

UNITED STATES PATENT OFFICE

2,590,835

ALLOY STEELS

Henry William Kirkby and Charles Sykes, Sheffield, England, assignors, by mesne assignments, to Firth-Vickers Stainless Steels Limited, Sheffield, England, a British company

No Drawing. Application November 10, 1949, Serial No. 126,698. In Great Britain December 16, 1948

2 Claims. (Cl. 75-126)

1

This invention comprises improvements relating to alloy steels.

The invention provides a ferritic alloy steel comprising as essential constituents carbon 0.05 to 0.5%, chromium 4 to 20%, molybdenum up to 3% interchangeable with tungsten up to 3%, columbium up to 2.5%, boron up to 0.5% and vanadium up to 2%.

The invention includes the following range of composition

Carbon	0.05-0.5%
Silicon	Up to 3%
Manganese	Up to 4%
Nickel	Up to 5%
Chromium	4.0-20.0%
Molybdenum	Up to 3% (interchangeable with tungsten)
Vanadium	Up to 2%
Tungsten	Up to 3% (interchangeable with molybdenum)
Columbium	Up to 2.5%
Nitrogen	Up to 0.25%
Boron	Up to 0.5%
Cobalt	Up to 10%
Iron	Remainder

The preferred proportions of the various constituents are as follows:

Carbon	.10 to .25%
Silicon	0.5 to 1.5%
Manganese	0.5 to 1.5%
Nickel	0.5 to 1.5%
Chromium	10.0 to 14.0%
Molybdenum	0.5 to 1.5%
Vanadium	0.1 to 0.3%
Tungsten	1.0 to 3.0%
Columbium	0.5 to 1.25%
Nitrogen	0.10 to 0.15%
Boron	0.025 to 0.10%
Cobalt	Nil to 5%
Iron	Remainder

The product according to the invention is a forgeable ferritic steel possessing exceptionally high creep resistance at temperatures at least up to 700° C. The special feature of the present steel is that it is a ferritic type that is to say it is magnetic, can be hardened and tempered and has thermal expansion properties similar to those of carbon and low alloy steels. Ferritic types of steels, as a class are generally regarded as being inferior in creep resistance to austenitic steels, but the steel of this invention is superior

2

to several known austenitic alloys at temperatures of 600-650° C.

Ferritic steels have the advantage for high temperature applications because of the lower thermal expansion characteristics (cf. austenitic steels).

The high tensile and proof properties of the present steel are also desirable features for many high temperature applications, particularly in jet engines and gas turbines.

The steel of the invention possesses excellent scale resistance up to at least 750° C.

After suitable heat treatment of steels according to the present invention the following typical high temperature properties have been obtained:

Stress	Test Temperature	Rupture Strength (hrs.)
15 tons/sq. in.	° C. 650	463

Stress	Temperature	Percent Deformation in 300 hrs.
18 tons/sq. in.	° C. 600	.4
10 tons/sq. in.	° C. 650	.24

Suitably selected alloys within the invention also have high resistance to softening at elevated temperatures as judged by room temperature hardness.

The special properties of the alloy according to the present invention are believed to be due to the combined effect of carbon, molybdenum, columbium, boron and vanadium. The columbium and carbon contents are of particular importance, but the combination of all five elements within the range of proportions set out herein is necessary in order to produce an alloy steel having the particular advantageous characteristics described herein.

We claim:

1. A forgeable ferritic alloy steel possessing high creep resistance at temperatures at least up to 700° C., and having a composition characterised by the absence of nickel above a proportion of 1.5% and by the presence as essential constituents of 0.05-0.5% carbon, 4-20% chromium, 0.5-3% molybdenum interchangeable at least in part with tungsten, an effective proportion up to 2.5% columbium, an effective proportion up to

3

0.25% nitrogen, an effective proportion up to 0.5% boron, 0.1-2% vanadium, and the balance substantially iron.

2. A forgeable ferritic alloy steel as claimed in claim 1 comprising carbon .10-.25%, silicon 5 0.5-1.5%, manganese 0.5-1.5%, nickel 0.5-1.5%, chromium 10.0-14.0%, molybdenum 0.5-1.5%, vanadium 0.1-0.3%, tungsten 1.0-3.0%, colum- bium 0.5-1.25%, nitrogen 0.10-0.15%, boron 0.025-0.10%, cobalt in an effective proportion up 10 to 5%, and the remainder substantially all iron.

HENRY WILLIAM KIRKBY.
CHARLES SYKES.

4**REFERENCES CITED**

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

UNITED STATES PATENTS

Number	Name	Date
2,432,616	Franks et al.	Dec. 16, 1947
2,432,617	Franks et al.	Dec. 16, 1947

OTHER REFERENCES

Alloys of Iron and Chromium, vol. 2, High Chromium, page 94. Edited by Kinzel and Franks. Published in 1940 by the McGraw-Hill Book Co., New York.