

Patented Oct. 4, 1927.

1,644,097

UNITED STATES PATENT OFFICE.

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MANUFACTURING EDGE TOOLS AND SPECIAL COMPOSITION OF STEEL FOR SAME.

No Drawing. Application filed August 2, 1926, Serial No. 126,739, and in Sweden September 26, 1925.

The object of this invention is a method of manufacturing all kinds of edge tools (cutlery, surgical instruments, weapons et cetera) characterized by high cutting efficiency, great rust-resistance and great resistance to attacks of acids, also a special composition of steel suitable for such edge tools.

The process is characterized thereby that an alloy steel of the following composition and by one of the usual methods is first produced:

From 0.7 to 1.1% carbon, from 10 to 16% chromium, from 0.75 to 2.0% manganese, the remainder being iron containing the average percentages of other elements in technical iron.

Treatment of this alloy steel is made in the usual way by hot rolling or forging. The soft condition eventually needed for the subsequent finishing can be obtained by heating the steel during several hours to about 800°-700° C. i. e. the same process as practiced in making some other special steels.

The mechanical properties needed for first class cutting tools cannot, with the composition of steel specified above, be obtained by adopting the usual hardening process. In consequence of the slight critical cooling rapidity of the steel the relatively best result is obtained if the steel is allowed to cool in air from a temperature over the critical point, but the result thereby obtained is still insufficient.

An extraordinary increase of cutting efficiency of the steel—great hardness and elasticity coupled to great toughness—is obtained if the objects, hardened in air are heated to a temperature of about 400° to 500° C. during about 5 to 30 minutes; thus a heat treatment through which a hardened steel generally is lessening its hardness. After this heat treatment the grinding, polishing and sharpening follow in the usual way.

The exceptional high cutting efficiency of the edge tools manufactured by the method above described was proved by practical tests made in comparison with tools manufactured by other methods already known. The tools manufactured by the method which is the object of this patent claim not only proved to be superior to other tools of so called stainless chromium or chrome-nickel steels already known both as regards

cutting efficiency and duration of edge but even excelled those made from the purest Swedish carbon steel.

Although the cutting efficiency of a steel so far cannot be exactly stated by figures from mechanical tests such figures, however, may prove to be of some value for judging this property:

Tempering temperature	Tensile strength kg/mm ²	Tons/sq. inc.	Elongation % norm. meas. lg.	Hardness Brinell
300° C.	ca 195	124	ca 2	ca 600
450° C.	ca 200	127	ca 4	ca 570

Such figures are so far not nearly reached by common stainless steels.

For comparison the figures for the purest Swedish carbon steel with "1.05% C. and 0.4% Mn are given below:

Tempering temperature	Tensile strength kg/mm ²	Tons/sq. inc.	Elongation % norm. meas. lgt.	Hardness Brinell
Blue tempered.....	ca 200	127	ca 4	ca 480

The steel for which patent is claimed tempered at 450° C. has a Brinell hardness number of about 90 units higher than carbon steel at about the same tensile strength and elongation. As the elongation is a measure of the toughness it is evident from this that the new steel with higher hardness combines almost the same toughness as carbon steel is merely showing at a considerably lower hardness.

It has been safely proved that by addition of fair quantities of the metal manganese the rust-resisting properties of the chromium steel were even increased by higher carbon content. Whereas the chromium and chrome-nickel steels as known lessen their non-corrosive properties as soon as the carbon exceeds 0.8% and the chromium simultaneously is under 15%, the following lower limits, at which the rust-resistance is still maintained and unreduded in the high carbon chrome-manganese steel above described, were fixed:

1. In steel cooled in air from high temperature; about 12% chromium.

2. In steel preliminary treated in the same way but afterwards reheated as above described to 400°-500° C.; only about 9% chromium.

From this it is clear that the heat treatment producing the excellent cutting efficiency at the same time adds to the resistance to corrosion.

- 5 As an example of the great rust resistance can be stated, that tools made of this steel for 6 weeks have been exposed to air-saturated river-water and moist air without showing a single attack from rust on its
10 surface.

Through the soft annealing the rust-resistance is more or less lost. By hardening in air from initially high temperature and tempering between 400° and 500° C. the
15 rust-resistance is regained. For the rest it is the same thing with this steel as with other so called stainless steel, that the rust-resistance is promoted by a fine polished surface.

- 20 Experiments with acids showed a very high resistance to attacks of same. Diluted nitric acid and weak organic acids such as acetic acid, tartaric acid et cetera, showed only very slight effect; on the other hand
25 the attack of warmed up and diluted hydrochloric acid took place comparatively easy.

The advantages of the new method are summarized in the following:

- 30 *I. With respect to the manufacturing of the steel.*—Relatively inexpensive alloy elements (ordinary manganese iron and cheap chrome irons of a medium carbon) could be used.

II. With respect to the heat treatment.— 35

As by the method of hardening above described no abrupt changes of the temperatures are needed the risk of undue and injurious stresses in the steel is eliminated such stresses else being apt to cause deformation
40 of the object and hardening cracks on same and in consequence thereof an unavoidable rejection on account of the hardening process.

III. With respect to the quality of the finished edge tools.—These show excellent cutting edges, which are even better than on tools made from the purest Swedish carbon steel, great resistance to rust at relatively high carbon contents and high resistance to attacks of various acids. 45 50

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Special composition of steel, intended for the manufacture of edge tools, and characterized by the presence of the following elements: Carbon 0.7–1.1%, chromium 10–16%, manganese 0.75–2.0%, the remainder Fe, with the secondary elements average in technical iron. 55 60

2. Edge tools of all kinds (cutlery, surgical instruments, weapons et cetera) characterized thereby that the tools are manufactured from a composition of steel according to patent claim No. 1. 65

In witness whereof, I have hereunto signed my name.

ARVED EDUARD GASTON THEOPHIL von VEGESACK.