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(54) **Method for treatment ceramics parts, using in industry for producing artificial synthetic fibers, for the purpose of recycling**

(57) Object of the invention is method for treatment ceramic parts (A), which are used in the industry of artificial synthetic fibers, for the purpose of recycling, which allows that changed and/or damaged and/spent ceramic parts (A), of different dimensions and shapes, which are eliminated from the production process of causing a variety of defects in the industry of synthetic artificial fibers and similar processes, is subjected to controlled treatment of the surface with a nozzle (C) which with controlled

directed movement over the static spanning of the ceramic part (A), removes the modified surface of the ceramic part (A) by means of an abrasive material (B), which may be sand or sand-like particles (such as beads or diamond particles, metal beads or particles) for the surface treatment of the ceramic parts (A), with a view to achieving the same or very similar surface properties as a new ceramic part.

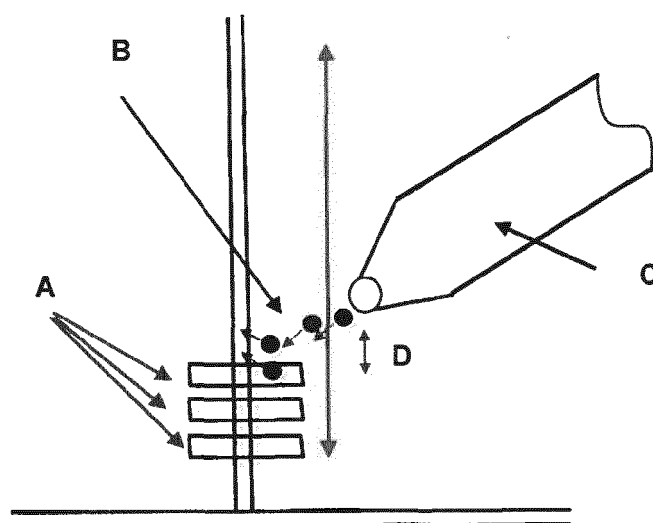


Fig. 3

Description

[0001] Object of the invention is a method for treatment ceramic parts, which are used in the industry of artificial synthetic fibers, for the purpose of recycling or more precisely controlled process of surface treatment with a view to the processing of the ceramic part to such a degree that it is achieved, that the ceramic part with the same purpose, or the same or similar characteristics is re-used in the production process of synthetic fibers as it has new ceramic part.

[0002] Technical problem presented by the process according to the invention successfully addresses the recycling process of ceramic parts, especially in the industry of synthetic fibers, where the ceramic components are present in apparatus and machines for processing fibers.

[0003] The present invention allows controlled mechanically treating the surface of ceramic by removing the damaged/modified surface in order to achieve a known end surface.

[0004] Ceramic parts used in the industry of synthetic fibers are usually made from high quality oxide ceramics, whose share of Al_2O_3 is about 99.6%. The ceramic materials are characterized by high mechanical strength, stability at high temperatures (temp. of the melting point $\geq 2000^\circ\text{C}$), low coefficient of thermal expansion and corrosion resistance. The ceramic parts, which are embedded in the manufacturing process are exposed to extreme operating conditions, such as high speed running artificial fibers (filament) to 5200 m/min, temperature from 30 to 80°C , the quantity of matting agents (from 0 % up to 1.6 % TiO_2) and the impact of the shape filament (tri-lobal, round). All previously described extreme conditions caused by constant changes in the surface of ceramic parts.

[0005] Ceramics is material widely used in fiber industry in the spinning, texturing, covering and downstream fiber processing. Mainly as Spin finish applicators, Pig-tails, Tread guides, discs for texturing yarns, Guide discs, working discs and knife discs, Jet plates, Traverse guides, Eyelets Ceramic, cutters Rollers, birotors, etc. spin finish applicators Pigtails Jet

[0006] Chemical corrosion, friction, surface wear and electrostatic interaction during the production process demand ceramic material with high surface quality. Mainly such ceramics are known as technical ceramics e.g. oxide ceramics Al_2O_3 purities more than 90% and with different additives to improve physical characteristics. Due to requested ceramics structure which define high demanding mechanical properties the manufacturing process is composed of high temperature sintering conditions up to 1800°C and time needed up to 200 minutes means high energy consumption. Therefore the ceramics parts present significant maintenance costs for fiber producers, especially when critical fibers are produced. Beside maintenance costs of fiber producers the production of new ceramic parts represent also a big environ-

mental impact as energy consumption and toxic exhausting gases within sintering process.

[0007] Nowadays fiber producers are forced to be focused on optimizing production yields and fiber quality. Only constant process conditions and polymer quality can lead to uniform dyability and efficient downstream processing.

[0008] One of the most critical part of fiber processing equipment found in field of invention are ceramic parts. Changed / damaged ceramics surface due to fiber production process leads to non-uniform fiber quality, mainly provokes by different yarn tension and consequently high temperature.

[0009] The process according to the invention allows that the changed and/or damaged and/or worn ceramic parts of various sizes and shapes that constitute the waste by-product of the processes of production and processing of synthetic artificial fibers and similar processes can be restored by subjecting the specific process of treating the surface with abrasive means, to reach the final quality of the known structure of the surface.

[0010] The method of the invention allow to altered and/or damaged and/or worn ceramic parts of different sizes and shapes, which are excluded from the production process of causing a variety of fiber tension, uneven application preparation oil, capillary breakage, the occurrence of loops in bobin and other physical and chemical changes in the fiber, which can lead to inhomogeneity of the fiber and a low production efficiency in the industry of synthetic artificial fibers and similar processes, exposed to controlled surface treatment by abrasive particles or sand-like particles (such as beads or diamond particles, or metal balls or particles) and other abrasive material in the form of spheres or particle, which can be used as a scrubbing agent for the surface treatment of the ceramic parts in order to achieve the same or very similar surface properties as a new ceramic works.

[0011] The invention will be explained in detail on the basis of an embodiment and the accompanying drawings, in which:

Figure 1 show the surface of the ceramic part which is subjected to a treatment with abrasive particles;
Figure 2 show the controlled passage through the nozzle staticsided ceramic part;
Figure 3 show guided nozzles with vertical and horizontal displacement in relation to a moving clamped ceramic part (rotating) ;
Figure 4 a comparison of the new, used and updated surface of the ceramic part of the process according to the invention.

[0012] A ceramic parts A of various shapes and dimensions, with a modified and/or damaged surface is exposed to controlled process of treating the surface with an abrasive agent B, that is, abrasive particles, or sand-like particles (such as beads or diamond particles, or metal balls particles) and many other abrasive materials in

the form of spheres or particles, which can be used as a scrubbing agent for the surface treatment of the ceramic parts (Figure 1).

[0013] Method of treating ceramic parts A, which is used in the industry of artificial synthetic fibers, for the purpose of recycling is divided into three main stages, namely:

- preparation of the ceramic part A, where changed/damaged ceramic part A is controlled with optical or similar magnifying device more than 30 x magnification to verify the surface of the ceramic part A suitable for processing with abrasive material B. In this step eliminating broken or damaged ceramic parts which would lead that further surface treatment would not proper change the ceramics surface to the level of new one. Method of optical determination can be manual or even upgraded to full automatic detection of changed/damaged surface of ceramics as cracks, fractures, broken edges, etc.). Ceramic part A preparation step can be also omitted but this leads to higher reject at the final treatment and the optical control.
- treatment the surface of the ceramic part A with abrasive material B, where ceramic part A which was already optically controlled for the readiness of the surface to be mechanical treated is embedded in the carrier of the sand blasting machine with the abrasive material B. Machine has to have precise (e.g. electronically) guided (according pre-set process cycle) nozzle C (Figure (a2)) which with controlled movement over the static embedded ceramic part A removes changed surface of ceramic part to the level as new ceramics part is demonstrating. The process can be also driven in such a way that carrier of the ceramic part A (Figure (a3)) of is moving (e.g. rotating) and movement of guided nozzle C is in relation of movements in vertical and horizontal direction to treat the ceramics surface of the ceramic part A. In a composition of machine settings for processing with abrasive material B (Figure 2 and 3) the following parameters are important;

- (i) inlet angle D of blasting nozzle C which should be between 0 degrees and 180° according to impact position to the ceramic part A surface,
- (ii) abrasive media B as sand or sand like materials (selection of right dimension, shape and material structure):

in the invention process two different materials were in use, such as Corundum 220 and Corundum 70, usage of both depending of ceramic parts A final surface properties were requested,

- (iii) the size of sand blasting nozzle C for abrasive media B (size of nozzle between 0.01 mm to 1

cm),

- (iv) speed or time which is needed that the sand blasting machine for processing with abrasive material B treat particular section of ceramic part surface (time of treating one surface point of ceramic part A surface and after each further part of ceramics surface area points among whole ceramics surface is between 0.1s to 3 minutes),
- (v) pressure of the sand blasting device for processing with abrasive material B which pushes the abrasive particles to the ceramic part A surface to achieve removal of changed surface of ceramic part (inlet air pressure is more than 2 bar).

- final treatment and optical control where the ceramic part A which was exposed to surface controlled abrasion is exposed to gentle polishing treatment of treated ceramics surface (e.g. movements of fine nylon / cotton brushes with direct contact over ceramics treated surface). After the polishing treatment also ultrasonic treatment is an option to achieve perfect non-dusty surface of ceramics part A surface (ultrasonic bathing is not a must but an option to achieving better result in matter of cleanliness of the ceramics part A surface). Last action is the optical control of the treated ceramics part with optical or similar magnifying device more than 30 x magnifications to confirm the ceramics part A surface is in the same condition as new ceramics part.

[0014] Within development of proper method for treating the changed / damaged ceramics surfaces several different methods were evaluated as;

- mechanical brushing of ceramic part A surface (e.g. abrasive rotating discs);
- mechanical abrasion of ceramics parts surface (e.g. high speed polishing yarn with polishing abrasive paste)
- protecting or renewing the ceramic part A surface with applying of mechanical resistant lacquer and backing that lacquer with high temperature up to 1500 °C or process of polymerization under ultraviolet light.

[0015] Figure 4 shows a comparison of the structure of the new ceramic part and the ceramic part, which has been treated with the procedure of processing ceramic parts according to the invention

Claims

1. Method of treatment ceramic parts, using in industry of artificial synthetic fibers, for the purpose of recycling, characterized in that,

it takes place in three stages, namely: ceramic part (A) preparation, treatment of the surface of the ceramic part (A) with abrasive material (B) and final treatment with optical control.

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2. Method according to claim 1,
characterized in that,
in the preparation of ceramic part (A), check the manual or automated machined ceramic part (A) with an optical magnifying device zoom more than 30x, eliminated cracked or such damaged areas of ceramic parts (A). 10
3. Method according to claim 1,
characterized in that, 15
in the processing surface of the ceramic part (A) with the abrasive material (B), optically inspected ceramic part (A) is inserted in the bed of the apparatus for processing with abrasive material (B), wherein the device has a precisely controlled, according to pre-process parameters nozzle (C) which, with controlled directed movement through static spanning the ceramic part (A), removes the modified surface of the ceramic part (A). 20
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4. Method according to claim 3,
characterized in that,
the ceramic part (A) is movable or rotating mounted in the device for treatment, or the ceramic part (A) is static mounted in the bed of the device for treatment and the nozzle (C) travel over them. 30
5. Method according to claims 3 or 4
characterized in that, 35
the angle (D) of sand blasting nozzle (C) for abrasive material (B) is between 0° and 180° according to impact position of the ceramic part (A) surface, abrasive material (B) is sand or sand like material such as Corundum 220 and Corundum 70;
the size of sand blasting nozzle (C) for abrasive material (B) is between 0.01 mm to 1 cm); 40
speed or time which is needed for processing with abrasive material (B) is between 0.1 sec to 3 minutes;
pressure of the sand blasting device is more than 2 bar). 45
6. Method according to claim 3,
characterized in that,
in the final processing of the ceramic part (A) its surface is treated with a gentle polishing action in the region where the modified surface is removed, and alternatively use ultrasonic bath, followed by a visual check the machined surface of the ceramic part (A). 50
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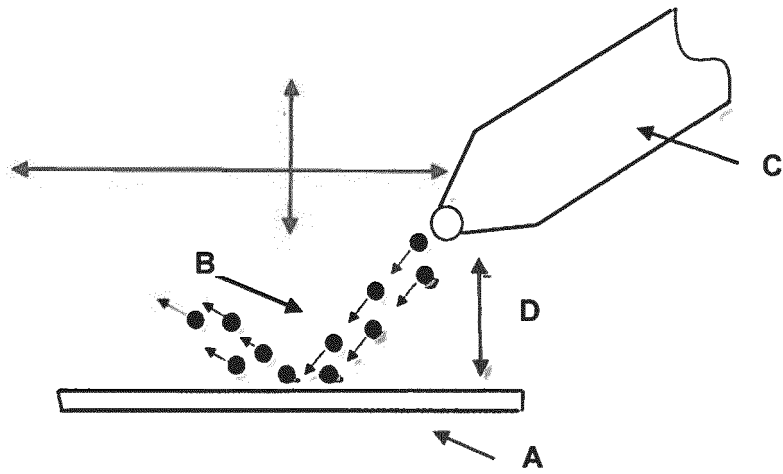


Fig. 1

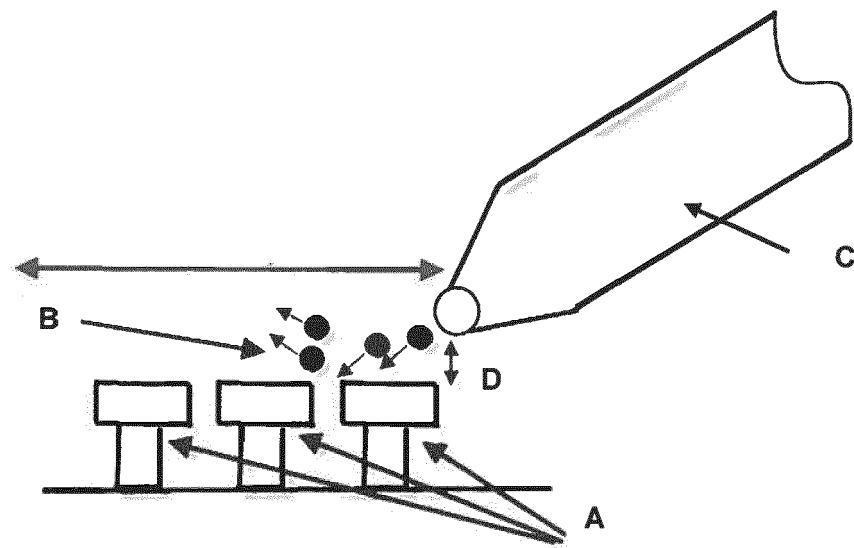


Fig. 2

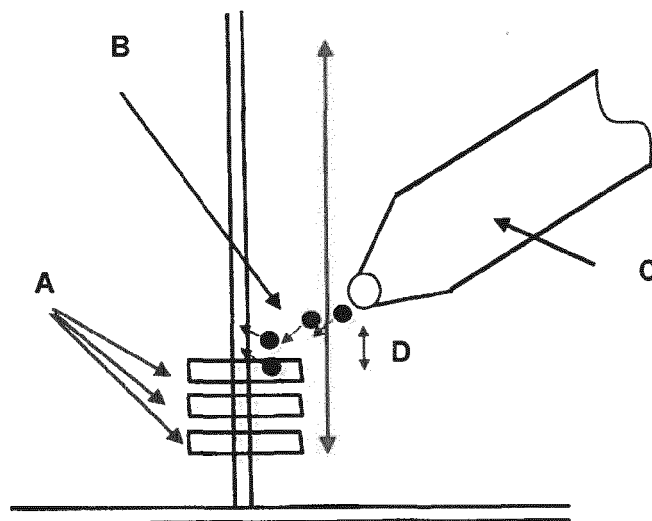


Fig. 3

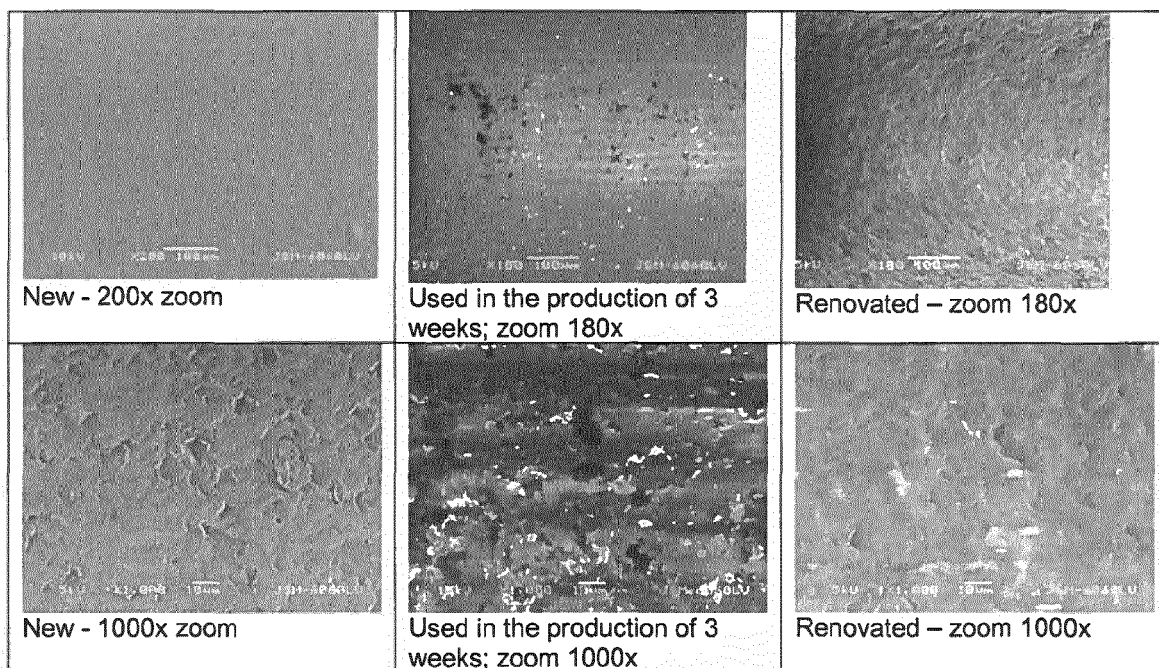


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 13 19 4206

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 3 839 769 A (ENGELS W) 8 October 1974 (1974-10-08) * column 5, lines 15-21 * * figures 9-11 *	1-6	INV. B24C1/08 D01H4/00
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 13 February 2014	Examiner Eder, Raimund
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 19 4206

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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13-02-2014

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