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AUSTENITIC ALLOY STEELS

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This invention comprises improvements in or relating to alloy steels and more particularly to high expansion austenitic steels suitable for use in the manufacture of internal-combustion engines and containing at least 0.35% of carbon, from 3.5% to 6% manganese and from 3.0% to 7.0% chromium, together with a proportion of nickel and a small quantity of a stabilising element such as vanadium, tungsten, titanium or columbium.

Known alloy steels of this character, which normally contain from 11% to 16% nickel and not more than 0.9% carbon, require heat treatment at a low temperature of the order of 700° C. to obtain optimum physical properties and it is known that the heat-treated material is difficult to machine.

We have found that the machining difficulties are reduced to a marked extent by the addition to the alloy of a proportion of copper, either with nickel in the proportion of 11% to 16% or with a reduced proportion of nickel. The alloy steel according to our invention, therefore, comprises a minimum carbon content of 0.35%, from 3.5% to 6% of manganese and from 3% to 7% of chromium together with a proportion of nickel and copper and a small addition of one or more stabilising elements such as vanadium, tungsten, titanium or columbium.

The proportion of nickel may be from 11% to 16% together with copper from 0.5% up to a maximum of 12%. Alternatively the proportion of nickel may be reduced and additional copper added in place of the nickel in equivalent proportions but the remaining nickel content should be greater than the additional copper used over 12%.

The alloy according to the invention is heat-treated at a low temperature, usually 700° C.—750° C. to give it the optimum tensile properties and the heat-treated metal is more easily processed in essential machining operations such as turning, shaping, milling, drilling, tapping and grinding than in similar alloys containing no copper. Owing to the easier machinability of the metal, the degree of internal stresses set up in the metal during the machining operations are materially reduced with consequent reduction in the distortion of the machined components.

The improved steel has the further advantage that it can be readily nitrified.

It is further found that the addition of copper to alloy steels of this character improves the resistance of the metal to fatigue, for exam-

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ple, the addition of 2% copper, to an alloy containing carbon 0.49%, silicon 0.72%, manganese 5.01%, chromium 5.5%, nickel 13.5%, vanadium 0.32% increases the fatigue limit of the material to ± 21.5 tons per square inch from ± 17.0 tons per square inch. Such an alloy with a 2% copper addition is typical of the invention. The proportions of the constituents may, however, be varied within the limits hereinbefore indicated and tungsten, titanium, columbium or other stabilising elements may be used in the place of the vanadium.

I claim:

1. A high expansion austenitic steel suitable for use in the manufacture of internal-combustion engines and containing carbon between 0.35% and the usual upper limits of carbon in austenitic steels, manganese from 3.5 to 6%, chromium from 3 to 7%, nickel from 9 to 16%, copper from 0.5 to 12%, silicon 0 to 2.0%, a small proportion of a carbide forming element taken from the group consisting of vanadium, tungsten, titanium and columbium, the remainder being substantially all iron and the steel having been normalized at a minimum of 700° C. to obtain optimum physical properties.

2. A high expansion austenitic steel suitable for used in the manufacture of internal-combustion engines and containing carbon between 0.35% and 0.90%, manganese from 3.5 to 6%, chromium from 3 to 7%, nickel from 9 to 16%, copper from 0.5 to 12%, silicon 0 to 2.0%, a small proportion of a carbide forming element taken from the group consisting of vanadium, tungsten, titanium and columbium, the remainder being substantially all iron and the steel having been normalized at a minimum of 700° C. to obtain optimum tensile properties.

3. A high expansion austenitic steel suitable for use in the manufacture of internal-combustion engines and containing carbon between 0.35% and 0.49%, manganese from 3.5% to 6%, chromium from 3 to 7%, nickel from 9 to 16%, copper from 0.5 to 12%, silicon 0 to 2.0%, a small proportion of a carbide forming element taken from the group consisting of vanadium, tungsten, titanium and columbium, the remainder being substantially all iron and the steel having been normalized at a minimum of 700° C. to obtain optimum physical properties.

4. A high expansion austenitic steel suitable for use in the manufacture of internal-combustion engines and containing carbon between 0.35% and 0.9%, manganese from 3.5 to 6%, chromium from 3 to 7%, nickel from 11 to 16%,

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copper from 0.5 to 12%, silicon 0.2 to 2.0% and a small proportion of a carbide forming element taken from the group consisting of vanadium, tungsten, titanium and columbium, the remainder being substantially all iron and the steel having been normalized at a minimum of 700° C. to obtain optimum physical properties.

5 5. An austenitic alloy steel comprising copper 2%, carbon 0.49%, silicon 0.72%, manganese 5.01%, chromium 5.5%, nickel 13.5%, vanadium 0.32%, the remainder being iron and the steel having been normalized at a minimum of 700° C. to obtain optimum physical properties.

6. A normalized austenitic alloy steel having a fatigue limit of approximately ± 21.5 tons per square inch and consisting of copper 2%, carbon 0.49%, silicon 0.72%, manganese 5.01%, chromium 5.5%, nickel 13.5%, vanadium 0.32% and iron the remainder.

7. A high expansion austenitic steel suitable for use in the manufacture of internal-combustion engines and containing carbon between 0.35% and the usual upper limits of carbon in austenitic steels, manganese from 3.5 to 6%, chromium from 3 to 7%, nickel from 9 to 16%, copper from 0.5 to 12%, silicon 0 to 2.0%, a small proportion of a carbide forming element taken from the group consisting of vanadium, tungsten, titanium and columbium, the remainder be-

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ing substantially all iron and the steel having been normalized as 700° to 750° C. to obtain optimum physical properties.

8. A high expansion austenitic steel suitable for use in the manufacture of internal-combustion engines and containing, carbon between 0.35% and 0.9%, manganese from 3.5 to 6%, chromium from 3 to 7%, nickel from 9 to 16%, copper from 0.5 to 12%, silicon from 0 to 2.0%, a small proportion of a carbide forming element taken from the group consisting of vanadium, tungsten, titanium and columbium, the remainder being substantially all iron and the steel having been normalized at 700° C. to 750° C. to obtain optimum tensile properties.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,319,538	Digby	May 18, 1943

FOREIGN PATENTS

Number	Country	Date
695,049	Germany	Aug. 14, 1940