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(54) SLIP RING ASSEMBLY AND COMPONENTS THEREOF

SCHLEIFRINGANORDNUNG UND KOMPONENTEN DAVON

ENSEMBLE DE BAGUE COLLECTRICE ET COMPOSANTS ASSOCIÉS

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(56) References cited:
US-A- 6 034 531

- **PLASMACHEM GMBH: "Abrasion resistant electroplated Silver through Nanodiamonds - DiamoSilb", INTERNET CITATION, 24 April 2012 (2012-04-24), pages 1-2, XP002731246, Retrieved from the Internet: URL:http://www.plasmachem.com/diamosilbpress [retrieved on 1077-04-24]**

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Description

Field of the invention

[0001] The invention relates to electrical sliding contacts. A sliding contact is provided between a metallic, e.g. golden sliding track being electrically contacted by a brush, for example a metallic wire, the latter being positioned to slide over the sliding track, if the sliding track and/or the brush are moved relative to each other. Sliding contacts allow for electrical transmission of data and/or energy between the sliding track and the brush, where the brush and the track may be moved relative to each other. For example, the sliding track may be a ring or a ring segment and may be driven to rotate about its center axis. A brush and ring combination is a slip ring assembly.

Description of the related art

[0002] Sliding contacts are particularly useful in slip ring assemblies. In this case the sliding track is a ring or ring segment like and thus referred to as slip ring. The slip ring may rotate relative to the brush. The brush may be static relative to a given coordinate system. Alternatively, the sliding track, i.e. the slip ring may be static and the brush be moved relative to the given coordinate system. The third alternative is that the brush and the slipring move relative to a given coordinate system. Often slip rings have a contact surface made of a precious metal like gold (Au) or silver (Ag) to provide a sliding contact with a low resistance. However, pure Au is supple and thus worn off quickly if contacted in particular by non Au metallic wires as brush.

[0003] US 4,398,113 suggests contacting an Au-sliding track with a brush having a higher resistance against abrasion than the Au-sliding track. In an initial run-in period, Au from the sliding track attaches to the brush, yielding a long-lasting brush and a reduced friction between the sliding track and the brush.

[0004] WO 2013/007458 A2 discloses a slip ring assembly with a sliding track for being contacted by a brush. The sliding track is a double layer sliding track with a first layer having a higher resistance against abrasion than the Au-layer on top of the first layer. The material of the brush is chosen to have a resistance against abrasion between the resistance against abrasion of the first layer and the resistance against abrasion of the Au-layer. Thereby, first the first Au-layer is worn of and subsequently the brush, which is easy to detect. The first layer is harder, i.e. has a higher rigidity than the Au-layer. This enhances the life-time of the Au-layer.

[0005] WO 2005/038985 relates to an electrical contact element having a contact layer. Said contact layer comprises a film comprising a multifilament material, the latter comprising a nanocomposite of nanocrystals and amorphous regions. On top of the multifilament material may be a metallic layer of Au, Ag, Pd, Pt or Rh.

[0006] US 2004/0000834 A1 relates to a commutator with commutator sliding members. The sliding members comprise a layer consisting of graphite, metal powders, binder, a solid lubricant and carbon nano tubes or carbon nano fibers. The components are mixed, molded and baked.

[0007] US 6,034,531 A suggests a method of monitoring the wear of sliding electrical contacts of an electrically conducting brush, sliding over an electrically conducting track. The method includes measuring the electrical resistance of said sliding contact, delivering at least one image signal corresponding to the measured resistance, tracking the variations of said image signal, constructing at least one reference signal indicative of a state of wear of said sliding contact, comparing said image signal with said reference signal and finally deriving a signal corresponding to the state of wear of said sliding contact from comparison of the image signal with the reference signal.

[0008] XP 002731246 advertises a coating for electrical contacts.

Summary of the invention

[0009] The problem to be solved is to provide a sliding track with a high durability and a low contact resistance.

[0010] Solutions of the problem are described in the independent claims. The dependent claims relate to further improvements of the invention.

[0011] The sliding track of the invention has a top layer for being contacted by at least one brush. The sliding track may comprise a top layer mainly made of a Gold (Au) and/or Silver (Ag). The top layer may comprise alloying components like Copper (Cu), Cobalt (Co) or the like to enhance the hardness and resistance against abrasion of the top layer. In addition, the alloying components may facilitate depositing the top layer by electrolytic deposition.

[0012] Preferably, nano particles (at least one) are embedded in the top layer. Nano-particles are defined by ISO/TS27687:2008 as particles with a diameter smaller than 100nm. The nano particles can thus be embedded in the top layer, e.g. of Au or Ag.

[0013] For example nano-particles of hard materials, like for example Carbides like Silicium Carbide (SiC) and/or Tungsten Carbide (WC) and/or Titanium Carbide (TiC) and/or Boron Carbide (B_4C) and/or Tantalum Carbide (TaC) and/or Beryllium Carbide (Be_2C) may be incorporated or in other words embedded in the top layer of the sliding track. Nitrides, as in particular Titanium Nitride (TiN) and/or Tantalum (TaN) and/or cubic Boron Nitride (BN) and/or Silicon Nitride (Si_3N_4) and/or Aluminum Nitride (AlN) may as well be embedded. As well one may embed nano particles of Diamond, Aluminum Oxide (Al_2O_3), Corundum, sapphire, Ruby, Zircon, Silicon Dioxide (SiO_2), Carbon Nano tubes (CNT), Titanium Diboride (TiB_2) and/or Molybdenum Disilicate ($MoSi_2$) or the like in the top layer. The nano particles may as well comprise mixed crystals like TiC-WCand/or TiC-TaC-WC and/or TiC-TiN, which are as well known for their high rigidity and good thermal and electrical conductivity. Multi- and Complexcarbides like in particular Co_3W_3C, Ni_3W_3C may as well be comprised in the nano particles as intermetallic compounds like W-Co and/or W-Os and/or W-Re and/or W-Ir and/or Mo-Be.

[0014] Nano particles of Sintered Ceramic Metals (briefly "Cermets") are as well suited. Possible compositions include in particular the following Cermets: Al2O3 - Cr; Al_2O_3 - Mo - Cr; Al_2O_3- Ni; UO_2 - Mo; ZrO_2 - Mo and/or Titancarbid (TiC)/ Titanni-trid (TiN) - Ni.

[0015] All these materials are hard and thus have in common a high resistance against abrasion. Thereby, wear of the top layer is reduced without significantly decreasing the contact resistance. In other words, the life cycle of the top layer is enhanced. It is believed that the experimentally observed hardening of the Au-layer is due to dispersion hardening. One might expect, that the hard nanoparticles could have a negative impact on the life cycle of the brush, however, astonish-ingly it turned out not to be the case. In a first phase abrasion of Au wire brushes seems to be enhanced, however, after a so called running in phase the abrasion of the Au wire is reduced. It is believed, that during the running in phase supple Au from the wire so to speak soils or smears out on the top layer and thereby reduces the top layer's roughness

[0016] Hardness is to be understood as indentation hardness that can be measured e.g. by Rockwell hardware testers and correlates linearly with the tensile strength of a material.

[0017] Alternatively or additionally, one may embed nano particles made of Graphite and/or Boron Nitride (BN) and/or Molybdenum Disulphide (MoS_2) and/or Polytetrafluoroethylene (PTFE). These materials reduce the friction between the top layer of the sliding track and the brush. In addition, wear is reduced.

[0018] A brush for contacting a sliding track, in particular a sliding track with embedded nano particles as explained above may comprise at least one metallic wire. Preferably the wire is of an Au and/or Silver coating to provide a low resistance contacting surface. Nano-particles, in particular those of the materials listed above may be embedded in the coating. The wire and/or the coating may comprise alloying components like Copper (Cu), Cobalt (Co) or the like to enhance the hardness and resistance against abrasion of the brushes contacting surface.

[0019] Embedding nano particles, e.g. of the above-named materials in the top layer can be obtained by electroplating the top layer in presence of dispersed nano particles. Accordingly, a method for providing a metal layer of a sliding track and/or a brush which embeds nano particles comprises at least:

- Preparing an electrolyte bath in which nano particles are dispersed,
- Galvanic deposition, i.e. electroplating of a metal layer preferably as top layer on a sliding track blank or a brush blank in said electrolyte bath. The metal layer is preferably of Au and/or Ag.

[0020] When electroplating the sliding track blank, the dispersed nano particles deposit on the sliding track blank and incorporate, i.e. are embedded, in the deposited top layer of the sliding track.

[0021] A sliding track blank is a substrate onto which the top layer of the later sliding track can be deposited. In the simplest form the blank can comprise a metallic layer on a PCB-carrier being suited for depositing the later top layer metal, e.g. Au or an Au alloy or a different precious metal or alloy. A ring like sliding track blank is a slip ring blank.

[0022] In case of a slip ring, manufacturing is often more complex, but in any cases the later top layer, is deposited on a conducting blank, i.e. sliding track blank or a slip ring blank. For example, the top layer may be deposited on the inner surface of a metal ring. The ring may be filled with a resin or any other plastic material. After curing of the plastic material, the metal ring may be removed e.g. using a lathe until the previously deposited top layer can be contacted by a brush.

[0023] If the sliding track blank is a slip-ring blank, the slip ring blank is preferably rotated in the electrolyte bath, to thereby obtain a very homogeneous deposition of the metal and a homogenous nano particle distribution in the deposited metal layer.

[0024] The rotating slip ring blanks are not necessarily fully below the fluid level of the electrolyte bath. In this case only a ring segment of the slip ring blank immerses into an electrolyte bath. This enables to apply the top layer to even large diameter slip ring blanks without the need for huge electrolyte baths and large amounts of electrolytes.

[0025] The electrolyte bath is preferably agitated. Thereby, the nano particles can be kept dispersed.

[0026] For dispersing the nano-particles the bath can be agitated using ultrasonic waves.

[0027] The method is explained above with respect to providing a sliding track with a preferably precious metal top layer into which nano particles have been embedded. The method can as well be used to provide a brush for contacting a sliding track, e.g. by electroplating a wire for use as brush.

[0028] A sliding track with a top layer in which nano-particles are embedded can be combined with a prior art brush as well as with a brush having a metal coating in which nano particles are embedded as well. The brush having a metal coating with embedded nano particles can be combined with a prior art sliding track as well as with a sliding track according to the invention. The combinations each form a slip ring assembly, if the sliding track is ring like.

Example Coatings:

[0029]

1. A commercially available electrolyte concentrate for hard Au-coating is diluted according to the suppliers specification. Preferably, a surface wetting agent is added as well. The pH is set to 2.8 to 4.6 more preferably to 4.1 to 4.3 using e.g. potassium hydroxide solution and/or an acid like citric acid. About 120g of SiC-nanoparticles (e.g. with a d_{50} of 20nm) are dispersed in the electrolyte solution using an ultrasonic bath for e.g. 1h, preferably just before electroplating. Alternatively, Carbon-Nano Tubes and/or at least one nano particles of at least one of the above-named materials can be dispersed as well, e.g. Diamond nano-particles and WC can dispersed as well. The obtained electrolyte solution can be used as electrolyte bath for electroplating Au with embedded SiC nano particles.

In said electrolyte bath a sliding track of slip ring was coated with an Au-layer incorporating the SiC nano particles. The sliding track with a surface of about 2,254 dm^2 being positioned fully in the electrolyte bath and was used as cathode. The sliding track was fully immersed in the electrolyte bath and rotated (about 400rpm $\pm$ 50%, preferably $\pm$ 25%, more preferably $\pm$ 10%). Additionally, the electrolyte bath may be stirred using a magnetic stirrer. A Pt-wire grid may be used as Anode. DC currents (e.g. between 0.2 and 10A/dm^2, preferably between 1 and 8 A/dm^2, more preferably between 2 and 6A/dm^2) were successfully applied. Alternatively plating was obtained using a pulsed current, e.g. using a rectangular pulse with t_{on} = 100ms ($\pm$25%, preferably $\pm$ 15%, more preferably $\pm$ 7.5%) and t_{off}=1000ms ($\pm$25%, preferably $\pm$ 15%, more preferably $\pm$ 7.5%). Mean current densities have been varied between about 0.5 A/dm^2 ($\pm$50%, preferably $\pm$ 25%, more preferably $\pm$ 10%) and 20A/dm^2 ($\pm$50%, preferably $\pm$ 25%, more preferably $\pm$ 10%), preferably between 2A/dm^2 and 17.5 A/dm^2 and more preferably between 4S/dm^2 and 15A/dm^2 (all current densities $\pm$50%, preferably $\pm$ 25%, more preferably $\pm$ 10%).

2. A commercially available electrolyte concentrate for hard Au- is diluted according to the suppliers specification. The pH is set to 7.0 to 7.8, preferably to 7,0 to 7.3 at 57°C ($\pm$10°C), using a base, e.g. potassium hydroxide solution, and/or an acid like citric acid, sulphuric acid and/or nitric acid or the like. About 120g (60g to 180g, preferably 90 to 150g) of SiC-nanoparticles (e.g. with a d_{50} of 20nm) are dispersed in the electrolyte solution using an ultrasonic bath for e.g. 1h ($\pm$30min), preferably just before electroplating. Other nano particles e.g. of Diamond and WC can dispersed as well. The obtained electrolyte solution can be used as electrolyte bath for electroplating Au with embedded SiC nano particles using DC or pulsed current electroplating as in example 1.

Description of Drawings

[0030] In the following the invention will be described by way of example, without limitation of the general inventive concept, on examples of embodiment with reference to the drawings.

Figure 1 shows a cross section of a first sliding track brush assembly.

Figure 2 shows a cross section of a second sliding track brush assembly.

Figure 3 shows a detail of a top layer as in Fig. 1 and Fig. 2.

Figure 4 shows an example for a slip ring assembly.

Figure 5 shows an example Au sliding track with embedded Carbon Nano tubes in 200.000 magnification.

[0031] Figure 1 show sliding contacts 50, 51 between a brush 10 and a sliding track. The sliding track has a support 30, with a first layer e.g. of Ni (Nickel) as mechanical support and diffusion barrier. On top of the first layer 32 is a top layer 31. The latter is electrically contacted by the brush 10. The brush 10 is preferably. In the example, the brush may be a wire 10, preferably a wire 10 with a precious metal coating 11, e.g. a gold (Au) coating. The brush may be positioned in a groove of the sliding track that on the one hand guides the brush 10 and on the other hand doubles the area where the sliding contact 50, 51 between the brush 10 and the sliding track is established. In the example of Fig. 1 the grove has a triangular cross section. However, other cross sections are as well possible.

[0032] In the examples of Fig. 1 and 2, the brush is a single wire brush. Alternatively, the brush may be for example a multi wire brush 10 or multi filament brush.

[0033] An alternative to the grooved sliding track is depicted in Fig. 2: The sliding track of Fig. 2 has an at least essentially plane cross section. This is the only difference to the sliding track of Fig. 1.

[0034] A detail of the top layer 31 as shown in Fig. 1 and Fig. 2 is shown in Fig. 3. As can be seen SiC nano particles are embedded randomly distributed in the top layer.

[0035] An application of the sliding track assemblies of Fig. 1 and 2 is shown in Fig. 4: The sliding track 30 has a ring-like or cylindrical side view and is contacted by brushes 10. Only for simplicity, the first layer 32 and the top layer 31 are not shown.

[0036] The top layer 31 and as well the coating 11 of the brushes 10 in Fig. 1 and Fig. 2 was applied using electroplating. Electroplating was performed using an electrolyte solution with dispersed nano particles, e.g. Carbon-Nano Tubes.

[0037] Figure 5 shows an Au-surface of a top layer 31 into which carbon nano tubes are embedded in about 20.000 magnification (STM-picture). The surface has been prepared as explained in Example 1 but using Carbon-Nano Tubes instead of SiC and a DC-current of about $2A/dm^2$ for deposition. The Carbon-Nano Tubes appear as thin lines. The arrow points to an agglomerate of Carbon-Nano Tubes.

List of reference numerals

[0038]

10	brush / wire of brush
11	precious metal coating of wire 10
20	brush holder
30	support
31	first layer, preferably of a metal harder than Au, e.g. Ni
32	top layer of a precious metal, e.g. Au
40	nano particles, e.g. SiC
50	sliding contact
51	sliding contact

Claims

1. A sliding track with a top layer (31) of Au and/or Ag for being electrically contacted by at least one brush (10) to provide at least one sliding contact (50,51) between the top layer 31 and the brush (10),

   characterized in that
   nano-particles having a higher resistance against abrasion and/or a lower frictional coefficient than Au and/or Ag are embedded in the top layer (31) and wherein said nano-particles are selected from a group consisting of Diamond, SiC, WC, PTFE, CNT, Corundum, Al_2O_3, sintered ceramic metals, B_4C, TaC, Be_2C, TiN, TaN, BN, Si_3N_4, AlN, Ruby, Zircon, TiB_2, $MoSi_2$, TiC-WC, TiC-TaC-WC, TiC-TiN, Co_3W_3C, Ni_3W_3C, W-Co, W-Os, W-Re, W-Ir, Mo-Be, Al_2O_3 - Cr, Al_2O_3- Mo-Cr, Al_2O_3- Ni, UO_2 - Mo, ZrO_2 - Mo and/or Titancarbide, TiC / Titannitride, TiN - Ni.

2. A brush (10) with an Au and/or Ag coating (11) for electrically contacting at least one sliding track to provide a sliding contact (50, 51) between the brush (10) and the sliding track,

   characterized in that
   nano-particles having a higher resistance against abrasion and/or a lower frictional coefficient than said Au and/or Ag are embedded in the precious metal coating (11) and wherein at least one of said nano-particles are selected from a group consisting of Diamond, SiC, WC, PTFE, CNT, Corundum, Al_2O_3, sintered ceramic metals, B_4C, TaC, Be_2C, TiN, TaN, BN, Si_3N_4, AlN, Ruby, Zircon, TiB_2, $MoSi_2$, TiC-WC, TiC-TaC-WC, TiC-TiN, Co_3W_3C, Ni_3W_3C, W-Co, W-Os, W-Re, W-Ir, Mo-Be, Al_2O_3 - Cr, Al_2O_3 - Mo - Cr, Al_2O_3-Ni, UO_2 - Mo, ZrO_2 - Mo and/or Titancarbide, TiC / Titannitride, TiN - Ni.

3. Slip ring assembly with a brush being in sliding contact with a sliding track,

   characterized in that
   the sliding track is a sliding track of claim 1 and/or the brush is a brush of claim 2.

4. A method for providing a Au and/or Ag layer of a sliding track and/or a brush (10), the method comprising at least the step of

   - depositing a Au and/or Ag layer by electroplating a sliding track and/or a brush blank using an electrolyte bath,

     characterized in that
     nano particles having a higher resistance against abrasion and/or a lower frictional coefficient than said Au and/or Ag are selected from a group consisting of Diamond, SiC, WC, PTFE, CNT, Corundum, Al_2O_3, sintered ceramic metals, B_4C, TaC, Be_2C, TiN, TaN, BN, Si_3N_4, AlN, Ruby, Zircon, TiB_2, $MoSi_2$, TiC-WC, TiC-TaC-WC, TiC-TiN, Co_3W_3C, Ni_3W_3C, W-Co, W-Os, W-Re, W-Ir, Mo-Be, Al_2O_3 - Cr, Al_2O_3 - Mo - Cr, Al_2O_3- Ni, UO_2 - Mo, ZrO_2 - Mo and/or Titancarbide, TiC / Titannitride, TiN - Ni are dispersed in the electrolyte bath.

5. The method of claim 4

   characterized in that
   the method further comprises

   - preparing an aqueous solution comprising noble metal ions,
   - dispersing at least one of said at least one nano particle in the solution, and
   - using the solution as electrolyte bath for deposition of the Au and/or Ag.

Patentansprüche

1. Eine Schleifbahn mit einer Deckschicht (31) aus Au und/oder Ag, um durch mindestens eine Bürste (10) elektrisch kontaktiert zu werden, um mindestens einen Schleifkontakt (50, 51) zwischen der Deck-

schicht (31) und der Bürste (10) bereitzustellen,

dadurch gekennzeichnet, dass Nanopartikel mit einer höheren Abriebfestigkeit und/oder einem niedrigeren Reibungskoeffizienten als Au und/oder Ag in die Deckschicht (31) eingebettet sind und wobei die Nanopartikel ausgewählt sind aus einer Gruppe, bestehend aus Diamant, SiC, WC, PTFE, CNT, Korund, Al_2O_3, gesinterten keramischen Metallen, B_4C, TaC, Be_2C, TiN, TaN, BN, Si_3N_4, AlN, Rubin, Zirkon, TiB_2, $MoSi_2$, TiC-WC, TiC-TaC-WC, TiC-TiN, Co_3W_3C, Ni_3W_3C, W-Co, W-Os, W-Re, W-Ir, Mo-Be, Al_2O_3-Cr; Al_2O_3-Mo-Cr; Al_2O_3-Ni, UO_2-Mo, ZrO_2-Mo und/oder Titancarbid, TiC/Titannitrid, TiN - Ni.

2. Eine Bürste (10) mit einer Au- und/oder Ag-Beschichtung (11) zur elektrischen Kontaktierung mindestens einer Schleifbahn, um einen Schleifkontakt (50, 51) zwischen der Bürste (10) und der Schleifbahn bereitzustellen,

dadurch gekennzeichnet, dass Nanopartikel mit einer höheren Abriebfestigkeit und/oder einem niedrigeren Reibungskoeffizienten als Au und/oder Ag in die Edelmetall-Beschichtung (11) eingebettet sind und wobei mindestens eines dieser Nanopartikel ausgewählt sind aus der Gruppe, bestehend aus Diamant, SiC, WC, PTFE, CNT, Korund, Al_2O_3, gesinterten keramischen Metallen, B_4C, TaC, Be_2C, TiN, TaN, BN, Si_3N_4, AlN, Rubin, Zirkon, TiB_2, $MoSi_2$, TiC-WC, TiC-TaC-WC, TiC-TiN, Co_3W_3C, Ni_3W_3C, W-Co, W-Os, W-Re, W-Ir, Mo-Be, Al_2O_3-Cr, Al_2O_3-Mo-Cr; Al_2O_3-Ni, UO_2-Mo, ZrO_2-Mo und/oder Titancarbid, TiC/Titannitrid, TiN - Ni.

3. Schleifringanordnung mit einer Bürste, die in Schleifkontakt mit einer Schleifbahn ist,

dadurch gekennzeichnet, dass die Schleifbahn eine Schleifbahn nach Anspruch 1 ist und/oder die Bürste eine Bürste nach Anspruch 2 ist.

4. Ein Verfahren zum Bereitstellen einer Au- und/oder Ag-Beschichtung einer Schleifbahn und/oder einer Bürste (10), wobei das Verfahren mindestens folgenden Schritt umfasst:

- Abscheiden einer Au- und/oder Ag-Beschichtung durch Galvanisieren einer Schleifbahn und/oder eines Bürstenrohlings unter Verwendung eines Elektrolytbades,

dadurch gekennzeichnet, dass Nanopartikel mit einer höheren Abriebfestigkeit und/oder einem niedrigeren Reibungskoeffizienten als Au und/oder Ag in dem Elektrolytbad dispergiert sind, wobei die Nanopartikel ausgewählt sind aus einer Gruppe, bestehend aus Diamant, SiC, WC, PTFE, CNT, Korund, Al_2O_3, gesinterten keramischen Metallen, B_4C, TaC, Be_2C, TiN, TaN, BN, Si_3N_4, AlN, Rubin, Zirkon, TiB_2, $MoSi_2$, TiC-WC, TiC-TaC-WC, TiC-TiN, Co_3W_3C, Ni_3W_3C, W-Co, W-Os, W-Re, W-Ir, Mo-Be, Al_2O_3-Cr, Al_2O_3-Mo-Cr, Al_2O_3-Ni, UO_2-Mo, ZrO_2-Mo und/oder Titancarbid, TiC/Titannitrid, TiN - Ni

5. Verfahren nach Anspruch 4,

dadurch gekennzeichnet, dass das Verfahren weiterhin Folgendes umfasst:

- Herstellen einer Edelmetallionen umfassenden wässrigen Lösung,
- Dispergieren von mindestens einem von dem mindestens einen Nanopartikel in der Lösung, und
- Verwenden der Lösung als Elektrolytbad zur Abscheidung von Au und/oder Ag.

Revendications

1. Gorge coulissante dotée d'une couche supérieure (31) d'Au et/ou d'Ag destinée à être mise en contact électrique par au moins un balai (10) pour fournir au moins un contact à glissement (50, 51) entre la couche supérieure (31) et le balai (10),

caractérisée en ce que des nanoparticules ayant une résistance plus élevée contre l'abrasion et/ou un coefficient de frottement inférieur audit Au et/ou Ag sont incorporées à la couche supérieure (31) et dans laquelle lesdites nanoparticules sont choisies dans un groupe consistant en le diamant, SiC, WC, PTFE, CNT, le corindon, Al_2O_3, des métaux en céramique frittés, B_4C, TaC, Be_2C, TiN, TaN, BN, Si_3N_4, AlN, la rubine, le zircon, TiB_2, $MoSi_2$, TiC-WC, TiC-TaC-WC, TiC-TiN, Co_3W_3C, Ni_3W_3C, W-Co, W-Os, W-Re, W-Ir, Mo-Be, Al_2O_3-Cr, Al_2O_3-Mo-Cr, Al_2O_3-Ni, UO_2-Mo, ZrO_2-Mo et/ou le carbure de titane, TiC/nitrure de titane, TiN-Ni.

2. Balai (10) doté d'un revêtement (11) en Au et/ou Ag pour établir un contact électrique avec au moins une gorge coulissante pour fournir un contact à glissement (50, 51) entre le balai (10) et la gorge coulissante,

caractérisé en ce que
des nanoparticules ayant une résistance plus élevée contre l'abrasion et/ou un coefficient de frottement inférieur audit Au et/ou Ag sont incorporées au revêtement (11) en métal précieux et dans lequel au moins l'une desdites nanoparticules est choisie dans un groupe consistant en le diamant, SiC, WC, PTFE, CNT, le corindon, Al_2O_3, des métaux en céramique frittés, B_4C, TaC, Be_2C, TiN, TaN, BN, Si_3N_4, AlN, la rubine, le zircon, TiB_2, $MoSi_2$, TiC-WC, TiC-TaC-WC, TiC-TiN, Co_3W_3C, Ni_3W_3C, W-Co, W-Os, W-Re, W-Ir, Mo-Be, Al_2O_3-Cr, Al_2O_3-Mo-Cr, Al_2O_3-Ni, UO_2-Mo, ZrO_2-Mo et/ou le carbure de titane, TiC/nitrure de titane, TiN-Ni.

3. Ensemble bague collectrice doté d'un balai qui est en contact à glissement avec une gorge coulissante,

caractérisé en ce que
la gorge coulissante est une gorge coulissante de la revendication 1 et/ou le balai est un balai de la revendication 2.

4. Procédé de fourniture d'une couche d'Au et/ou d'Ag d'une gorge coulissante et/ou d'un balai (10), le procédé comprenant au moins l'étape de

- dépôt d'une couche d'Au et/ou d'Ag par le plaquage électrolytique d'une gorge coulissante et/ou d'une ébauche de balai à l'aide d'un bain d'électrolyte,

caractérisé en ce que
des nanoparticules ayant une résistance plus élevée contre l'abrasion et/ou un coefficient de frottement inférieur audit Au et/ou Ag sont choisies dans un groupe consistant en le diamant, SiC, WC, PTFE, CNT, le corindon, Al_2O_3, des métaux en céramique frittés, B_4C, TaC, Be_2C, TiN, TaN, BN, Si_3N_4, AlN, la rubine, le zircon, TiB_2, $MoSi_2$, TiC-WC, TiC-TaC-WC, TiC-TiN, Co_3W_3C, Ni_3W_3C, W-Co, W-Os, W-Re, W-Ir, Mo-Be, Al_2O_3-Cr, Al_2O_3-Mo-Cr, Al_2O_3-Ni, UO_2-Mo, ZrO_2-Mo et/ou le carbure de titane, TiC/nitrure de titane, TiN-Ni et sont dispersées dans le bain d'électrolyte.

5. Procédé selon la revendication 4,

caractérisé en ce que
le procédé comprend en outre

- la préparation d'une solution aqueuse comprenant des ions de métal noble,
- la dispersion d'au moins l'une de ladite au moins une nanoparticule dans la solution, et
- l'utilisation de la solution en tant que bain d'électrolyte pour le dépôt d'Au et/ou d'Ag.

Fig. 1

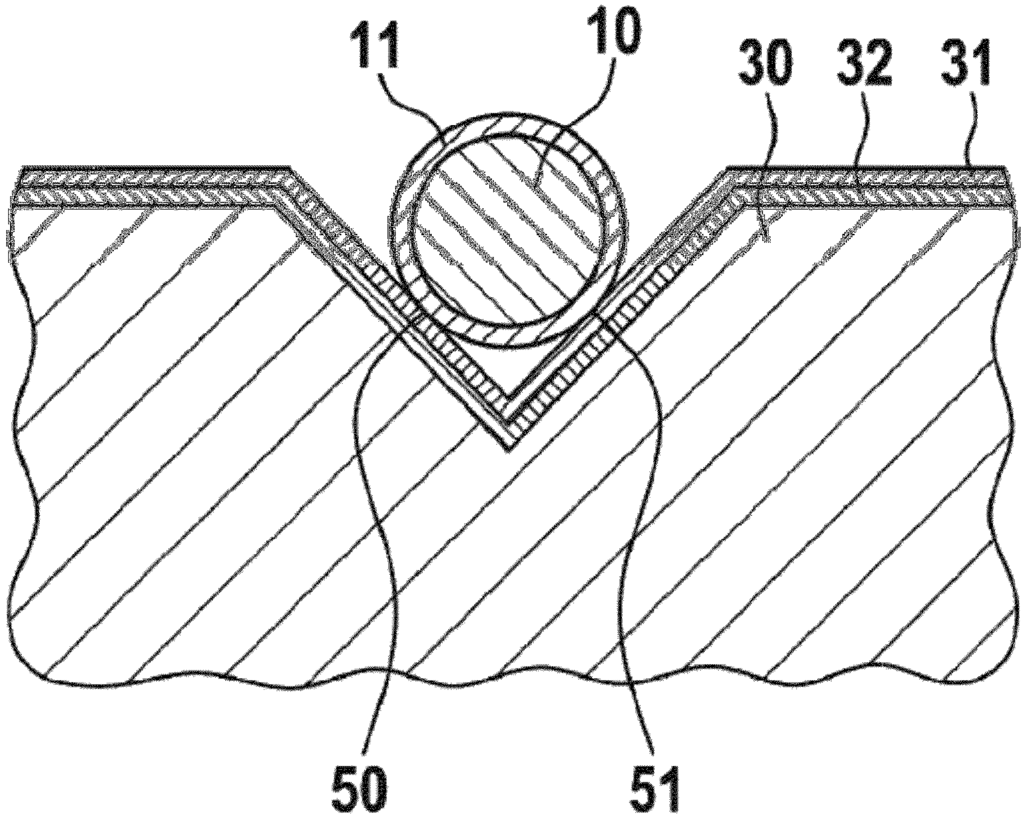


Fig. 2

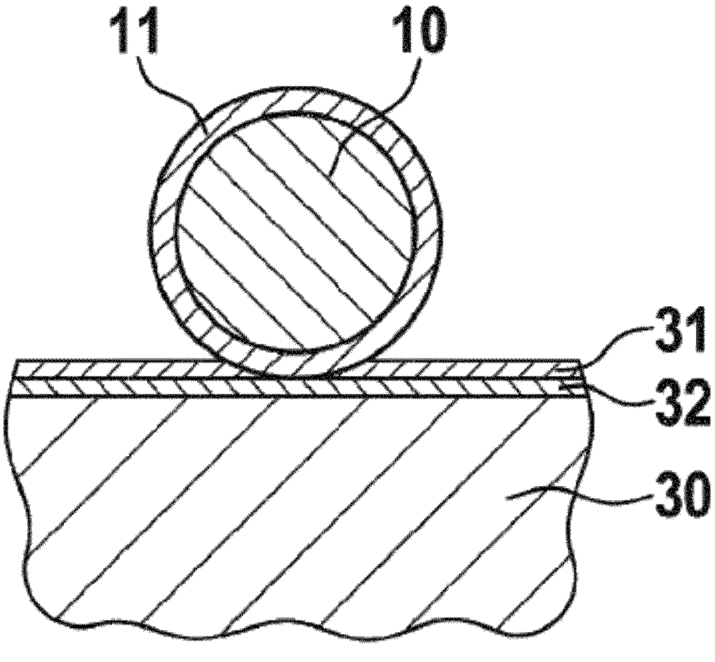


Fig. 3

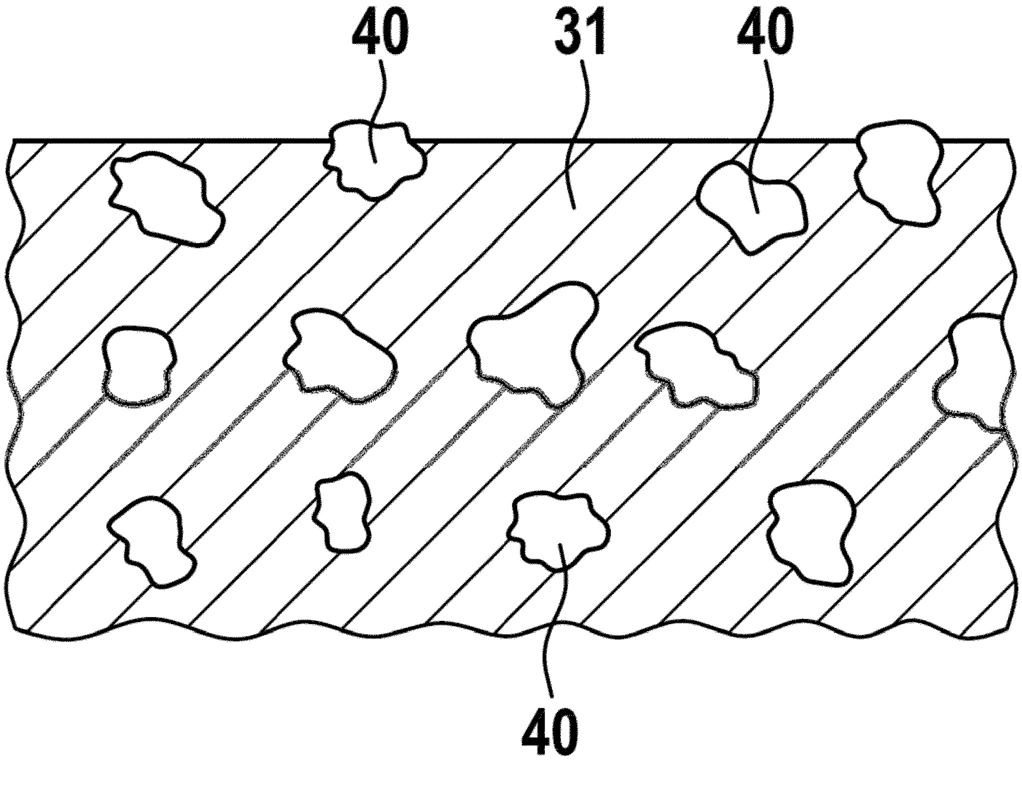


Fig. 4

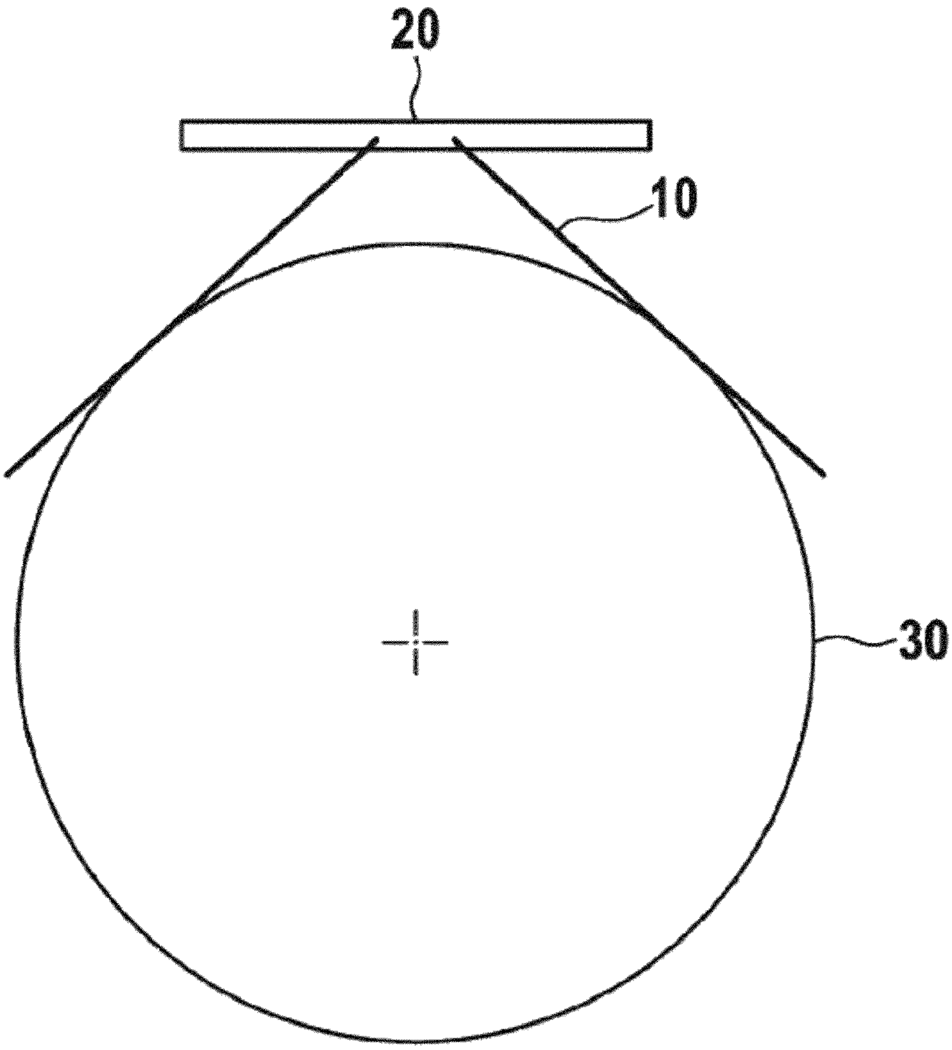
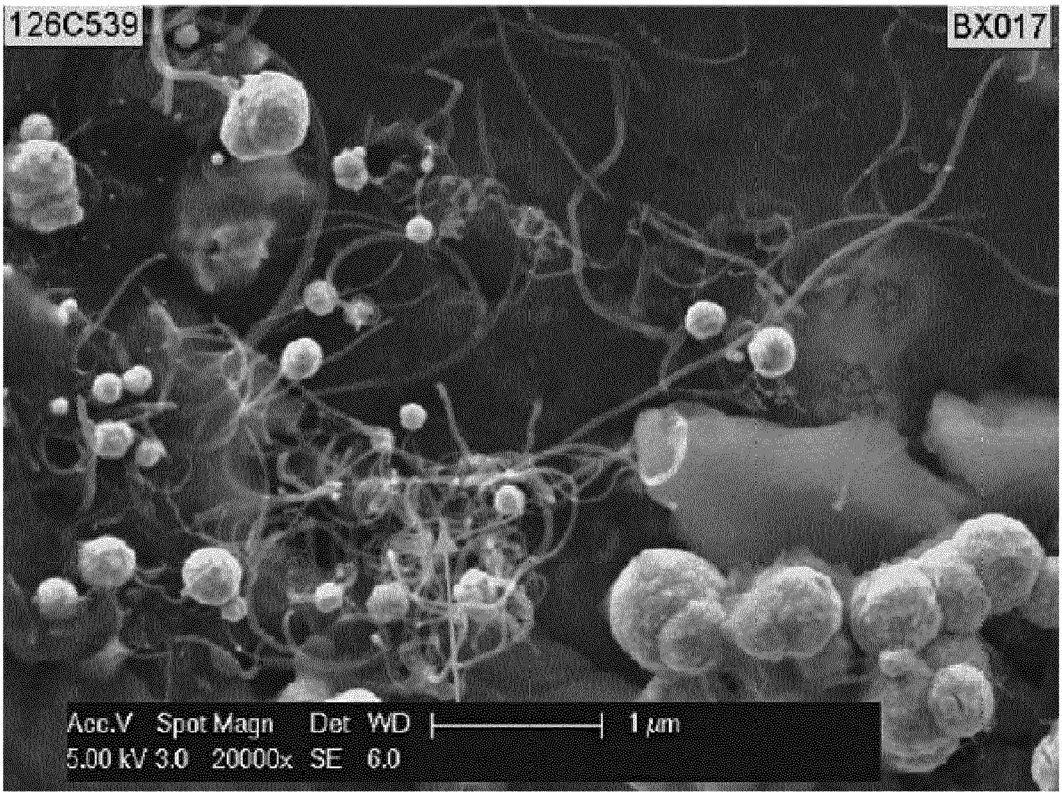


Fig. 5



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4398113 A **[0003]**
- WO 2013007458 A2 **[0004]**
- WO 2005038985 A **[0005]**
- US 20040000834 A1 **[0006]**
- US 6034531 A **[0007]**