtained particularly good results from an alloy steel comprising from 2% to 2.20% of carbon; from 11% to 13% of chromium; from .60% to 1% of cobalt; from .75% to 1.25% of vanadium; .30% of silicon; .30% of manganese; .02% of sulphur; .02% of phosphorus, and the remainder of iron.

An improvement of these cobalt-vanadium high-carbon high-chromium steels is obtained by the addition of small quantities, up to 1% of the semi-rare metals such as molybdenum, tungsten and uranium or any one or more of the same.

Steels of this range of analyses are also adapted for hot and cold shearing of steel shapes, bars and plates and for machining brass.

In general they meet the requirements of all workings of metals wherein the chief requisite is high resistance to abrasion.

What I desire to claim is:—

1. An alloy steel for dies and the like com-

prising substantially from .50% to .99% of cobalt; from .50% to 1.25% of vanadium; from 1.50% to 2.50% of carbon; from 8% to 18% of chromium, and the remainder of iron.

2. An alloy steel for dies and the like comprising substantially from .50% to .99% of cobalt; from .50% to 1.25% of vanadium; from 8% to 18% of chromium; from 1.50% to 2.50% of carbon; not more than 1% of semi-rare metal, and the remainder of iron.

3. An alloy steel for dies and the like comprising substantially 2.20% of carbon; 12% of chromium; .80% of cobalt; .80% of vanadium; .30% of silicon; .30% of manganese; .02% of sulphur; .02% of phosphorus, and the remainder of iron.

4. An alloy steel for dies and the like comprising substantially 2.20% of carbon; 12% of chromium; .80% of cobalt; .80% of vanadium; .30% of silicon; .30% of manganese; .02% of sulphur; .02% of phosphorus, not more than 1% of semi-rare metal, and the remainder of iron.

Signed at Latrobe, Pa., this 20th day of March, 1928.

JAMES P. GILL.

CERTIFICATE OF CORRECTION.

Patent No. 1,727,282. Granted September 3, 1929, to

JAMES P. GILL.

It is hereby certified that the name of the assignee in the above numbered patent was erroneously written and printed as "Vanadium Alloy Steel Company", whereas said name should have been written and printed as "Vanadium Alloys Steel Company", as shown by the records of assignments in this office; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of October, A. D. 1929.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)

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