

UNITED STATES PATENT OFFICE

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HIGH TENSILE ALLOY STEEL

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2 Claims. (Cl. 75-128)

This invention consists in a new or improved high tensile alloy steel.

In order to obtain steels of high tensile strength for structural purposes and other high duty applications, it has been general practice to employ the addition of certain elements to the composition, which in conjunction with the carbon content rendered the steel capable of being hardened and tempered, the latter operation giving a degree of control over the residual hardness and tensile strength in conjunction with the elimination of brittleness generally left as a result of the hardening operation.

The present invention relates to a new combination of iron and alloying elements which contains no great amount of carbon, and gives a substantially high tensile strength in combination with a high degree of ductility. This combination has the advantages that over a wide range of tempering temperatures its hardness and tensile strength fall comparatively slowly, thus giving a distinct advantage in heat treatment operation.

The invention provides an alloy steel of the type containing small proportions of nickel and chromium (say up to 7% of each element) together with molybdenum, characterised in that the carbon content does not exceed 0.12%, while the molybdenum content is relatively high for this type of steel, namely of the order of 2 to 5%.

More specifically, the invention consists in an alloy steel having the following composition:

	Per cent
Carbon	0 to 0.12
Nickel	3 to 7
Chromium	3 to 7
Molybdenum	2 to 5

with or without the usual percentages of other elements such as silicon and manganese, employed in steel making operations. It is, however, within the scope of the invention to add somewhat higher proportions of manganese in quantities up to say 5%, as this element tends to produce the desired properties. If desired, tungsten may be added in quantities not exceeding 4 or 5%.

A typical example of such a steel in accordance with the invention and with the mechanical properties obtained is as follows:

Analysis Percent

Carbon	0.08
Silicon	0.54
Manganese	0.54
Nickel	5.00
Chromium	4.16
Molybdenum	3.18

Hardness tests. (30 kg. Brinell)	As forged	650°	700°	750°	800°	850°	900°	950°	1000°
Air cooled			333	366	393	398	398		351
Oil quenched				360	377	393	398	377	364
Water quenched		329	321	360	386	375	388	388	375

MECHANICAL PROPERTIES

(Tests on 0.423" x 1 1/2"). Treated as 7/8" diameter bar

		Treatment: Air cooled from 900° C.—air cooled after tempering for 1 hour at—		
		200° C.	500° C.	600° C.
Yield point	tons/sq. in.	71.8	80.4	53.8
Maximum stress	tons/sq. in.	85.5	87.8	70.6
Elongation	percent	18.4	20.8	26.4
Reduction of area	percent	53.0	56.0	62.0
Izod test		38, 36, 34	37, 40, 37	57, 54, 56

		Treatment: Oil quenched from 900° C.—air cooled after tempering for 1 hour at—		
		200° C.	500° C.	600° C.
Yield point	tons/sq. in.	79.0	76.9	52.2
Maximum stress	tons/sq. in.	85.7	86.0	69.0
Elongation	percent	20.0	22.4	26.4
Reduction of area	percent	55.0	61.0	65.5
Izod test		37, 35, 37	39, 40, 42	56, 64, 62

I claim:

1. A high tensile alloy steel containing about 5% nickel, 4% chromium, 3% molybdenum, 0.08% carbon, 0.5% silicon, 0.5% manganese, and the remainder iron, the alloy being quenched from about 900° C. and subsequently tempered and air cooled from the tempering temperature.

2. A high tensile alloy steel containing nickel above 3% and up to 7%, chromium 3-7%, molybdenum above 2% and up to 5%, carbon a trace up to a maximum of 0.12% and the remainder being substantially all iron except incidental impurities, the alloy being air cooled from about 900° C. and subsequently tempered for 1 hour and air cooled from the tempering temperature,

and the alloy having the following mechanical properties for the tempering temperatures given:

Tempering temperature.....	200° C.	500° C.	600° C.
Yield point tons/sq. in. at least.....	71	80	53
Elongation percent at least.....	18	20	26
Reduction in area percent at least.....	53	56	62

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