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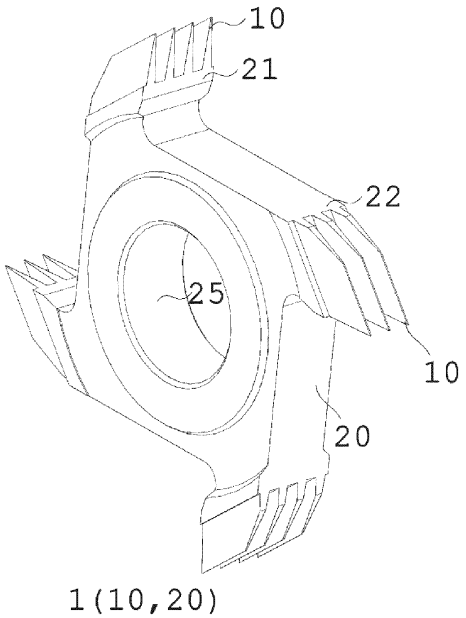
(54) WOOD-CUTTING CUTTER AND METHOD FOR REGRINDING SAME

(57) An object is to provide a wood-cutting edged tool that is easily reground and that is used for cutting a woody material. The wood-cutting edged tool includes: a cutting part provided with a cutting edge having a surface; and a hardening layer with a base material being modified through nitriding or carburizing, the hardening layer being formed on the surface. The hardening layer has a surface hardness of higher than 40 HRC. The wood-cutting edged tool is formed from a tool steel. The hardening layer formed on the surface through nitriding or carburizing is integrated with the base material. Thus, unlike a coating layer, the hardening layer has a low risk that independently-occurring damage that involves peeling or the like occurs owing to regrinding.

Fig.1



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Description

Technical Field

[0001] The present disclosure relates to an edged tool used for cutting wood and a woody material.

Background Art

[0002] In cutting wood and a woody material, various edged tools such as circular saws, routers, cutters, gimlets, and flat-blade knives are used according to purpose.

[0003] For example, there is a finger joint cutter as an edged tool that is used in a finger joint technique for wood and that is used for machining wood into the shape of a comb before interlocking. The finger joint cutter includes an edged tool body formed from a high-speed tool steel. The edged tool body has a blade edge on which a coating layer is sometimes formed in order to elongate the lifespan of the finger joint cutter.

[0004] In general, edged tools having been used are reground in order to restore the sharpened states thereof. The coating layer formed on the surface easily sustains damage that involves peeling or the like owing to regrinding, and thus the type of a grindstone and a grinding condition need to be adjusted to fall within appropriate ranges in order to obtain a favorable sharpened state as a result of regrinding.

[0005] In a case where sharpening work is performed under such an appropriate regrinding condition, a longer time is required for grinding than in the case of regrinding an edged tool on which no coating layer is formed, and meanwhile, in a case where sharpening work is not performed under such an appropriate grinding condition, the grinding quality is not stabilized and the lifespan of the edged tool is not stabilized, either. Therefore, regrinding of such coated products is not widely practiced.

[0006] In addition, edged tools used for the finger joint technique and the like have the following unique drawback. That is, the blade edge of each of such edged tools has a low bending strength owing to a characteristic related to the shape thereof. Therefore, in a case where the edged tool is formed from a high-speed tool steel, the edged tool is sometimes broken or damaged owing to a cutting resistance at the time of machining of wood regardless of whether or not regrinding is performed.

Citation List

[Patent Literature]

[0007]

Patent Literature 1: JP2003-048203 (A)
Patent Literature 2: JPH9-99404 (A)
Patent Literature 3: JP3191238 (B)
Patent Literature 4: JP3200665 (B)

Summary of Invention

Technical Problem

[0008] The present disclosure has been made in view of the above circumstances, and an object of the present disclosure is to provide: a wood-cutting edged tool used for cutting a woody material, the wood-cutting edged tool having a longer lifespan than an edged tool formed from a high-speed tool steel, and furthermore, being easily reground; and an easily executable method for regrinding the wood-cutting edged tool.

Solution to Problem

[0009] A wood-cutting edged tool according to the present disclosure to achieve the above object is a wood-cutting edged tool including: a cutting part provided with a cutting edge having a surface; and a hardening layer with a base material being modified through nitriding or carburizing, the hardening layer being formed on the surface, wherein the hardening layer has a surface hardness of higher than 40 HRC, and the wood-cutting edged tool is formed from a tool steel.

[0010] The hardening layer formed on the surface through nitriding or carburizing is integrated with the base material. Thus, unlike a coating layer, the hardening layer has a low risk that independently-occurring damage that involves peeling or the like occurs owing to regrinding.

[0011] The nitriding is treatment that is sometimes employed for metal-machining edged tools used for machining metals such as iron, steel, and nonferrous metal. Meanwhile, in general, treatment for forming a coating layer to obtain a higher hardness is performed for edged tools for machining a woody material.

[0012] In the present disclosure, for an edged tool for cutting a woody material, a hardening layer formed through nitriding or carburizing is purposely employed without forming any coating layer, as a solution to a regrinding-related problem that arises owing to presence of a coating layer.

Brief Description of Drawings

[0013]

Fig. 1 is a perspective view showing a finger joint cutter as a wood-cutting edged tool used in an Example;

Fig. 2 shows a cutting part after the finger joint cutter in the Example was reground, (a) being a partially-enlarged perspective view of the cutting part, (b) being a view of the cutting part as seen from the rake surface side; and

Fig. 3 shows a cutting part after a finger joint cutter in a Comparative Example was reground, (a) being a partially-enlarged perspective view of the cutting part, (b) being a view of the cutting part as seen from

the rake surface side.

Description of Embodiments

(Wood-Cutting Edged Tool)

[0014] A wood-cutting edged tool according to the present embodiment is an edged tool for cutting a woody material. Examples of the wood-cutting edged tool include typical edged tools such as cutters, tipped saws, router bits, square chisels, gimlets, dowel gimlets, and flat-blade knives. Particular examples of the wood-cutting edged tool include cutters that have blade bodies having complicated shapes. The wood-cutting edged tool is preferably used as a finger joint cutter for use in a finger joint technique among these cutters.

[0015] The wood-cutting edged tool according to the present embodiment is formed from a tool steel and has, on a surface thereof, a hardening layer with a base material being modified through nitriding or carburizing. The tool steel is not particularly limited but is an alloy tool steel, a carbon tool steel, a high-speed tool steel, or the like, and an alloy tool steel excellent in balance between hardness and toughness such as a die steel is particularly preferably used.

[0016] The hardening layer is formedthroughnitridingorcarburizing. The hardening layer has a hardness of higher than 40 HRC. The hardening layer is for improving the hardness of a cutting edge. Thus, the hardening layer is formed over at least a part (e.g., with the length of the cutting edge being a reference, 50% or higher of the length of the entirety) of the cutting edge of the edged tool and is particularly preferably formed over the entire cutting edge. Also, the hardening layer is preferably formed on at least one of a rake surface and a flank surface. Formation on either of these surfaces leads to formation of the hardening layer on the cutting edge. The depth of the hardening layer is not particularly limited, and examples of the depth include 10 μm, 15 μm, 20 μm, 25 μm, 30 μm, 35 μm, 40 μm, 45 μm, 50 μm, 55 μm, 60 μm, 65 μm, and the like.

[0017] A method for performing the nitriding or the carburizing to form the hardening layer is not particularly limited as long as the nitriding or the carburizing is performed until the surface hardness of the hardening layer becomes higher than the hardness of the base material and higher than 40 HRC. Examples of the lower limit value of the hardness further include 50 HRC, 55 HRC, 60 HRC, 65 HRC, and 69 HRC. The surface hardness of the hardening layer is a value measured particularly at a surface near the cutting edge.

[0018] One surface out of the rake surface or the flank surface is preferably ground. Out of the rake surface and the flank surface, a surface different from the surface on which the hardening layer is formed is preferably ground. Alternatively, when the hardening layer is formed on each of both the rake surface and the flank surface, one of the surfaces may be ground.

[0019] The wood-cutting edged tool according to the present embodiment has excellent re-grindability. Thus, the lifespan during which the edged tool is usable to machine wood is maintained, and furthermore, a favorable sharpened state is maintained even after regrinding, whereby an edged tool lifespan equivalent to the lifespan of a brand-new product is obtained.

(Regrinding Method)

[0020] A regrinding method according to the present embodiment is a method to be applied to the above wood-cutting edged tool according to the present embodiment. When a woody material is cut by using the wood-cutting edged tool according to the present embodiment, the sharpened state of the wood-cutting edged tool is changed. By regrinding the wood-cutting edged tool after this change, the sharpened state is restored.

[0021] The regrinding method according to the present embodiment includes grinding one surface out of the rake surface and the flank surface. When the hardening layer is formed on each of both the rake surface and the flank surface, either of these surfaces may be ground in a first stage of grinding. When the hardening layer is formed only on one of the rake surface and the flank surface, the surface on which the hardening layer is not formed is ground. When regrinding is performed one or more times, the hardening layer is removed from the ground surface, and thus the same ground surface (the surface opposite to the surface on which the hardening layer is present) is ground. An example of a condition for the grinding is a condition in which grinding is performed such that: the amount of the portion removed through one time of regrinding is 2/100 mm; and the total amount of the portion removed through 10 times of regrinding is 2/10 mm. The number of times of regrinding to be performed is about 30 to 40 times.

Examples

[0022] The wood-cutting edged tool and the regrinding method according to the present disclosure will be described below in detail on the basis of an Example. A wood-cutting edged tool in this Example is a finger joint cutter 1 shown in Fig. 1. The finger joint cutter 1 in this Example has a blade diameter of 170 mm. The finger joint cutter 1 includes cutting parts 10 and a body 20. Four sets of the cutting parts 10 are provided. Each of the four sets has the shape of a comb. The four sets are respectively composed of four cutting parts 10, three cutting parts 10, four cutting parts 10, and three cutting parts 10. Thus, the total number of the mountain-like cutting parts 10 is 14. All of the cutting parts 10 have the same mountain-like shape. There is also a case where: the four sets are respectively composed of four cutting parts 10, four cutting parts 10, four cutting parts 10, and four cutting parts 10; and each of the sets has the shape of a comb. The body 20 includes: first base portions 21 to each of which

four cutting parts 10 are fixed; and second base portions 22 to each of which three cutting parts 10 are fixed. The first base portions 21 and the second base portions 22 are alternately arranged at an angle of 90° therebetween. Fixation to a power source (not shown) is achieved by a fixation hole 25. A plurality of finger joint cutters 1 each of which is the finger joint cutter 1 in this Example are optionally used in a state of being stacked in a rotation axis direction.

(Example)

[0023] Each of the cutting parts 10 of the finger joint cutter 1 was formed from a die steel having a nitrided surface. The die steel forming the cutting part 10 had a hardness of 53 HRC, and a hardening layer formed on the surface of the cutting part 10 had a hardness of 69 HRC. The hardening layer had a thickness of 20 to 30 μm. After the hardening layer was formed, a rake surface was ground to be sharpened and turned into a sharp blade edge.

[0024] This finger joint cutter 1 was used to machine awoodymaterial (MDF) under conditions of a cutting depth of 5 mm, an edged tool rotation speed of 5000 rpm, a feed speed of 5 m/min, and a cut material length of 12 m. Then, the length by which the blade edge was worn was measured as a blade edge-worn amount. The blade edge-worn amount was 23.4 μm.

[0025] Next, a rotary grindstone formed from CBN was used to perform regrinding at 3,000 rpm for 55 seconds. As a result, generation of a burr or a chip on the blade edge was not observed (see Fig. 2).

(Comparative Example)

[0026] Each of cutting parts 10 of a finger joint cutter 1 was formed from a high-speed tool steel. The high-speed tool steel forming the cutting part 10 had a hardness of 65 HRC. A rake surface was ground to be sharpened and turned into a sharp blade edge.

[0027] The finger joint cutter 1 in this Comparative Example was used to measure a blade edge-worn amount in the same manner as in the Example. As a result, the blade edge-worn amount was 38.0 μm.

[0028] Regarding the cutting part 10 of the finger joint cutter 1, the rake surface formed from the high-speed tool steel and a coating was reground. Consequently, generation of a burr of the base material and a chip of the coating was observed (Fig. 3).

(Observations)

[0029] The following finding has been obtained. That is, the surface of the blade edge portion of the cutting part in the Example had a hardness of 69 HRC which was higher than 65 HRC as the hardness of the cutting part in the Comparative Example. Regarding toughness, in general, the Charpy impact values of die steels such as one in the Example are at least 10 times as large as the Charpy impact values of high-speed tool steels. Furthermore, the blade edge-worn amount of the cutting part in the Example was smaller, by about 40%, than the blade edge-worn amount of the cutting part formed from a high-speed tool steel in the Comparative Example. The cutting part in the Example was recovered without generation of any burr or chip by being reground.

[0030] In this manner, the finding that formation of a hardening layer on a surface through nitriding leads to provision of an excellent cutting part has been obtained.

Description of the Reference Characters

[0031]

1 finger joint cutter

10 cutting part
20 body
21 first base portion
22 second base portion
25 fixation hole

Claims

1. A wood-cutting edged tool comprising:

a cutting part provided with a cutting edge having a surface; and
a hardening layer with a base material being modified through nitriding or carburizing, the hardening layer being formed on the surface, wherein
the hardening layer has a surface hardness of higher than 40 HRC, and
the wood-cutting edged tool is formed from a tool steel.

2. The wood-cutting edged tool according to claim 1, wherein the hardening layer has a surface hardness of 65 HRC or higher.

3. The wood-cutting edged tool according to claim 1 or 2, wherein the cutting part has a rake surface and a flank surface out of which one surface is ground after the hardening layer is formed.

4. A method for regrinding the wood-cutting edged tool according to claim 1 or 2, the method comprising grinding a rake surface or a flank surface of the wood-cutting edged tool.

Fig.1

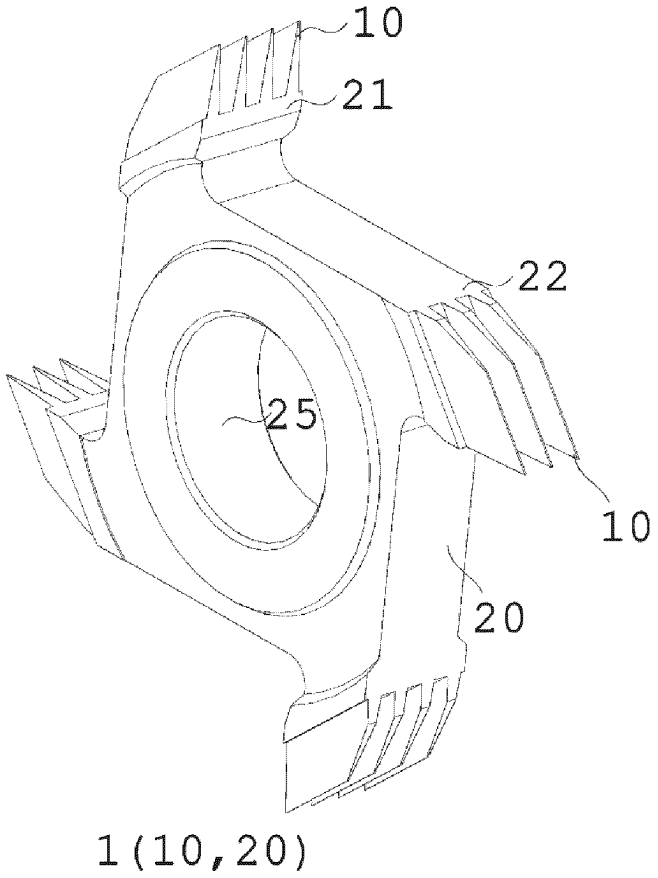


Fig.2

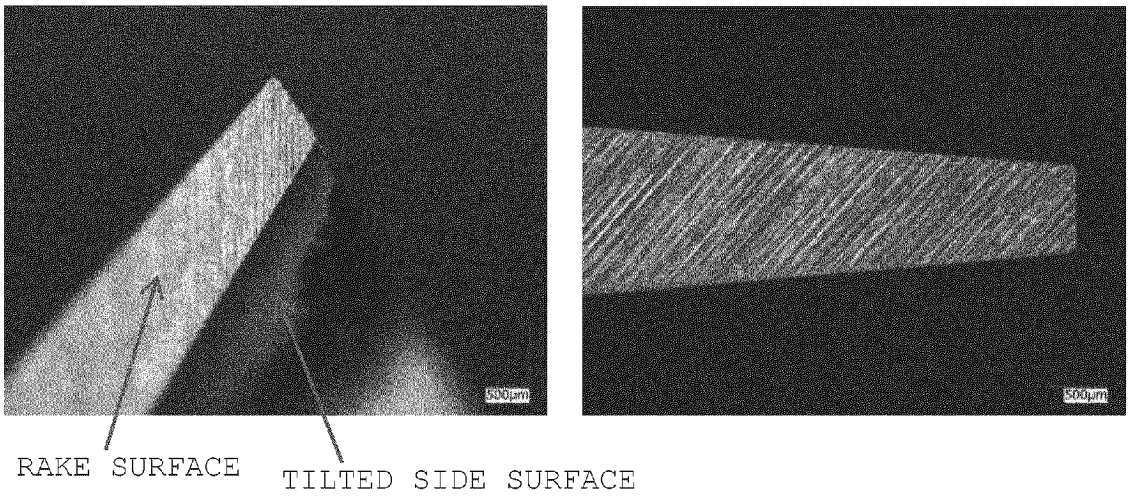
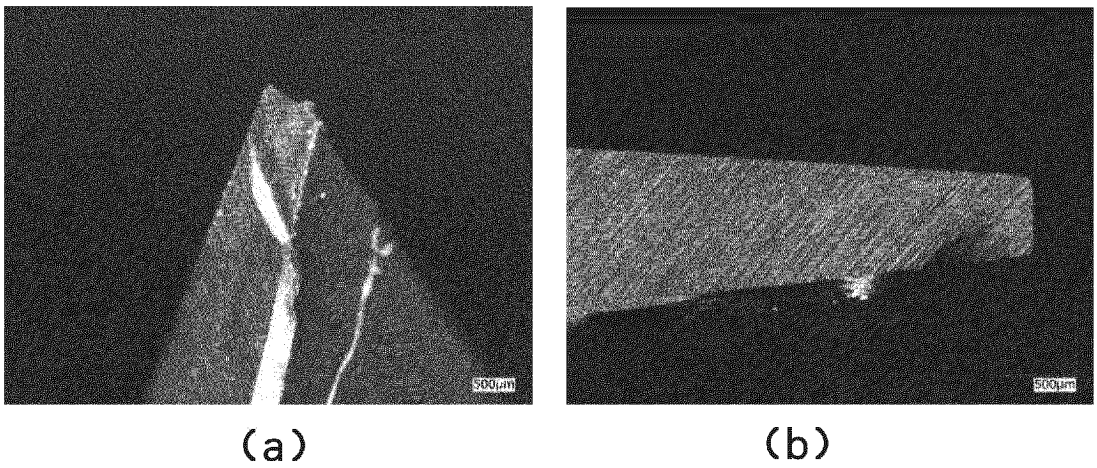

500μm
500μm
RAKE SURFACE
TILTED SIDE SURFACE
(a)
(b)

Fig.3


500μm
500μm
(a)
(b)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/020465

A. CLASSIFICATION OF SUBJECT MATTER

B27G 13/08(2006.01)i; ***B24B 3/46***(2006.01)i; ***B27B 33/08***(2006.01)i; ***B27G 13/14***(2006.01)i
FI: B27G13/08 Z; B27B33/08 Z; B24B3/46; B27G13/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B27G13/08; B24B3/46; B27B33/08; B27G13/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2023
Registered utility model specifications of Japan 1996-2023
Published registered utility model applications of Japan 1994-2023

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2015/064010 A1 (KANEFUSA KK) 07 May 2015 (2015-05-07) paragraphs [0003], [0006], [0013], [0016], fig. 3	1-4
Y	JP 2002-275581 A (HONDA MOTOR CO., LTD.) 25 September 2002 (2002-09-25) paragraphs [0002], [0050], fig. 5	1-4
Y	JP 4-9449 A (NIPPON SEIKO KK) 14 January 1992 (1992-01-14) page 3, lower left column, line 18 to lower right column, line 2, page 6, upper right column, line 1 to page 7, upper right column, line 6, table 5	1-4
A	JP 60-141213 A (YAMADA KIKAI KOGYO KK) 26 July 1985 (1985-07-26) entire text, all drawings	1-4
A	JP 59-80711 A (NATIONAL RES. DEV. CORP.) 10 May 1984 (1984-05-10) entire text, all drawings	1-4

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 July 2023	**01 August 2023**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/020465

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2015/064010 A1	07 May 2015	(Family: none)	
JP 2002-275581 A	25 September 2002	US 2004/0069378 A1 paragraphs [0002], [0067], [0068], fig. 5 EP 1371744 A1 CN 1526033 A	
JP 4-9449 A	14 January 1992	US 5122000 A column 4, line 66 to column 5, line 2, column 8, line 1 to column 10, line 55, table 5	
JP 60-141213 A	26 July 1985	(Family: none)	
JP 59-80711 A	10 May 1984	US 4469511 A entire text, all drawings EP 104841 A1	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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- JP 2003048203 A **[0007]**
- JP H999404 A **[0007]**
- JP 3191238 B **[0007]**
- JP 3200665 B **[0007]**