Sept. 29, 1936. A. B. KINZEL 2,055,769

TOOL

Filed March 26, 1931

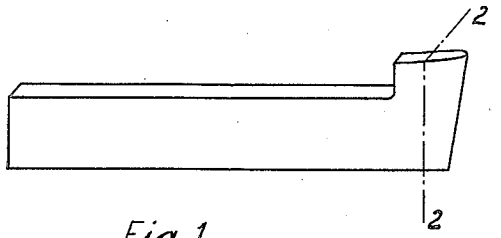


Fig. 1

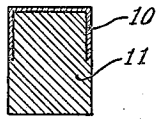


Fig. 2

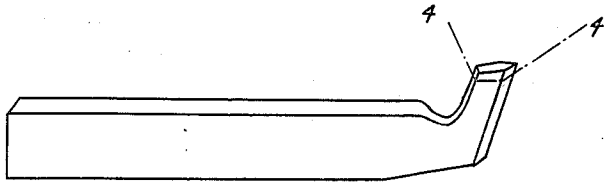


Fig. 3

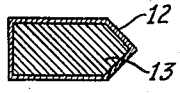


Fig. 4

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TOOL

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Application March 26, 1931, Serial No. 525,623

3 Claims. (Cl. 29—95)

The invention relates to edged tools which are used for the cutting and scraping of metals and other materials, and especially to the production of more durable cutting edges for such tools.

Steels having self-hardening properties imparted by the presence of tungsten or molybdenum in combination with manganese or chromium and carbon, generally known as high-speed steels, have been extensively used for cutting tools. When the steels are properly heat treated by rapidly quenching from about 1900° F. to 2400° F. and reheating and holding them for a time at about 1050° F. to produce a martensitic structure, they can be subjected to high temperatures such as red heat without marked transformation of the martensite or a marked loss in hardness. Vanadium is now generally used in these steels to improve the soundness, hardness, and toughness.

It has been found that when vanadium is present in the high speed steel in amounts sufficient to constitute a nitride-promoting agent, and the tool is given a nitrided coating, the durability of the tool becomes remarkably improved. The exact reasons for the improvement in the cutting properties of the tool are unknown to me, since it is commonly supposed that nitriding decreases the toughness of the surface layers of a steel. It is my present belief that the nitriding increases the red hardness of the steel and that the increase of red hardness gives advantages in cutting tools which outweigh any disadvantages that may arise from losses of toughness resulting from the treatment. It is essential only that the working or edged portion of the tool be given the hard structure known as nitrided steel. This hard nitrogenous structure is produced by introducing nitrogen at temperatures below 600° C. into the surface layers of steels which contain nitride promoting agents.

The structure of the tools of my invention is to be more readily understood by reference to the accompanying drawing, in which:

Figure 1 represents a typical metal-cutting tool,

Figure 2 represents a cross-section of the tool of Figure 1, taken along the plane 2—2,

Figure 3 represents another form of metal-cutting tool, and

Figure 4 represents an enlarged cross-section of the tool of Figure 3, taken along the plane 4—4.

The cross-sectional diagram Figure 2 shows a hard nitrided case 10, in exaggerated scale, formed of nitrided material of the same composition as the metal of the core or body 11, the case 10 covering only a portion of the tool, as shown.

The cross-sectional diagram of Figure 4 shows a nitrided case 12 completely encasing the body metal 13.

The following description is illustrative of the invention. Lathe tools were prepared from a bar of high-speed steel of the following approximate composition, tungsten 18.0%, chromium 4.0%, vanadium 1.0%, carbon 0.76%, and the remainder iron except small amounts of impurities. The tools were uniformly heat treated according to well known methods to give them hardness, and divided into two groups. The tools of the first group were given a nitrided coating by heating them in ammonia to about 500° C. for 24 hours. The tools of the second group were not nitrided. The tools were tested by cutting semi-steel under like conditions. It was found that the nitrided cutting edges gave about 45% more cutting service than the untreated tools. A series of nitrided tools, known as threading chasers, of approximately the above composition was compared with a series of the same composition which were not nitrided. It was found that the nitriding of the cutting edges nearly doubled the life of the threading chasers.

The term "high speed steel" as used in the specification and claims refers to steels having the above described self-hardening properties. They contain about 0.25% to 1.2% carbon, generally not over 0.9% carbon; about 5% to 25% tungsten, generally between 7% and 21%; about 2% to 10% chromium, generally between 3% and 6%; and seldom over 0.4% manganese. Tungsten may be replaced by molybdenum but both tungsten and molybdenum may be present. Various other elements, such as cobalt and uranium are sometimes present.

According to the present invention the high-speed steel must contain vanadium in solid solution in sufficient amount to constitute a nitride promoting agent. As described in applicant's Patent No. 1,736,920, a minimum of approximately 0.3% to 0.5% of non-carbide vanadium is required in steel for this purpose. Large excesses of non-carbide vanadium may be present. The total vanadium which is required in the steel to give this amount of vanadium in solid solution cannot be stated exactly in terms of percentage. The vanadium content depends on the carbon content of the steel and the presence of other carbide forming elements, such as tungsten, molybdenum, and chromium which combine with

some of the carbon. Higher carbon contents require more vanadium to give non-carbide vanadium. It may be stated that the high speed steel which constitutes the base metal or core of the tool should contain more than about 0.4% vanadium to give good nitriding but a large excess of non-carbide vanadium is not detrimental. Amounts of non-carbide vanadium which are produced by the presence of about 1.0% of vanadium with the lower carbon self-hardening steels and about 1.5% of vanadium with the higher carbon steels give excellent results.

It is evident that the invention may be embodied in various kinds of edged tools and it is to be understood that the invention is not limited to the embodiments of the invention which have been specifically described or shown in the accompanying drawing.

I claim:—

1. An edged cutting tool suitable for cutting metal and comprising a body portion of high speed steel containing about 0.25% to 1.2% carbon, about 7% to 21% metal of the group consisting of tungsten and molybdenum, about 2% to 10% chromium, and vanadium in amount sufficient to give at least about 0.3% non-carbide vanadium; and a working edge, the outer layers of said working edge being composed of nitrided body metal.

2. An edged lathe tool comprising a body portion of high speed steel containing about 0.25% to 0.9% carbon, about 7% to 21% metal of the group consisting of tungsten and molybdenum, about 3% to 6% chromium, vanadium in amount sufficient to give about 0.4% to 1.5% non-carbide vanadium, the remainder principally iron; and a working edge, the outer layers of said working edge being composed of nitrided body metal.

3. An article of manufacture embodying an alloy consisting of iron with about 0.70% carbon, about 18.00% tungsten, about 4.00% chromium, about 1.00% vanadium and having a surface nitrided.

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