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(54) Wooden article having particularly smooth surface and method for preparing thereof

(57) The present invention generally relates to the abrading of wooden articles comprising fibers. According to the invention, wooden articles comprising fibers are obtained that have a smooth surface which contains virtually no loose fibers.

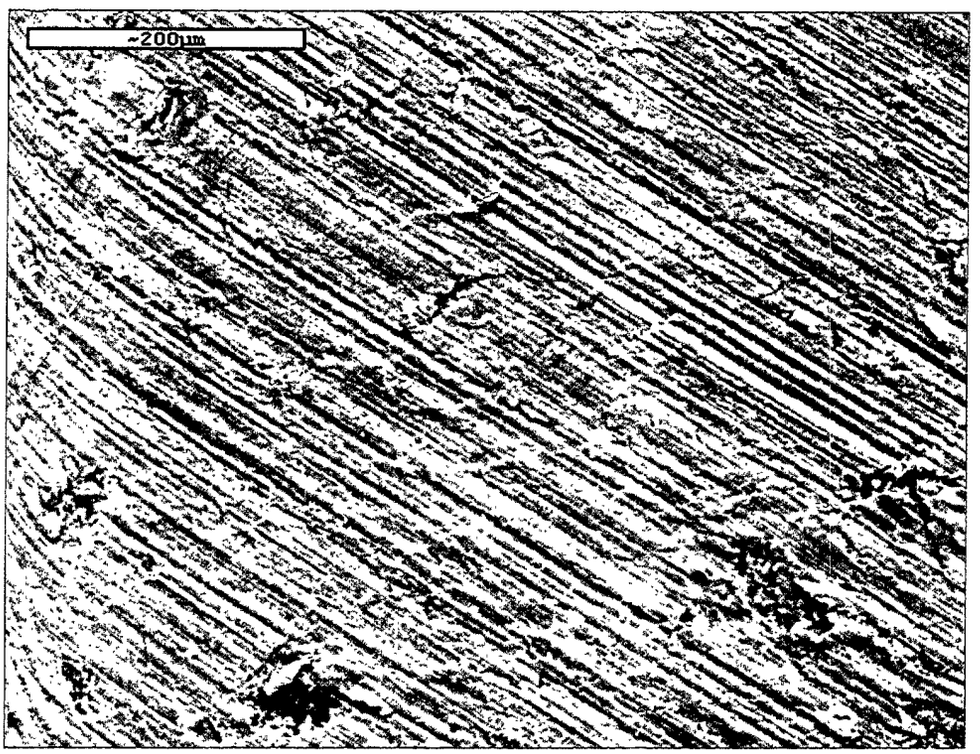

FIG. 4a

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Description

[0001] The invention relates to wooden articles comprising fibers having particularly smooth surfaces. Furthermore, the invention relates to a method of sanding or abrading wooden articles comprising fibers with abrasive articles yielding particularly smooth surfaces. The invention further relates to the use of an abrasive article having a defined structured abrasive coating for the sanding of a wooden article comprising fibers.

[0002] The sanding of wooden components to obtain a smooth surface which preferably is to be coated with a lacquer is well known for many decades. This technique is generally applied to all materials. These can be distinguished as either solid wood, on the one hand, or wooden materials, on the other hand. Solid wood can be either soft solid wood or hard solid wood. It is preferred that the wooden materials pertaining to the present invention are hard wood. Wooden materials can be categorized as chip board, plywood, veneered boards and fiber boards. Chip board is a material widely used in the wood working industry for all kinds of furniture, floors, walls, ceilings, etc. This material consists of wood particles or wood chips that are formed to a plain mat, and the adhesion of the wood chips is obtained through adhesives or resins that are added to the material. This mat is then pressed and heated in a generally well known manner.

[0003] There are different types of chip board articles which are defined by specific standards, namely "Flachpreß-platten für allgemeine Zwecke" (FPY-board) ("flat pressed boards for general purpose") according to the German DIN standard 68761, part 1. More particular the material FPO according to the German DIN standard 68761, part 4, is used. The FPO-board is a Chip board for general purposes and for furniture with a special fine particle surface. Furthermore, "Kunststoffbeschichtete dekorative Flachpreßplatten" (KF) ("decorative laminated particle boards") according to the German DIN standard 68765 is known.

[0004] Veneered boards are applicable to the invention as the above mentioned hard solid wood. This results from the fact that a veneer is essentially the same material as hard wood which only is brought into a very thin layer which through appropriate adhesive means is attached to other boards. In principle its surface then is not distinguishable from a solid piece of hard wood.

[0005] A further group of materials are the plywoods which are also generally known. The same is applicable to these materials as for the veneered boards because plywood essentially consists of a multiplicity of veneered layers which are laminated together. Also here the treatment of the outer surface in principle is indistinguishable from that of a solid piece of hard wood.

[0006] Another group of materials related to the so-called "fiber boards" which are also used in the wood working industry especially for all kinds of furniture, parquet, ceilings and floors, walls, etc. This material consists of wooden fibers that are formed to a plain mat. These extremely small and fine fibers are agglomerated to form a felt type configuration and their cohesion is then achieved through adhesives that are added. Also in this case a mat is pressed and subsequently heated. These fiber boards have a finer and more uniform surface compared to the chip boards.

[0007] Fiber boards are also defined in standards, namely MDF/ HFM "Medium density fiber board" according to the German DIN standard 68754, part 1, ("Harte und mittelharte Holzfaserplatten für das Bauwesen") having a density of 350-800 kg/cbm. An alternative is HFH "Hard fiber board" according to the German DIN standards 68750 and 68754, part 1, having a density of more than 800 kg/cbm. Another alternative is KH according to the German DIN standard 68751 ("Kunststoffbeschichtete dekorative Holzfaserplatten" ("Decorative laminated fiber boards")). Said decorative laminated fiber boards (KH-boards) are hard fiber boards according to DIN 68750, and are provided on one or both surfaces with support layers. The support layers are impregnated with a condensation resin, and are applied to the surfaces of the board under heat and pressure. The resin of the decorative layer essentially consists of melamine resin.

[0008] Fiber boards are further specified in European standard EN 622, parts 1 through 4.

[0009] The materials to be considered are all based on wood and should be distinguished from other materials such as plastic, glass and metal surfaces. As the surface as such is decisive, the group of plastic surfaces also has to include plastic surfaced chip board and plastic surfaced fiber board. In these cases the chip boards or fiber boards as defined above are coated with a plastic material and the sanding only takes place on the plastic surface as such and is in principle indistinguishable from the sanding of solid plastic components.

[0010] As stated above the groups of materials are solid wood, either soft solid wood or hard solid wood and wooden materials comprising chip boards, veneered boards, plywood and fiber boards. It will be stated below that the invention is applicable to the following materials: hard solid wood, veneered boards, plywood and fiber boards. In the group of fiber boards preference is given to medium density fiber boards as stated above as they are especially suitable for the invention. All these materials have in common that they comprise wooden fibers in their surface layer. The role of these fibers will be further explained below. In the following, therefore, the above stated group of materials of the present invention is referred to as "wooden articles comprising fibers". Therefore, these exclude soft solid wood and chip boards.

[0011] Typically the abrading or sanding of the above described wooden articles comprising fibers is obtained through the use of coated abrasive belts. These belts normally consist of a backing onto which a plurality of abrasive particles are bonded. These abrasive particles may include fused alumina, heat treated alumina, ceramic alumina, alumina

zirconia, garnet, silicon carbide, diamond, cubic boron nitride and the like. The abrasive articles are adhered to the belt through the use of appropriate adhesives or resins. Both the backing as well as the adhesives or resins are well known to the person skilled in the art.

[0012] Typically the abrading or sanding has to be effected in several steps starting with an abrasive article with coarser particles ending with abrasive articles with fine particles. This results from the relationship associated between the cut rate and the surface finish.

[0013] When applying these well known techniques to the sanding of wooden articles comprising fibers, severe problems have been observed when trying to create a particularly smooth surface with a roughness value Ra below 2 μm and more preferably below 1.5 μm. The abrasive articles tend to be loaded rather quickly so that in an industrial application it is not possible to utilize the finer materials. The sanding is especially limited to the grit sizes P 180 or P 220 and only in extreme applications to P 240. What is observed is that with these finer grit sizes the abraded material from the wooden articles comprising fibers cannot be removed from the abrasive article or belt, stays between the individual abrasive particles and inhibits a further abrasion. This results in a non-free cutting abrasive and increased frictional forces. If the abrasive belt is not removed, then this loading will start to burn and possibly cause serious damage to the wooden articles being abraded. The abrasive article as such is then so much loaded with the wooden particles that it becomes completely ineffective after a relatively short time. Therefore, in industrial applications the abrasive article has to be exchanged by a new one after a few pieces of wooden articles comprising fibers that have to be sanded so that this method becomes un-economical. The belt has to be changed far too often due to the extensive loading. In this context, reference is made to "Grundlagen des Mobel- und Innenausbaus" by Rüdiger Albin et al., DRW-Verlag, 1991, pages 195, 196, describing these drawbacks of sanding of wooden articles comprising fibers.

[0014] Furthermore, the abrasive particles in the abrasive belt wear down significantly so it is not possible to obtain the desired particularly smooth surface of the wooden article comprising fibers. In conventional abrasive belts the above described abrasive particles are fixed to the belt in a statistical distribution in a very irregular manner. Especially the tips of these particles are not arranged at the same level and, therefore, it is possible that single particles that protrude from the overall surface of the belt can cause relatively deep scratches, so called "wild scratches", on the surface of the wooden article comprising fibers. Furthermore, the irregularity of the abrasive particles on the belt may yield a relatively high inconsistency of the surface quality after sanding. The effectiveness of the abrasion varies significantly during the lifetime of the abrasive belt in that with the known technique there is a continuos degradation of the surface finish. This means that the quality of the surface finish gradually decreases over the lifetime of the belt. As a consequence it is not possible to obtain the same smooth surface for all work pieces, and, therefore, the subsequent desired application of a lacquer requires a relatively high coating thickness. This results in additional cost or an unacceptably low yield when applying a thinner lacquer layer.

[0015] Another aspect of known techniques to be considered is the generation of burning marks on the surface of the wooden article comprising fibers. Due to the loading of the known abrasive article the abrasion is significantly reduced and consequently the energy brought onto the surface is not used to abrade the particles but to an increasing extent converted into heat. In the end this results in the mentioned burning marks.

[0016] Another problem observed with known techniques is that the sanded articles show a significant number of loose fibers. These fibers are typically 10-50 μm in length and they are the cause for the following problem: these fibers are essentially loose when the surface, as this is usually done, is coated with a lacquer. They tend to lift up and cause protrusions in the lacquer layer, especially if this is thin enough so that either a thicker layer of lacquer is needed or an additional sanding operation. In an appropriate surface finish this can be directly seen and felt by an expert in the field. The loose fibers, as shown, e.g., in Fig. 3b, have a length in the area of 10-50 μm and the thickness of the lacquer layer is in the range of 20-50 μm (thickness of the dried lacquer coating) for veneered panels or solid wood and about 80-100 μm for medium density fiber boards.

[0017] Recently abrasive articles have become known in which the abrasive particles are embedded in the resin material so that a structured three-dimensional surface with a non-random pattern of protrusions and grooves is formed. These structures will be explained in more detail below. It is known to use these structures for the sanding of the above mentioned plastic surface materials including plastic surfaced chip boards and fiber boards and especially all kinds of metal surfaces. Applications to wooden articles comprising fibers have only been observed for the generation of coarser surfaces comparable with the use of conventional abrasive articles with grit sizes not finer than P 180/220 providing roughness values Ra of more than 1.5-2.0 μm. However, the generation of smoother surfaces corresponding to conventional abrasive articles with grit sizes finer than P 180/220 and providing Ra values below 1.5-2.0 μm are not known in the art because it was assumed by the skilled artisan that the above described loading is a limiting factor. (It is to be noted that the roughness value Ra is what is typically measured, however, with the exception that due to wood as a natural material occasionally inhomogeneities occur which locally have a larger roughness. This means that inhomogeneities of this type have always to be excluded).

[0018] The object of the invention, therefore, is to provide improved wooden articles comprising fibers that overcome the above drawbacks of known articles, for example with respect to the application of a lacquer layer. A further object

is to identify a process through which such wooden articles comprising fibers can be obtained. These objects are achieved with the features of the claims.

[0019] According to the invention, the above mentioned object is achieved with a wooden article comprising fibers having smooth surfaces with a roughness value Ra below 1.5-2.0 μm, preferably below 1.5 μm, and more preferably in the range of 0.8 - 1.1 μm.

[0020] Furthermore, according to the invention, the above mentioned object can be achieved through the use of abrasive articles that have a textured, three-dimensional abrasive coating for the sanding of a wooden article comprising fibers. These articles do not have an irregular or statistical arrangement of abrasive particles adhered to the backing but a configuration in which a three-dimensional structure has been created and where the abrasive particles are embedded within this structure. Such a structure typically is a configuration in which the abrasive articles are embedded in the resin so that a three-dimensional surface with a non-random pattern of protrusions and grooves is created. The protrusions for example can have the form of regularly arranged pyramids with the tips of these pyramids essentially arranged within a well defined plane. The bottom portions of these pyramids then form grooves. However, the invention is not restricted to such a geometry. In the most general sense the structure has a multiplicity of protrusions, the upper portions or tips of which are essentially arranged in a well defined plane, and some kind of grooves being arranged between these protrusions. The abrasive articles are primarily arranged in the upper portions of the protrusions. In a preferred configuration these protrusions are arranged in a regular manner and the groove portions are more preferably arranged in lines. Another preferred feature is that the geometrical configurations provide rather well defined and smooth surfaces. The use of such abrasive articles results in wooden articles comprising fibers that have the above described significantly smoother surface which contain virtually no loose fibers.

[0021] According to the invention, the term "virtually no loose fibers" refers to a surface having essentially a minimum of loose fibers, the length of which is no more than 10 μm.

[0022] Abrasive articles of this type are generally known to the person skilled in the art and their configuration and method of manufacture are described in several patents, e.g., US-A-5 152 917, US-A-5 489 235 and US-A-5 378 251. The abrasive particles of these abrasive articles typically have a particle size ranging from about 0.1 to 1500 micrometers, usually between about 0.1 to 400 micrometers, preferably between 0.1 to 100 micrometers and most preferably between 0.1 to 50 micrometers.

[0023] In a second aspect, the invention provides wooden articles comprising fibers obtainable by a method comprising the steps of (i) providing said wooden article comprising fibers; and (ii) abrading said wooden article with an abrasive article having a textured, three-dimensional abrasive coating, wherein the textured, three-dimensional abrasive coating comprises a surface with a non-random pattern of protrusions and grooves.

[0024] In a third aspect, the invention relates to the use of the method according to the third aspect for improving the surface of a wooden article comprising fibers.

[0025] In a fourth aspect, the invention provides a method for abrading a wooden article comprising fibers, comprising the steps of (i) providing said wooden article comprising fibers; and (ii) abrading said wooden article with an abrasive article having a textured, three-dimensional abrasive coating, wherein the textured, three-dimensional abrasive coating comprises a surface with a non-random pattern of protrusions and grooves.

[0026] In a fifth aspect, the invention provides a method for improving the smoothness of the surface of a wooden article comprising fibers, said method comprising the steps of (i) providing said wooden article comprising fibers; and (ii) abrading said wooden article with an abrasive article having a textured, three-dimensional abrasive coating, wherein the textured, three-dimensional abrasive coating comprises a surface with a non-random pattern of protrusions and grooves.

[0027] According to a sixth aspect, the present invention provides a belt sanding machine for improving the smoothness of the surface of a wooden article comprising fibers, said belt sanding machine comprising an abrasive article having a textured, three-dimensional abrasive coating, wherein the textured, three-dimensional abrasive coating comprises a surface with a non-random pattern of protrusions and grooves.

[0028] The use of an abrasive article having a textured, three-dimensional abrasive coating for the sanding of a wooden article comprising fibers is accompanied by the technical results as described in the following. The main technical result achieved is that the wooden articles comprising fibers being worked or sanded according to the invention have a surface being significantly smoother than surfaces achievable with conventional abrasive articles. The roughness value Ra is preferably in the range of 0.8 - 1.1 μm. Such articles are not obtainable with conventional methods or abrasive articles, respectively.

[0029] The present invention provides a number of advantages: the particles abraded from the wooden articles comprising fibers to be sanded, which can be considered as swarf or debris are removed from the wooden articles comprising fibers essentially through the abrasion of the upper portions or tips of the protrusions. Due to the regular and particularly smooth structure they can move into the grooves of the configuration and can easily be transported away. It has been observed that the loading effect is surprisingly low, the swarfs or debris are not only moved into the grooves but can also be removed from the entire structure. Accordingly, much finer grits as expected can be used when operating

with these structures or three-dimensional configurations.

[0030] As discussed above, loading is the major problem with conventional coated abrasives. However, according the invention, even if the swarfs or debris get stuck into the structure of the abrasive article it will easily and automatically be removed through the air pressure of the belt cleaning device of the sanding machine. Almost all sanding machines are equipped with this standard cleaning device. The belt can be kept clean during its whole life and therefore it lasts several times longer.

[0031] Typically the abrasive articles on the upper portions or tips of the protrusions are removed after being worn out and they are transported away in the same manner as the wooden swarfs or debris. Due to the construction the removed mineral particles expose additional particles arranged below them in the construction so that the sanding can be continued very efficiently.

[0032] Another advantage is that due to the very regular geometry of the abrasive article the upper portion or tips of the protrusions are essentially arranged in a defined plane and, therefore, the above described "wild scratches" can be practically eliminated.

[0033] Furthermore, the above mentioned gradual decrease in the quality of the surface finish does not occur and a burning of portions of the wooden surface is practically eliminated as well. The quality practically remains to be the same over the entire lifetime.

[0034] As a further advantage of wooden articles comprising fibers according to the invention, loose fibers are significantly reduced to a surprisingly high degree. As a consequence the subsequent lacquer coating can be much thinner thus reducing the cost, or increasing the yield and requiring a lower level of sanding of the lacquer surface which usually is necessary after the lacquering process. As a further consequence a re-working of the wooden articles comprising fibers is only necessary in a significantly reduced percentage of cases.

[0035] The essential advantage is that due to the above described process the swarfs and debris as well as the loosened abrasive particles are removed through the grooves of the configuration of the abrasive article, so that the lifetime of the article is significantly increased at a surprisingly high level. This is particularly further enhanced through the smoothness or evenness of the three-dimensional structure of the abrasive article. Simultaneously, a surprisingly smooth surface of the wooden article comprising fibers is observed.

[0036] The invention is now described with reference to the Figures.

Fig 1 is a photograph of a conventional abrasive article in which the abrasive particles are bonded to the backing through an adhesive or a resin, the particles being arranged in an irregular manner;

Fig. 2 shows a photograph of an abrasive article having a structured three-dimensional surface showing protrusions with tips and well defined surfaces and grooves between the tips;

Fig. 3a shows a photograph (magnification x 200) of a wooden article comprising fibers that was sanded with a conventional abrasive article as shown in Fig. 1;

Fig. 3b shows a photograph (magnification x 500) of a wooden article comprising fibers that was sanded with a conventional abrasive article as shown in Fig. 1;

Fig. 4a shows a photograph (magnification x 200) of a wooden article comprising fibers according to the invention sanded with an abrasive article having a structured three-dimensional surface as shown in Fig. 2; and

Fig. 4b shows a photograph (magnification x 500) of a wooden article comprising fibers according to the invention sanded with an abrasive article having a structured three-dimensional surface as shown in Fig. 2.

[0037] Fig.1 shows a photograph of a conventional abrasive article with a grit size P 220 . This is a product from Minnesota, Mining & Manufacturing Company, U.S.A., type 961 ZU having a paper backing, a resin bond and Cubitron (CM) ceramic abrasive grain. The material is shown prior to its use in a sanding process. It can be clearly seen that the abrasive particles are adhered to the backing through the use of resins in a well known manner, and furthermore it can be seen that the surface structure is quite irregular. It can be observed that the particles somehow protrude from the surface but tips or portions that project from the surface more than others can hardly be identified. Accordingly, it is also not possible to bring the highest portions of these particles into a relatively well defined plane. As described above, individual particles can protrude more from the surface than others, and thus may cause the above described "wild scratches".

[0038] Furthermore, it can be understood that swarfs and debris that are removed from the wooden article comprising fibers with the conventional abrasive article of Fig. 1 cannot easily move in any other desired direction. There are no traces in one direction through which eventually the particles, the swarfs or debris could be removed from the abrasive article. Furthermore, the surfaces of the individual particles are irregular and therefore can easily capture the swarfs and debris which is the essential reason for the so-called loading of the abrasive article. The swarfs and debris remain in the article and relatively fast they prevent the abrasive particles from removing additional wooden particles so that the entire system becomes ineffective rather soon.

[0039] Fig. 2 shows a photograph of a typical structured three-dimensional abrasive article as described above. The

upper portions of the tips are apparently removed. The abrasive particles are embedded in a manner into this configuration that they are not visible in the photograph. Only around the tips the particles become exposed and can cause any abrasion to the article to be sanded. The lower portions of the pyramids are rather smooth and it can be understood that the swarfs and debris can move into the grooves together with the worn out abrasive particles and since the grooves are arranged in lines it appears to be understandable that all abraded or worn out particles can be removed from the abrasive article. The shown article is a material from Minnesota Mining & Manufacturing company, U.S.A. with the product number 237 AA having a grit size of A30 which corresponds to a conventional abrasive material FEPA P600, alternatively the grit size A 16 could be used which would be comparable to FEPA P1200.

[0040] Figures 3a,b and 4a,b show photographs of sanded medium density fiber boards. The wooden materials were obtained from a normal do-it-yourself shop or warehouse dealing with wooden materials. It is a medium density fiber board with a density of about 500 kg/cbm. In Figs. 3a,b an abrasive article according to Fig. 1 was used, namely P 280 which is already finer than the normally used P 180/P 220. As described above, with such an abrasive article the loading occurs so rapidly that under normal manufacturing conditions P 280 is not really suitable. It can be seen that both photographs show a portion of the surface as obtained through a scanning electron microscope. The surface was treated in the usual manner through gold sputtering. A multiplicity of loose fibers can be seen, some of them marked in Fig. 3b with a "O". Furthermore, the surface is not very smooth. The roughness value Ra was determined as ranging between 1.6 and 1.9 μm.

[0041] Loose fibers, as shown in Fig. 3b, are typically 10-50 μm in length and they are the cause for the following problem: these fibers are essentially loose when the surface, as this is usually done, is coated with a lacquer. They tend to lift up and cause protrusions in the lacquer layer, especially if this is thin enough so that either a thicker layer of lacquer is needed or an additional sanding operation. In an appropriate surface finish this can be directly seen and felt by an expert in the field. The loose fibers, as shown, e.g., in Fig. 3b, have a length in the area of 10-50 μm and the thickness of the lacquer layer is in the range of 20-50 μm (thickness of the dried lacquer coating) for veneered panels or solid wood and about 80-100 μm for medium density fiber boards.

[0042] Figures 4a and 4b show the same type of medium density fiber board treated with the TRIZACT A30 abrasive article from Minnesota Mining & Manufacturing Company, U.S.A., being equivalent to a P 600 conventional grit size material. It can be seen that almost no fibers are visible and that also the surface is significantly smoother providing the above described advantages. In this case the roughness value Ra was determined as being in the range of 0.8-1.1 μm.

[0043] In contrast to Fig. 3b, Figs. 4a,b show that the number of loose fibers has been significantly reduced and their length is definitely below 10 μm.

[0044] The conditions for the sanding of the MDF panels were as follows:

Machine:	Wide belt sander from Karl Heesemann Maschinenfabrik GmbH, Germany.
Type:	FGA 8 CSD system - Computerized selective pressure control utilizing segmented pressure bars that only apply pressure on the portions of the board that have to be sanded.
Belt speed:	12 m/sec
Infeed speed:	10 m/min
Pressure:	40-50% (This is a relative value of the maximum pressure of the specific machine which cannot be transferred into actual pressure values).
Belt for finish:	**3M** TRIZACT™ belt 237 AA-A30, dimensions: 1350x2620 mm
Material removed per pass:	below 0.1 mm

[0045] Other types of sanding machines are, for example, the Cross Sanding machines LSM 8, KSA 8, MFA 8, and MFA 8 CC of Karl Heesemann GmbH. Other types including Wide belt sander, Cross hatch sander, Edge sander, Profile sander, Fladder sander, Stroke sander, Hand sander, or Orbital sander can also be used in the present invention.

[0046] An abrasive article with a textured three-dimensional surface provides a lifetime which is between 1 and 2 orders of magnitudes larger. Lifetimes in the range of 10-40 times longer than the conventional abrasive belts have been observed.

[0047] In a specific test work pieces of the size 500 x 800 mm have been used and by using a conventional abrasive article with a grit size of P 280 the lifetime of the belt was only below 12 work pieces. Utilizing the abrasive article according to Fig. 2 with a structured three-dimensional surface the same work pieces could be handled and no loading was observed even after 250 work pieces. This means that with the conventional material an industrial production does not appear to be suitable while with the abrasive articles with a textured three-dimensional surface the lifetimes are significantly higher than with the conventional abrasive articles and in addition to that the appearance of the wooden surface was observed to be significantly better as described above by having virtually no loose fibers and roughness value Ra well below 1.5 μm.

Claims

1. A wooden article comprising fibers **characterized by** having a smooth surface with a roughness value Ra below 1.5 - 2.0 μm, and preferably lower than 1.5 μm.

2. A wooden article comprising fibers obtainable by a method comprising the steps of:

   providing said wooden article comprising fibers; and

   abrading said wooden article with an abrasive article having a textured, three-dimensional abrasive coating, wherein the textured, three-dimensional abrasive coating comprises a surface with a non-random pattern of protrusions and grooves.

3. Use of an abrasive article having a textured, three-dimensional abrasive coating for the sanding of a wooden article comprising fibers.

4. Use of a method for improving the smoothness of the surface of a wooden article comprising fibers, said method comprising the steps of:

   providing said wooden article comprising fibers; and

   abrading said wooden article with an abrasive article having a textured, three-dimensional abrasive coating, wherein the textured, three-dimensional abrasive coating comprises a surface with a non-random pattern of protrusions and grooves.

5. Use according to claim 2 or 3, wherein said wooden article is made of a wooden material selected from the group consisting of plywood, veneered boards, fiber boards, and hard solid wood.

6. Use according to claim 5, wherein the fiber board is a medium density fiber board, preferably having a density of 350 to 800 kg/m^3.

7. Use according to claim 5, wherein the fiber board is a hard fiber board, preferably having a density of greater than 800 kg/m^3.

8. Use according to any of claims 3 to 7, wherein the surface of the sanded wooden article comprises a roughness value Ra lower than 2 μm, and preferably lower than 1.5 μm.

9. Use according to claim 8, wherein the surface of the sanded wooden article comprises a roughness value Ra between about 0.8 and 1.1 μm.

10. Use according to any of claims 3 to 9, wherein the loose fibers of the sanded wooden article have a length of less than 10 μm.

11. Use according to any of claims 3 to 10, wherein the abrasive coating of said abrasive article comprises a three-dimensional surface with a non-random pattern of protrusions and grooves.

12. Use according to claim 11, wherein said three-dimensional surface comprises a plurality of protrusions, the upper portions of which are essentially arranged in a plane, and wherein at least some grooves are arranged between said protrusions.

13. Use according to claim 12, wherein at least some of said protrusions have the form of regularly arranged pyramids with the tips of said pyramids being essentially arranged within said plane, and wherein the bottom portions of said pyramids form said grooves.

14. Use according to claim 11, 12 or 13, wherein said protrusions are arranged in a regular manner, and wherein said grooves are arranged in lines.

15. Method for abrading a wooden article comprising fibers, comprising the steps of:

providing said wooden article comprising fibers; and

abrading said wooden article with an abrasive article having a textured, three-dimensional abrasive coating, wherein the textured, three-dimensional abrasive coating comprises a surface with a non-random pattern of protrusions and grooves.

16. Method for improving the smoothness of the surface of a wooden article comprising fibers, said method comprising the steps of:

providing said wooden article comprising fibers; and

abrading said wooden article with an abrasive article having a textured, three-dimensional abrasive coating, wherein the textured, three-dimensional abrasive coating comprises a surface with a non-random pattern of protrusions and grooves.

17. Use according to any of claims 3 to 14 or method according to claim 15 or 16, wherein said abrasive article comprises abrasive particles having a particle size ranging from about to 0.1 to 1500 μm, preferably between about 1 to 400 μm, more preferably between 0.1 to 100 μm, and most preferably between 0.1 to 50 μm.

18. A belt sanding machine for improving the smoothness of the surface of a wooden article comprising fibers, said belt sanding machine comprising an abrasive article having a textured, three-dimensional abrasive coating, wherein the textured, three-dimensional abrasive coating comprises a surface with a non-random pattern of protrusions and grooves.

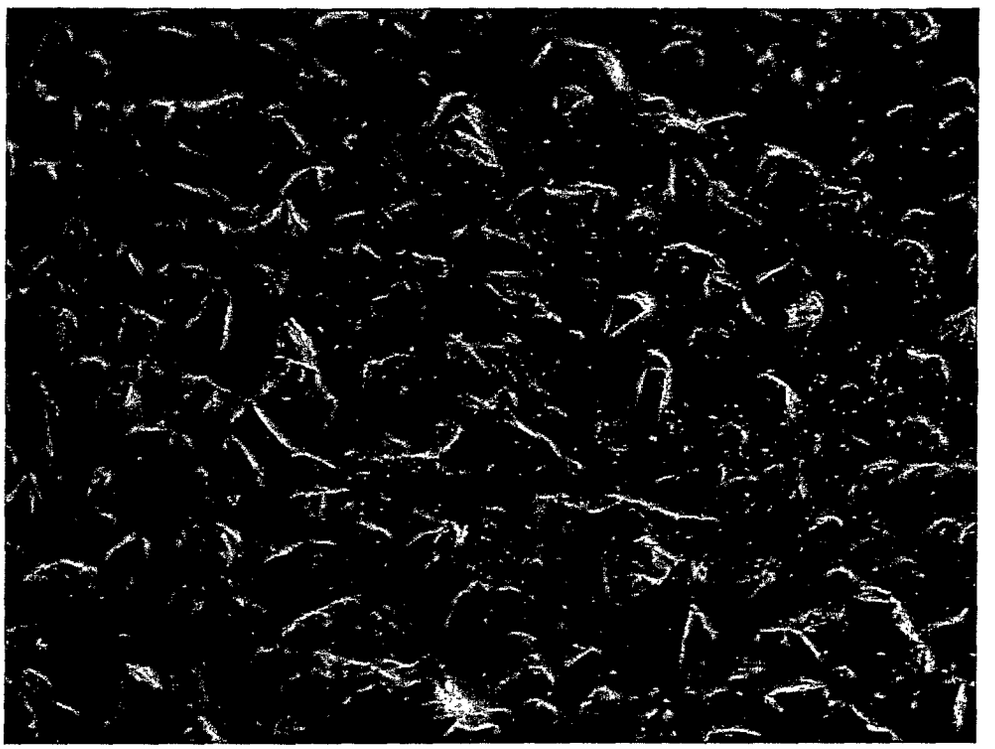

FIG. 1

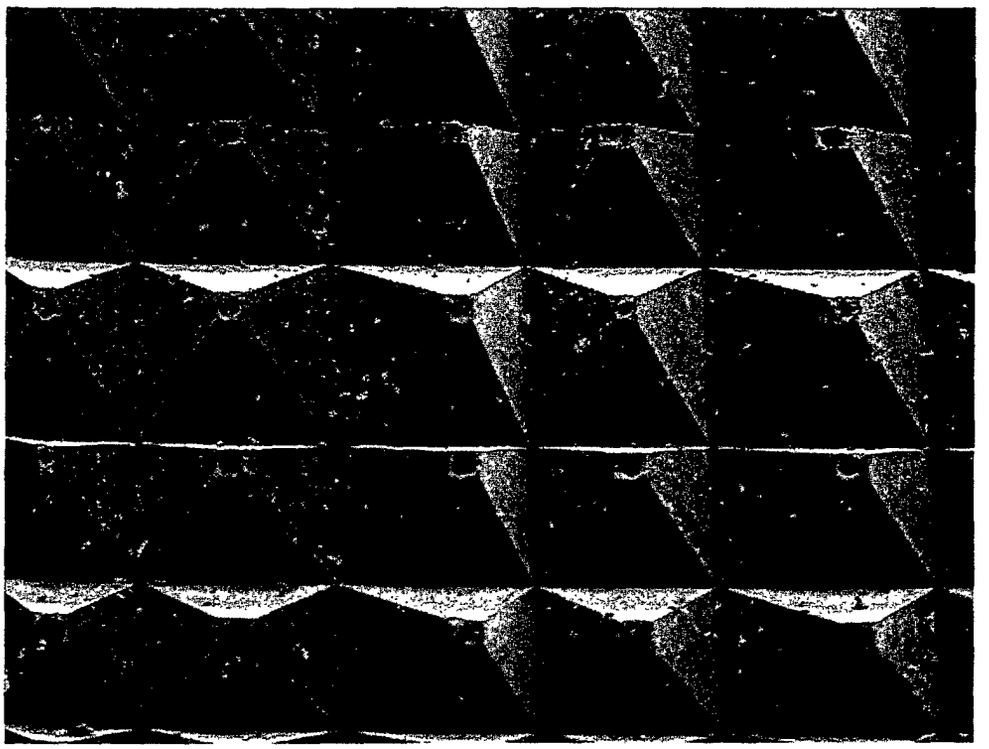

FIG. 2

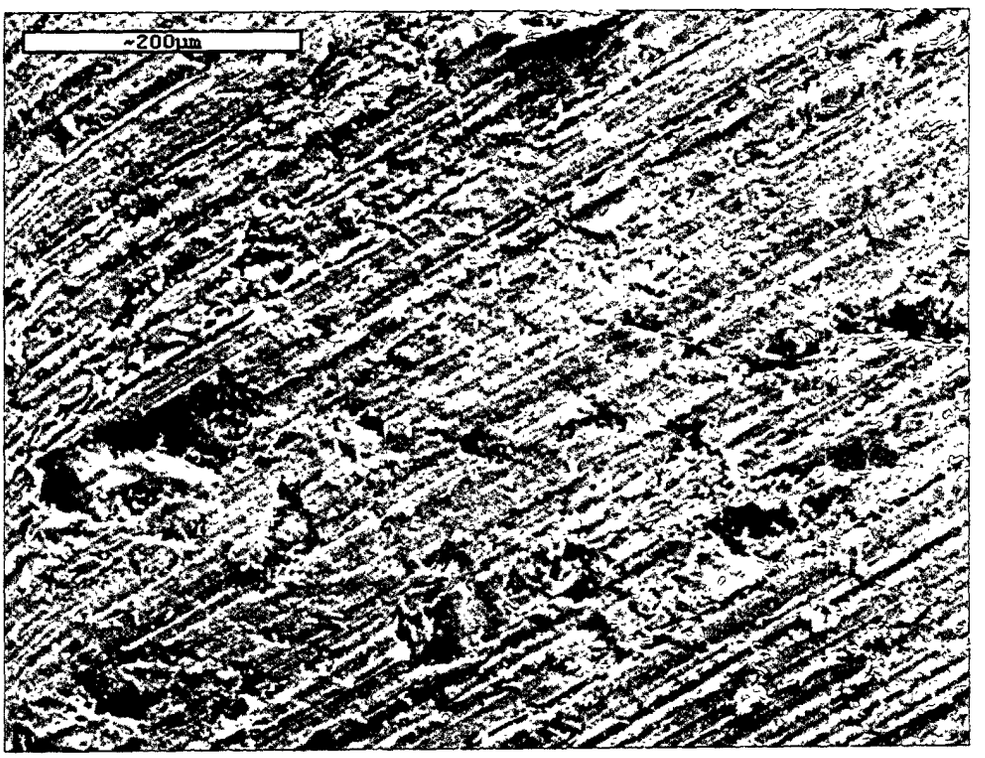

FIG. 3a

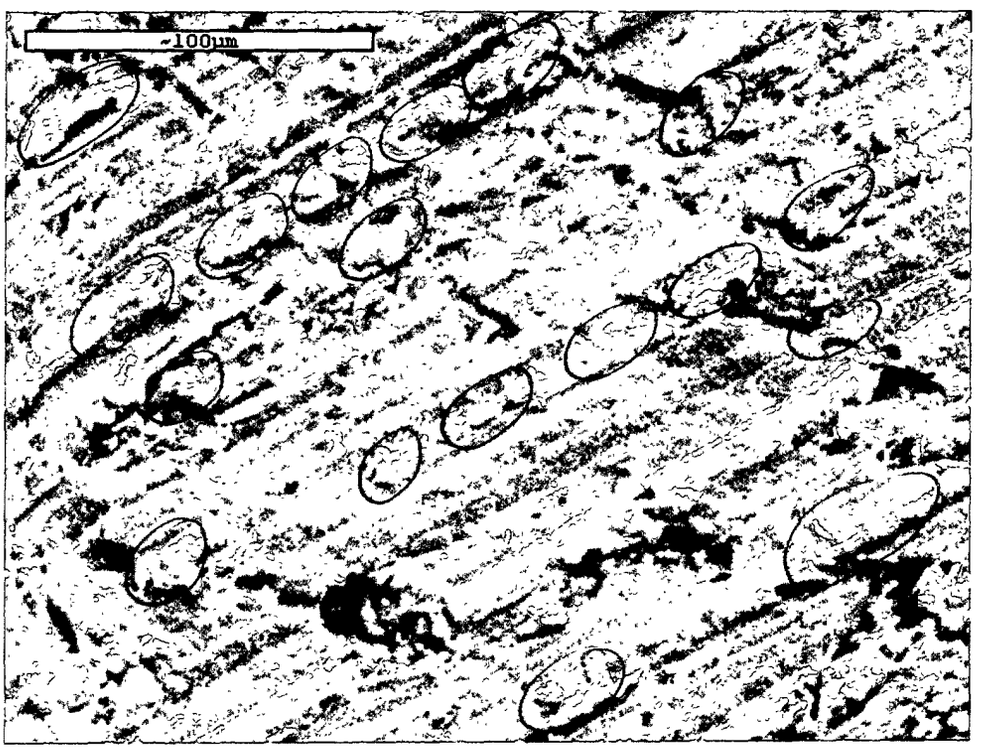

FIG. 3b

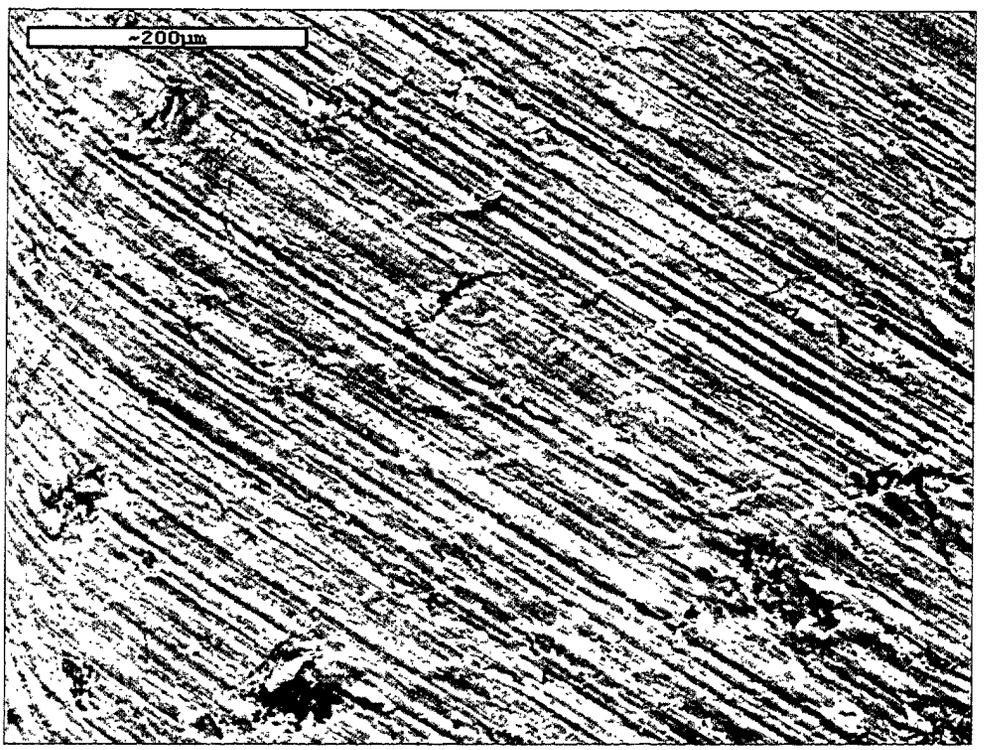

FIG. 4a

FIG. 4b

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EUROPEAN SEARCH REPORT

Application Number
EP 00 12 3940

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X A	US 6 080 215 A (STUBBS ROY ET AL) 27 June 2000 (2000-06-27) * column 15, line 7 - line 20 * * column 16, line 53 - column 17, line 15 * * column 24, line 30 - line 56 * -----	2-5, 11-16,18 1	B24B1/00 B24B7/28 B24B9/18 B24B19/24 B24D11/00

TECHNICAL FIELDS SEARCHED (Int.Cl.7)
B24B B24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 April 2001	Eschbach, D

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

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04-04-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6080215 A	27-06-2000	AU 6845396 A	12-03-1997
		JP 11510745 T	21-09-1999

EPO FORM P0459

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