

UNITED STATES PATENT OFFICE

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STABLE-SURFACE ALLOY STEEL

No Drawing.

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This invention relates to alloys of steel, and more particularly to such alloys as are known to the trade as stable surface alloy steels.

grain, whether the reducing work is done either by hammering or by rolling. The bars furthermore have good physical properties, from the standpoint of both strength and ductility. From the appearance of fractured ingots, it may be readily seen that copper silicides are formed incident to the melting and freezing of the steel.

The main objects of my invention are to provide an alloy steel of new composition which will be resistant to scaling action at high temperatures and which shall have a fine grain, fair strength, and good ductility when high percentages of silicon are the essential and in most cases the main ingredient of said alloy.

The presence of these copper silicides indicates that the silicon is not present in the alloy in the form of a mechanical mixture, but that the silicon is in chemical combination. This may account for the fact that the bar rolled from the ingot possesses good physical properties.

To the best of my knowledge it has heretofore never been possible to use for general engineering and structural purposes, an alloy which contains silicon in the ranges of 4% to 6%. Such malleable alloys as have heretofore been suggested, containing silicon in the proportions just mentioned, have not possessed the strength and ductility requisite for steels useful for general engineering and structural purposes.

An alloy steel made in accordance with my invention contains chromium from 1.0% to 2%, silicon from 1.0% to 6.0%, and copper from 0.5% to 5.0%. I have discovered that where the minimum of chromium (i. e. 1.0%) is used the permissible minimum of silicon and copper together is 3.0%, and of this 3.0% at least two-thirds must be silicon. All properties given are percentages of the whole by weight.

It is a matter of common knowledge that high silicon steels have been employed for very special electrical purposes, such as transformer sheets, but such alloys when rolled into sheets do not possess any marked degree of strength or easy machining qualities, such as are necessary for most structural and engineering purposes.

Alloys of this composition can be melted practically carbon free, but for some purposes may contain carbon as high as 1%. The usual amount of manganese found in tool and structural steels may be present, or slightly greater amounts up to 1.5% may be used. Impurities and metalloids such as sulphur, phosphorus, etc., will be kept as low as possible. Typical examples of this alloy may be noted as having the following composition:

I have found that an alloy which includes not only silicon, but also copper and chromium possesses these valuable characteristics. When copper and chromium are alloyed in the steel with silicon, the steel is especially useful for internal combustion engine poppet valves, electrical resistance heating elements, carburizing boxes, and for other purposes wherein metal is desired which will resist scaling particularly at high temperatures. In the course of my experiments, I have found that when this alloy steel is poured the ingots show very large crystals in their structure. Such ingots, however, although apparently having the inherent disadvantages which in the past have been commonly found in all ingots which contain high percentages of silicon, undergo on hammering and rolling, a remarkable transformation. The bars formed from such ingots have a remarkably fine

Chromium	Silicon	Copper	Carbon	Iron
<i>Per cent</i> 2.00	<i>Per cent</i> 4.00	<i>Per cent</i> 3.00	<i>Per cent</i> 0.27	Balance
1.36	4.00	2.00	0.41	Balance

Alloy steels made in accordance with my invention can be readily hardened by heating above their critical ranges and then cooling in water, oil, or air as desired. For many purposes for which this alloy is adapted, it will be desirable to vary the physical properties by heat treatment which may consist of hardening as mentioned and drawing the steel by reheating after such hardening.

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I claim—

As a new product, a stable surface alloy comprising chromium about 1%, silicon about 2%, copper about 1%, and carbon less than 1%, the balance being principally iron.

In testimony whereof I have signed my name to this specification.

RALPH P. DE VRIES.

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