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ALLOY STEEL

Byramji D. Saklatwalla, Crafton, Pa.

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4 Claims. (Cl. 75—125)

This invention relates to an alloy steel and particularly to a steel which possesses a high degree of strength and resistance to deformation at high temperatures. The steel also possesses a great degree of hardness at ordinary temperatures, although it can be worked, machined and otherwise handled with ease.

For most purposes where resistance to high temperature and to scaling is required, steels of the so-called stainless type are used containing high percentages of chromium, approximately 15% to 20% or even as high as 40%. The cost of such steels is notoriously exorbitantly high and therefore their use is precluded from very many applications. An object of my invention is to produce a high temperature resistant steel at a cost only a fraction of the cost of such high chromium steels and not very much over the cost of ordinary carbon steels. Another object of my invention is to produce a hard steel which is suitable for the manufacture of valves, dies, tools, etc., which are required to possess surface hardness during their use and which should be free from distortion due to strains and can be comparatively easily machined. In the ordinary steels used for these purposes, the hardness is obtained by quenching operations which put strains in the parts made from such steels, bringing about distortion. The steels of my composition, however, produce the hardness without the presence of such strains and by a very cheap method of hardening, namely, by heating the steels to above their critical temperatures and allowing them to cool in air.

For these various different purposes the desired properties are obtained by varying the composition within the limits hereinafter described. For production of articles to resist moderately high temperatures such as for the construction of flues, ducts for high temperature gases, steam, etc., the carbon content within the low carbon ranges specified can be used. For the production of hard tools, dies and the like, the higher carbon ranges as given below can be utilized. The self-hardening properties of this steel are derived by the use of comparatively low amounts of relatively cheap elements, namely, chromium, copper and molybdenum. In the production of tools, dies and the like, expensive hardening agents have been heretofore used, as for example the use in high speed tool steel of vanadium, cobalt, tungsten and the like, which has unduly increased the cost of the steel thus produced. By the proper relationship of molybdenum and copper in the presence of chromium, it is possible to control the degree of air hardening that such steels will display, although within the ranges specified all the steels will be more or less self-hardening.

Steels made according to my invention contain the following elements within the ranges specified below:

	Percent
Carbon	.03 to 1.5
Chromium	.75 to 8.0
Silicon	.5 to less than 2.0
Copper	.15 to less than 5.0
Molybdenum	.6 to 3.0
Manganese	.10 to 2.0

The balance of the steel is substantially all iron with the exception of incidental impurities such as phosphorus and sulphur.

I have found that for general construction purposes where a material for high temperature use is required, steels coming within the following ranges give very satisfactory results:

	Percent
Carbon	.08 to .40
Chromium	2.5 to 5.0
Silicon	.5 to 1.0
Copper	.30 to 1.5
Molybdenum	.65 to 1.5
Manganese	.10 to 1.0

For the production of hard materials suitable for making dies, tools and the like, the carbon content can be increased so that a very high degree of hardness at the temperatures at which they are used is obtained, combined with the necessary toughness which would not be the case if the hardness were derived merely by increase of the carbon content. Also, it is the presence of the alloying elements, namely, chromium, copper and molybdenum, within the ranges and in the proportions to each other as specified above that permits the hardness to be introduced in the finished tool or die without quenching operations and merely by allowing the material to cool in air after being heated to temperatures above its critical range. Tools and dies obtained by this treatment of the composition of my invention are free from any quenching strains and are therefore less subject to distortion, cracking and breakage in use. I have found that they are much freer from these defects than if the air hardening qualities are derived in the steel from elements other than copper and molybdenum in conjunction with the chromium, such for example as tungsten.

I have found that tools, dies and the like according to my invention are obtained to best advantage by compositions falling within the following ranges:

	Percent
Carbon	.60 to 1.25
Chromium	3.0 to 6.0
Silicon	.5 to 1.5
Copper	.3 to 1.5
Molybdenum	.6 to 3.0
Manganese	.10 to 1.0

This application is a continuation in part of my prior copending application Serial No. 521,012, filed Mar. 7, 1931.

The invention may be embodied within the scope of the following claims.

I claim:

1. An alloy consisting of chromium 2.5% to 5.0%, copper .30% to 1.5%, molybdenum .65% to 1.5%, carbon .08% to .40%, manganese .10% to 1.0%, silicon .5% to 1.0%, and the balance being iron with the exception of incidental impurities such as phosphorus and sulphur.

2. An alloy consisting of chromium 3% to 8%, copper 2% to less than 5%, molybdenum .6% to 1%, carbon .1% to .25%, manganese .1% to 1%, silicon .5% to less than 1%, and the balance being iron with the exception of incidental impurities such as phosphorus and sulphur.

3. An alloy consisting of chromium 3.0% to 6.0%, copper .3% to 1.5%, molybdenum .6% to 3.0%, carbon .60% to 1.25%, manganese .10% to 1.0%, silicon .5% to 1.5%, and the balance being iron with the exception of incidental impurities such as phosphorus and sulphur.

4. An alloy consisting of chromium 2.5% to 5.0%, copper .30% to 1.5%, molybdenum .65% to 1.5%, carbon .08% to .40%, manganese .10% to 1.0%, silicon .5% to 1.0%, and the balance being iron with the exception of incidental impurities such as phosphorus and sulphur, said alloy being characterized by air hardening properties combined with high creep value at increased temperatures together with ductility and machinability.

BYRAMJI D. SAKLATWALLA.