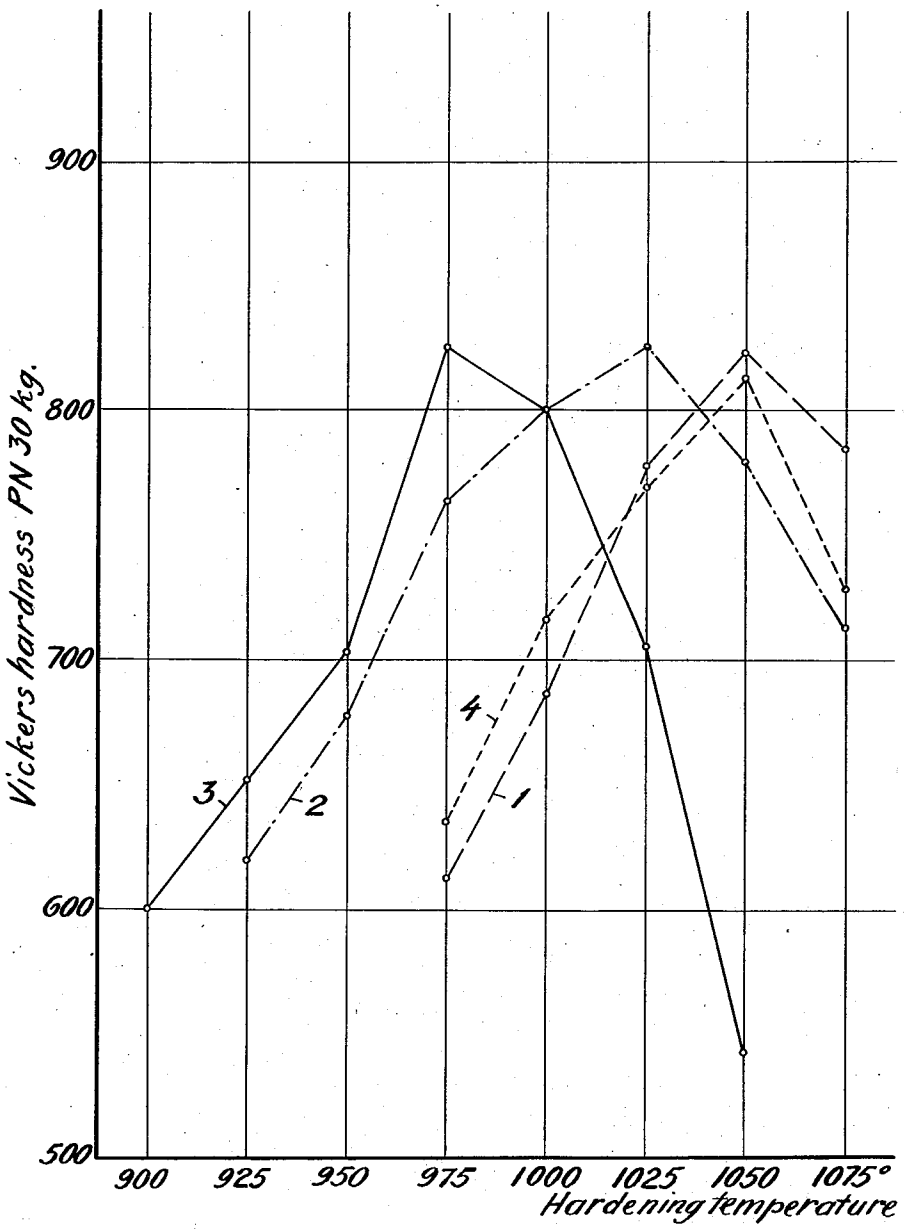
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ALLOY STEEL

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ALLOY STEEL

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The present invention relates to an alloy steel which is capable of being hardened to martensitic structure, and which is particularly adapted to be used for the manufacture of corrosion resistant hardened articles, such as pointed tools and tools having a cutting edge. It is an object of the invention to produce an alloy steel which has a considerably lower hardening temperature for attaining optimum hardness than chromium steels hitherto used for the purposes above mentioned. This object is attained, according to the invention, by incorporating in the steel the alloy components nitrogen and molybdenum and/or tungsten.

The alloy steel according to the present invention is principally characterized by that it contains from 0.50 to 2.50% carbon, from 8 to 22% chromium, from 60 to 90% iron, from 0.050 to 0.25% nitrogen and at least 0.20% molybdenum and/or tungsten, and normal percentages of manganese, silicon, phosphorus and sulphur contained in commercial iron and steel.

Corrosion resistant chromium steels that are capable of being hardened to martensitic structure are, generically speaking, built up on an alloy base the composition of which lies within the following approximate limits:

	Per cent
Carbon	0.20– 2.50
Chromium	8 –22
Iron, maximum about	90

The carbon content that is most suitable for different fields of use is determined, in the main, by the maximum hardness that it is sought to attain by hardening, and also by the desired quality and properties of the edge of the tool. If the edge is required to possess a high degree of hardness and a long life, the carbon content should be at least 0.50%, and suitably not lower than 0.70%. To make it possible to work the steel in a cold state by cold rolling or cold drawing, the carbon content should not exceed 1.35% or 1.40%. The most suitable chromium content lies in general between 13% and 18%.

The characteristic hardening properties of a steel of this known type may be exemplified by a steel of the following analysis:

	Per cent
Carbon	1.23
Manganese	0.43
Silicon	0.07
Chromium	13.4
Nitrogen	0.021

Test plates made of this steel and measuring about 4 by 30 by 25 mm. were first heated during five minutes in a salt bath at different temperatures and were afterwards hardened in oil. The hardness of these samples was determined in a Vickers' hardness testing machine at a load of 30 kg. The dependence of hardness upon the hardening temperature is illustrated by the curve I in the diagram on the attached drawing in which the horizontal line represents temperatures and the vertical line represents hardness.

In this case optimum hardness is obtained when hardening at a temperature of 1050° C. The shape of the curve shows that optimum hardness can only be attained within a very limited temperature range. The maximum hardness that can be attained with a chromium steel of this type is considerably lower than the hardness that is obtained by hardening a non-alloy steel having the corresponding percentage of carbon. For this reason it is as a rule very important, when hardening a chromium steel of this type, that the maximum hardness is really attained. The hardening temperature required for this purpose, in this instance 1050° C., is in many cases inconveniently high. Most electric hardening furnaces used in the industry are provided with resistance elements of chromium-nickel or a similar alloy which, having regard to the required duration, particularly in the case of large furnaces, may hardly be used at higher temperatures than about 1000° C. In practice, therefore, it is not possible in such a furnace to harden a simple chromium steel of this type to maximum hardness.

Extensive experiments with different alloy components have proved that the hardening temperature required for attaining maximum hardness is lowered by increasing the percentage of nitrogen to a value which considerably exceeds the normal amount of the said substance when present as an unintentional impurity, which a great number of analyses have proved lies usually between 0.010 to 0.020% and only exceptionally rises to about 0.030%.

As an example of a steel having a nitrogen content higher than normal, a steel of the following analysis is given:

	Per cent
Carbon	0.96
Manganese	0.48
Silicon	0.16
Chromium	13.3
Nitrogen	0.145

The dependence of hardness upon the harden-

