(19) Europäisches Patentamt / European Patent Office / Office européen des brevets

(11) **EP 2 933 362 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
21.11.2018 Bulletin 2018/47

(51) Int Cl.:
D01H 7/60 *(2006.01)*

(21) Application number: **15161587.9**

(22) Date of filing: **30.03.2015**

(54) RING-TRAVELER SYSTEM FOR RING SPINNING MACHINE

RING-LÄUFER-SYSTEM FÜR EINE RINGSPINNMASCHINE

SYSTÈME ANNEAU-CURSEUR POUR UNE MACHINE À FILER À ANNEAUX

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **16.04.2014 JP 2014084872**

(43) Date of publication of application:
21.10.2015 Bulletin 2015/43

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a ring-traveler system for a ring spinning machine, and in particular, to a ring-traveler system for a ring spinning machine without liquid lubrication.

[0002] It has been demanded to decrease frictional wear and seizing that affect the performance of the ring-traveler system of the ring spinning machine, while increasing the speed and prolonging the life of the system. To meet the demand, material variation, surface treatment, shape variation, the use of lubrication liquid, and the like have been proposed. In particular, the use of lubrication liquid is effective and relatively inexpensive. However, the passing yarn may be smeared with lubricating oil, and the use of oil leads to frequent maintenance. Thus, lubrication liquid is used for only limited applications such as spinning of woolen yarns.

[0003] Japanese Laid-Open Patent Publication JP 2014-29045 A (see family member EP 2 682 508 A2) and Japanese Laid-Open Patent Publication JP 2014-29046 A disclose a ring-traveler system of a ring spinning machine, which improves a friction reduction effect and keeps the friction reduction effect longer without using liquid lubrication as compared to conventional articles. In the ring-traveler system of the ring spinning machine described in Japanese Laid-Open Patent Publication JP 2014-29045 A, a concave portion having a depth of 0.1 to 20 μm and a planar portion having a width of 1 to 250 μm are alternately formed on a sliding surface of a ring on which a traveler slides when the traveler travels. In this case, the "ring spinning machine" refers to a ring spinning machine, a ring twisting machine, or the like that includes a ring supported by a ring rail to rise and fall and a traveler sliding on the ring, and winds a yarn via the traveler. The "concave portion" includes a groove, and a recess surrounded by a plane. According to this configuration, when the traveler slides, air around the concave portion brings a wedge effect, and a friction reduction effect is obtained. Moreover, since the traveler slides on the planar portion, there is no wear of the concave portion.

[0004] Moreover, Japanese Laid-Open Patent Publication JP 2014-29045 A describes that preferably, the concave portion is a circular recess, the diameter of the recess is 5 to 50 μm, the depth of the recess is 1 to 10 μm, and the distance between the adjacent recesses is 10 to 100 μm. Moreover, the document describes that when the concave portion is the circular recess, and the diameter and the depth of the recess, and the distance between the adjacent recesses fall in the above-mentioned ranges, a good friction reduction effect in addition to the wedge effect is obtained because wear powders and other foreign substances are discharged from the sliding interface between the ring and the traveler.

[0005] In a ring-traveler system of a ring spinning machine described in Japanese Laid-Open Patent Publication JP 2014-29046 A, 400 or more concave portions per centimeter are formed on a sliding surface of a ring on which a traveler slides when the traveler travels. Japanese Laid-Open Patent Publication JP 2014-29046 A describes that since a fiber film enters the concave portions on the sliding surface of the ring-traveler system to improve the adhesive force of the film and to prevent the fiber film from peeling off, the friction reduction effect caused by lubrication of the fiber film maintains reduced traveling resistance of the traveler.

[0006] Japanese Laid-Open Patent Publication JP 2014-29045 A discloses the relationship between the traveling distance of the traveler of less than 9000 km and the traveling resistance, and describes that the traveling resistance in the example is smaller than that of the commercial article, and the friction reduction effect is sustained. However, in the case of using the traveler disclosed in this document, when the traveling distance of the ring spinning machine is extended to 17000 km for spinning, the traveling resistance increases and replacement of the traveler becomes necessary.

[0007] Japanese Laid-Open Patent Publication JP 2014-29046 A discloses that micro-cracks formed on a surface of a hard chromium plating layer are used as concave portions. However, the formation of the micro-cracks brings about the possibility of negatively affecting the durability of the hard chromium plating layer. Moreover, the document discloses that grooves or recesses processed on the surface of the ring or the traveler are used as concave portions. However, when 400 or more grooves or recesses per centimeter are processed, the area of a planar portion where no groove or recess is formed becomes extremely small. Since this leads to early wear of the grooves or recesses, the friction reduction effect cannot be sustained JPH04-135977 discloses a ring-traveler system with liquid lubrication for a ring spinning machine, in which a plurality of circular recesses is formed on a sliding surface of a ring on which a traveler slides when the traveler travels, wherein in the ring-traveler system a depth of the recess is 1 to 3 μm, a diameter of the recess is 10 to 100 μm, and an area ratio of the recess is 10 to 35%.

SUMMARY OF THE INVENTION

[0008] It is an object of the present invention to provide a ring-traveler system for a ring spinning machine capable of sustaining a friction reduction effect long without using liquid lubrication.

[0009] The object is solved by a ring-traveler system of claim 1. Further developments are stated in the dependent claims.

[0010] In the ring-traveler system, the depth of the recess is 0.5 to 8 μm. The diameter of the recess is 5 to 30 μm. Moreover, the area ratio of the recess is 5 to 16%. "Circular" is not limited to a perfect circle, and may be an ellipse having an ellipticity of 0.8 or more. The "area ratio" is a value represented by a percentage of the area of all the recesses in the area of the entire sliding surface of the ring on which the traveler slides.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1A is a perspective view illustrating a ring according to an embodiment of the present invention;
Fig. 1B is a partial perspective view illustrating the ring;
Fig. 1C is a partial sectional view illustrating the relationship between a traveler and the ring during spinning;
Fig. 2A is a partial plan view illustrating concave portions;
Fig. 2B is a partial sectional view illustrating the concave portions;
Fig. 3A is a schematic view illustrating an effect of the ring according to the present invention;
Fig. 3B is a schematic view illustrating an effect of a ring that is a conventional article;
Fig. 4 is a graph illustrating the relationship between traveling resistance and a traveling distance;
Fig. 5A is a plan view illustrating the state of deposit having adhered to the surface of the ring;
Fig. 5B is a plan view illustrating the state of deposit having adhered to the surface of the ring having no recess;
Fig. 6A is a sectional view illustrating the state of deposit having adhered to the surface of the ring;
Fig. 6B is a sectional view illustrating the state of deposit having adhered to the surface of the ring having no recess;
Fig. 7 is a view illustrating the relationship between an area ratio and a wear level; Fig. 8A is a schematic view illustrating the wear state of the traveler when the ring according to the present invention is used; and
Fig. 8B is a schematic view illustrating the wear state of the traveler when a ring in a comparative example is used.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Referring to Figs. 1 to Fig. 8, an embodiment of a ring-traveler system of a ring spinning machine according to the present invention will now be described.

[0013] As illustrated in Fig. 1A to Fig. 1C, a ring 11 constituting the ring-traveler system includes a flange 11a having a T-shaped cross section, and a traveler 12 is formed having a C-shaped cross section. The ring 11 is formed of a bearing steel. As illustrated in Fig. 1B and Fig. 1C, a plating layer 13 is formed on a surface of the flange 11a. The plating layer 13 is formed by being plated with chromium. The plating layer 13 has a thickness of about 10 to 20 μm.

[0014] The plating layer 13 is a sliding surface of the ring 11 on which the traveler 12 slides when the traveler 12 travels. In this embodiment, as illustrated in Fig. 1C, a surface texture having a periodic structure 14 is formed on the plating layer 13 on an inner peripheral surface of the flange 11a. As illustrated in Fig. 2A and Fig. 2B, the periodic structure 14 is configured by arranging circular recesses 15 at predetermined intervals. The depth of each recess 15 is 0.5 to 8 μm, preferably, 1 to 5 μm, more preferably, 2 to 4 μm. The diameter of the recess 15 is 5 to 30 μm, preferably, 8 to 25 μm, more preferably, 10 to 20 μm. The area ratio of the recesses 15 is 5 to 16%. The area ratio is a value represented by a percentage of the area of all the recesses 15 in the area of the entire sliding surface of the ring 11 on which the traveler 12 slides. The recesses 15 are formed, for example, by irradiating locations where the recesses 15 of the ring 11 are to be formed with a femtosecond pulsed laser or a high-power nano-pulsed laser.

[0015] Next, effects of the above-mentioned ring-traveler system will be described with reference to Fig. 1C, Fig. 3A, and Fig. 3B.

[0016] As illustrated in Fig. 1C, a yarn Y is sent out from a draft part not illustrated, and then is wound around a high-speed rotating bobbin not illustrated through the traveler 12. The maximum rotating speed of a spindle in the normal spinning operation of the ring spinning machine is about 25000 rpm. The traveler 12 travels on the flange 11a by the winding tension of the yarn Y. The traveling posture of the traveler 12 slightly varies depending on the rotating speed. The traveler 12 travels on the ring 11 while abutting on an inner lower portion of the flange 11a.

[0017] In the ring-traveler system in this embodiment, the surface texture having the periodic structure 14 is formed on the sliding surface of the ring 11 on which the traveler 12 slides when the traveler 12 travels. The periodic structure 14 is formed such that the recesses 15 satisfy predetermined conditions. This decreases the traveling resistance of the traveler 12, because a yarn component deposit is formed in the recesses 15 when the traveler 12 slides.

[0018] Moreover, the recesses 15 satisfy the requirement that the area ratio is 5 to 16%. Thus, as illustrated in Fig. 3A, when the traveler 12 slides, the surface texture of the ring 11 causes yarn component-derived carbon to be formed as a thin deposit 16 on the entire sliding surface. The thin deposit 16 is formed on the entire sliding surface and then, acts as a lubricating film. Since this prevents metal-to metal contact between the ring 11 and the traveler 12, wear of the traveler 12 reduces. As a result, since the friction reduction effect is sustained long, the traveler 12 becomes difficult to wear. Fig. 3A and Fig. 3B exaggeratedly illustrate irregularity of the sliding surface of the ring 11 on which the traveler 12 slides.

[0019] On the other hand, when requirements that the depth of the recess 15 is 0.5 to 8 μm, the diameter of the recess is 5 to 30 μm, and the area ratio of the recesses is 5 to 16% are not satisfied, as illustrated in Fig. 3B, the deposit 16 is formed on only a portion of the sliding surface, and the deposit 16 becomes thick. In this case, the metal-to metal contact between the ring 11 and the traveler 12 occurs on a portion where no deposit is formed. As a result, the friction increases and the wear of the traveler 12 advances. Therefore, the friction reduction effect is not sustained longer as compared to the case where yarn component-derived carbon is formed as the thin deposit 16 on the entire sliding surface.

(Example 1)

[0020] The bearing steel ring 11 formed by plating the surface of the flange 11a with Cr was used. Moreover, a surface texture having the periodic structure 14 was formed on the sliding surface of the ring 11 on which the traveler 12 slides.

[0021] The surface texture was formed on the ring 11 by using a high-power nano-pulsed laser (HIPPO 355-5W manufactured by Spectra-Physics KK., with a laser having a wavelength of 335 nm). As laser irradiation conditions, pulse energy was set to 86 uJ, and pulse time was set to 12 ns. Moreover, the ring was fixed to a jig in air, the rotating speed was set to 50°/sec, and the ring was rotated 25 times. The diameter and the depth of each hole of the surface texture formed by the laser irradiation were 20 μm and 2 μm, respectively. Moreover, the surface texture was formed at intervals of 70 μm in the ring circumferential direction and at intervals of 60 μm in the axial direction. The processing time per ring was about 160 seconds. Various textures were formed by changing other laser irradiation conditions than the above. An example of the conditions is shown in Table 1. The number of the holes per centimeter was 111 to 125.

(Table 1)

	Diameter (μm)	Area Ratio (%)	Depth (μm)
Sample 1	10	1.6	2
Sample 2	10	8.7	2
Sample 3	20	6.4	4
Sample 4	20	12.6	4

[0022] In Table 1, Sample 1 is a conventional article disclosed in Japanese Laid-Open Patent Publication No. 2014-29045. Sample 2 to Sample 4 are articles according to the present invention.

[0023] A ring-traveler system using the ring 11 having the surface texture formed thereon (hereinafter may also be referred to as a surface textured article) and a ring-traveler system using a commercial ring having no surface texture formed thereon were constituted. Then, a spinning test was performed until the traveling distance reached 25000 km, and the relationship between the traveling resistance and the traveling distance was examined. The spinning test was performed by increasing the rpm in stages from 15000 to 21000 rpm until the traveling distance of the traveler 12 reached 1400 km, and by keeping high-speed rotation of 22000 rpm after the traveling distance reached 1600 km. Concerning the traveling resistance, a co-rotating force applied from the traveler 12 to the ring 11 was measured using a load cell in the state where the ring 11 was rotationally supported.

[0024] Fig. 4 illustrates the results of the relationship between the traveling resistance and the traveling distance. As apparent from Fig. 4, at high-speed rotation spinning after running-in performed until the traveling distance reaches 1400 km, the traveling resistance of the ring 11 having the surface texture with the periodic structure 14 formed thereon is smaller than the traveling resistance of the commercial ring. Thus, the effect of the surface texture was confirmed. Moreover, the traveling resistance of Sample 1 (conventional article) that is the ring 11 having the surface texture, but does not satisfy the configuration requirement that the area ratio is 5 to 16% according to the present invention increased to 18[gf] to 19[gf] when the traveling distance reached 17000 km. On the other hand, the traveling resistance of Sample 2 to Sample 4, which are articles according to the present invention, almost did not change when the traveling distance exceeded 17000 km. That is, it was confirmed that the article according to the present invention, which satisfies the requirement for the surface texture different from the requirement of the conventional article, can sustain the friction reduction effect longer than the conventional article.

[0025] Further, the spinning test was continued until the traveling distance of the traveler 12 reached 25000 km. Then, wear of the traveler 12 was evaluated at a time point when the traveling distance reached 25000 km. Moreover, sliding surfaces of the surface textured article and the commercial ring after spinning and cross sections near the sliding surfaces were observed using a scanning electron microscope (SEM). Moreover, carbon on the sliding surfaces was analyzed using an electron probe microanalyzer (EPMA).

[0026] Fig. 5A and Fig. 5B are schematic views illustrating analysis results of the EPMA. Fig. 5A illustrates the analysis results of the sliding surface of the surface textured article according to the present invention, and Fig. 5B illustrates the analysis results of the sliding surface of the ring having no surface texture formed thereon. In Fig. 5A and Fig. 5B, portions where dots are present represent locations where the deposit 16 has adhered. As the number of the dots per unit area is larger, the deposit 16 is thicker.

[0027] As illustrated in Fig. 5A, in the surface textured article, the thin carbon deposit 16 present on the entire sliding surface was detected, and the thick and highly-concentrated deposit 16 present on the portions of the recesses 15 was detected. On the other hand, as illustrated in Fig. 5B, in the ring having no surface texture formed thereon, the deposit 16 adhered to only a portion of the sliding surface, and the deposit 16 was thicker in many portions than the deposit 16 in the article according to the present invention. The deposit 16 is considered to have been formed by wear powders of the yarn Y that are generated by sliding of the traveler 12 and the yarn Y and enter the sliding surface of the ring 11 on which the traveler 12 slides.

[0028] A main component of the yarn is cellulose. For this reason, it is considered that an organic component-derived fluorescent component was analyzed using the EPMA. The deposit was analyzed by Raman analysis. As a result, in the deposit in the surface textured article, an amorphous carbon component-derived spectrum was detected on the sliding surface that is glossier than the recesses 15. In addition to the above-mentioned cellulose-derived component, it is considered that the amorphous carbon component-derived component also contributes to the lubricating ability and wear is reduced.

[0029] Fig. 6A illustrates the deposit 16 formed on the sliding surface of the surface textured article, and Fig. 6B illustrates the deposit 16 formed on the sliding surface having no surface texture formed thereon. The deposit 16 illustrated in Fig. 6B is thicker than the deposit 16 illustrated in Fig. 6A. Specifically, the thickness of the deposit 16 formed on the sliding surface of the surface textured article was about submicron, that is, less than 1 μm. On the contrary, the thickness of the deposit 16 on the sliding surface having no surface texture formed thereon was for example, about 2 μm.

[0030] Wear of the traveler 12 having slid on the surface textured article was evaluated. For the evaluation of the wear of the traveler 12, the minimum thickness that remains after the spinning test was used. In this case, the initial thickness of the traveler 12 was used as a reference value. Then, a wear level at which the traveler has no wear was defined as wear level 1. Moreover, a wear level at which the traveler wore to have the thickness half or more of the initial thickness of the traveler 12 was defined as wear level 2. Moreover, a wear level at which the traveler wore to have the thickness less than a half of the initial thickness of the traveler was defined as wear level 3. Further, according to stages where the wear advanced, wear levels 4 and 5 were defined, respectively. These stages are stages where the spinning performance of the yarn decreases and the replacement of the traveler 12 is necessary.

[0031] Fig. 7 illustrates the evaluation results. An unprocessed article having no texture formed thereon was used as a comparative article. The wear level in the unprocessed article was about 4. On the contrary, in the traveler having slid on the surface textured article, the results of the best wear level of 1.5 to 2 and less wear were obtained. Even in the surface textured article, when the area ratio was 2%, that is, the area ratio did not satisfy the requirement of 5 to 16%, the wear level was 3. Moreover, although not illustrated, in the surface textured article, when the diameter of the recess 15 exceeded 30 μm, the wear level was 3 or more. Therefore, it was confirmed that the diameter of the hole is preferably 8 to 30 μm. It was also confirmed that the area ratio is also important and is preferably 5 to 16%.

[0032] The wear state of the traveler 12 was observed. As a result, when the ring in Sample 1 that is the comparative example was used, as illustrated in Fig. 8A, a worn portion 20 was formed on the sliding surface of the ring. However, as illustrated in Fig. 8B, when the rings 11 in Sample 2 to Sample 4 in the example were used, formed worn portions 20' each were smaller than the worn portion 20 when the ring in Sample 1 was used.

[0033] According to this embodiment, the following effects can be obtained.

(1) In the ring-traveler system of the ring spinning machine, the circular recesses 15 are formed on the sliding surface of the ring 11 on which the traveler 12 slides when the traveler 12 travels. The depth of the recess 15 is 0.5 to 8 μm, the diameter of the recess 15 is 5 to 30 μm, and the area ratio of the recesses 15 is 5 to 16%. According to this configuration, when the traveler 12 slides, the recesses 15 cause yarn component-derived carbon to be formed as the thin deposit 16 on the entire sliding surface. Since the deposit 16 acts as a lubricating film and thus the metal-to metal contact between the ring 11 and the traveler 12 is prevented, wear of the traveler 12 reduces. Moreover, according to the above-mentioned diameter and area ratio, a sufficiently large area can be ensured in the planer portion between the adjacent recesses 15, that is, the planer portion where no recess 15 is formed. Therefore, the friction reduction effect can be sustained longer without using liquid lubrication than the conventional article.

(2) The diameter of the recess 15 may be 8 to 25 μm. When the diameter of the recess 15 is too smaller or too larger, due to the relationship with the area ratio, the deposit 16 that acts as the lubricating film is difficult to become thin and uniform and it becomes difficult to sustain the friction reduction effect long. On the contrary, when the diameter of the recess 15 is 8 to 25 μm, the deposit 16 is easy to become thin and uniform and it becomes easy to

sustain the friction reduction effect long. Moreover, when the diameter of the recess 15 is 10 to 20 μm, it becomes easy to sustain the friction reduction effect still longer.

(3) The depth of the recess 15 may be 1 to 5 μm. When the depth of the recess 15 is 1 to 5 μm, a good friction reduction effect is obtained. Moreover, when the depth of the recess 15 is 2 to 4 μm, it becomes easy to sustain the friction reduction effect still longer.

[0034] The present embodiment may be embodied as follows.

[0035] The recesses 15 of different sizes may be present.

[0036] The recesses 15 of different depths may be present.

[0037] The recesses 15 of different sizes and the recesses 15 of different depths may be present.

[0038] The periodic structure 14 is not limited to the configuration where the recesses 15 are arranged on the entire sliding surface at regular intervals in a staggered or lattice-like manner. The recesses may be arranged in a partially different manner or in a random manner.

[0039] The periodic structure 14 may be formed on the flange 11a without forming the plating layer 13. However, when the material of the ring 11 is a material currently used in the commercial article, it is preferable to form the plating layer 13.

[0040] The ring 11 constituting the ring-traveler system is not limited to the configuration of including the flange 11a having a T-shaped cross section, and may include an inclined flange 11a. In this case, a traveler of a shape corresponding to the inclined flange is used as the traveler 12.

[0041] As a method of forming the periodic structure 14 other than the method using an extremely-short pulsed laser such as a femtosecond pulsed laser, a high-power picosecond pulsed laser, or a nanosecond pulsed laser, other well-known methods may be applied.

[0042] The periodic structure 14 may be formed on the traveler 12 in place of the ring 11 of the ring-traveler system. When the periodic structure 14 is formed on the traveler 12, the area of the periodic structure 14 becomes much smaller than when the periodic structure is formed on the ring 11. For this reason, it is preferable to form the periodic structure 14 on the traveler 12.

[0043] The spinning yarn is not limited to cotton, and may be linen, silk, wool, chemical fiber (nitrocellulose, nylon, vinylon). Among them, cotton and linen are preferable in the point that cotton and linen discharge wear powders most and it is easy to form the deposit 16 on the sliding surface of the ring on which the traveler slides.

[0044] In a ring-traveler system of a ring spinning machine, a circular recess is formed on a sliding surface of a ring on which a traveler slides when the traveler travels. The depth of the recess is 0.5 to 8 μm, the diameter of the recess is 5 to 30 μm, and the area ratio of the recess is 5 to 16%.

Claims

1. A ring-traveler system without liquid lubrication for a ring spinning machine, in which a plurality of circular recesses (15) is formed on a sliding surface of a ring (11) on which a traveler (12) slides when the traveler (12) travels, wherein in the ring-traveler system
   a depth of the recess (15) is 0.5 to 8 μm,
   a diameter of the recess (15) is 5 to 30 μm, and
   an area ratio of the recess (15) is 5 to 16%, wherein
   the area ratio is a value represented by a percentage of the area of all the circular recesses (15) in the area of the entire sliding surface of the ring (11) on which the traveler (12) slides, and
   a periodic structure (14) is configured by arranging the circular recesses (15) at predetermined intervals.

2. The ring-traveler system without liquid lubrication of the ring spinning machine according to claim 1, being **characterized in that** the diameter of the recess (15) is 8 to 25 μm.

3. The ring-traveler system without liquid lubrication of the ring spinning machine according to claim 1 or 2, being **characterized in that** the depth of the recess (15) is 1 to 5 μm.

Patentansprüche

1. Ring-Läufer-System ohne Flüssigkeitsschmierung für eine Ringspinnmaschine, bei dem eine Vielzahl an kreisartigen Vertiefungen (15) an einer Gleitfläche eines Rings (11) ausgebildet ist, an dem ein Läufer (12) gleitet, wenn der Läufer (12) läuft, wobei in dem Ring-Läufer-System
   eine Tiefe der Vertiefung (15) 0,5 bis 8 μm beträgt,

ein Durchmesser der Vertiefung (15) 5 bis 30 μm beträgt, und
ein Flächenverhältnis der Vertiefung (15) 5 bis 16 % beträgt, wobei das Flächenverhältnis ein Wert ist, der repräsentiert wird durch einen prozentualen Anteil der Fläche von sämtlichen kreisartigen Vertiefungen (15) in dem Bereich der gesamten Gleitfläche des Rings (11), an dem der Läufer (12) gleitet, und
eine periodische Struktur (14) aufgebaut ist durch Anordnen der kreisartigen Vertiefungen (15) unter vorbestimmten Intervallen.

2. Ring-Läufer-System ohne Flüssigkeitsschmierung der Ringspinnmaschine gemäß Anspruch 1, **dadurch gekennzeichnet, dass** der Durchmesser der Vertiefung (15) 8 bis 25 μm beträgt.

3. Ring-Läufer-System ohne Flüssigkeitsschmierung der Ringspinnmaschine gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Tiefe der Vertiefung (15) 1 bis 5 μm beträgt.

Revendications

1. Système de curseur sans lubrification liquide pour un métier à filer continu à anneaux, dans lequel une pluralité d'évidements circulaires (15) est formée sur une surface coulissante d'un anneau (11) sur lequel un curseur (12) coulisse lorsque le curseur (12) se déplace, dans lequel, dans le système de curseur :

   une profondeur de l'évidement (15) est de 0,5 à 8 μm,
   un diamètre de l'évidement (15) est de 5 à 30 μm, et
   un rapport de surface de l'évidement (15) est de 5 à 16 %, dans lequel :

      le rapport de surface est une valeur représentée par un pourcentage de la surface de tous les évidements circulaires (15) dans la surface de toute la surface coulissante de l'anneau (11) sur lequel le curseur (12) coulisse, et
      une structure périodique (14) est configurée en agençant les évidements circulaires (15) à intervalles prédéterminées.

2. Système de curseur sans lubrification liquide d'un métier à filer continu à anneaux selon la revendication 1, **caractérisé en ce que** le diamètre de l'évidement (15) est de 8 à 25 μm.

3. Système de curseur sans lubrification liquide d'un métier à filer continu à anneaux selon la revendication 1 ou 2, **caractérisé en ce que** la profondeur de l'évidement (15) est de 1 à 5 μm.

Fig.1A

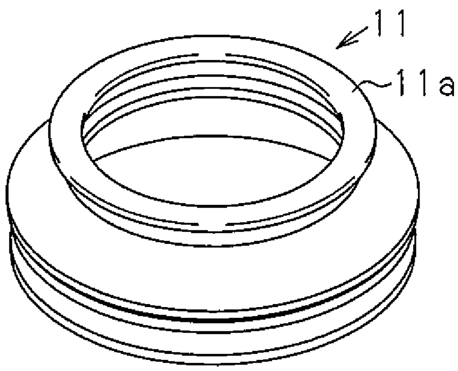


Fig.1B

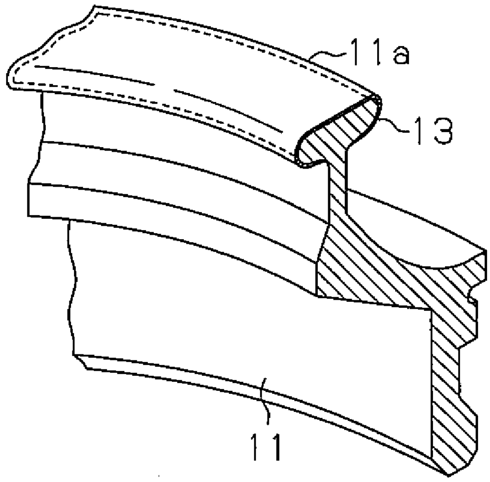


Fig.1C

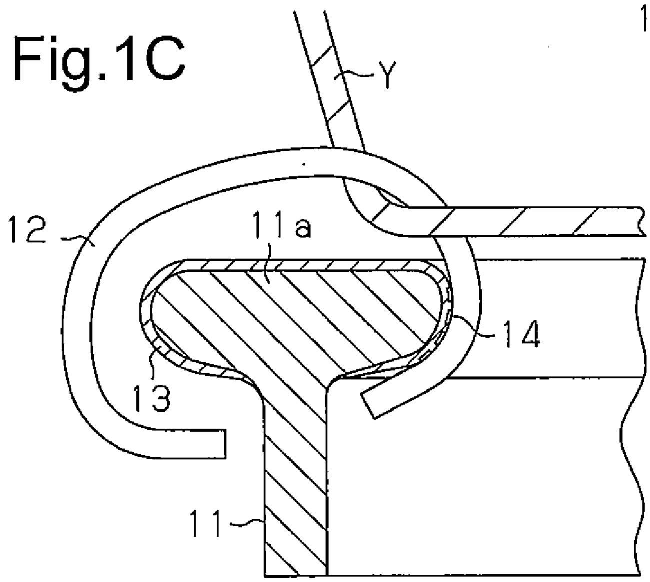


Fig.2A

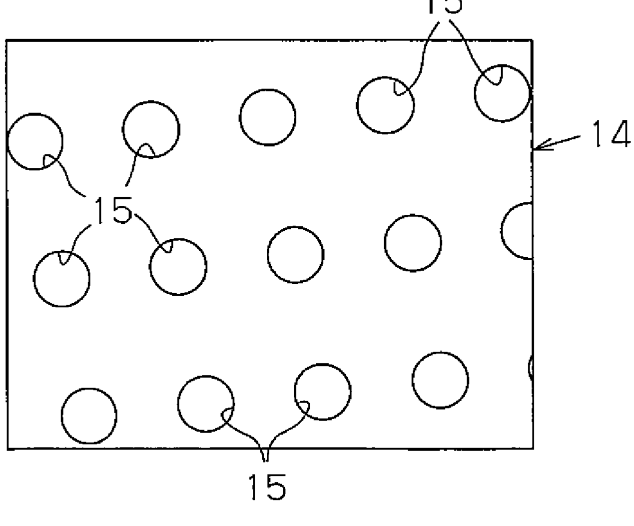


Fig.2B

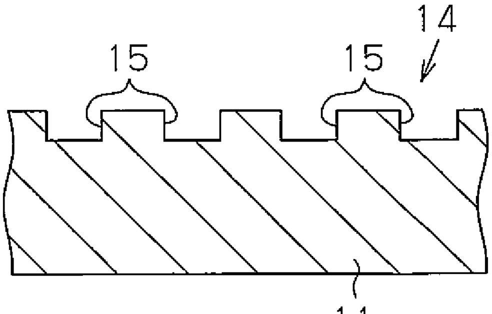


Fig.3A

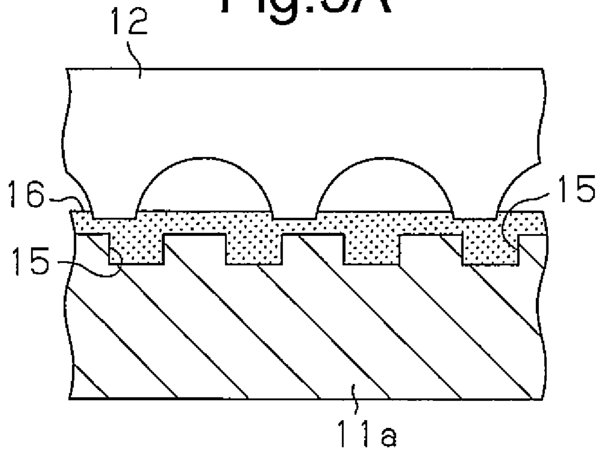


Fig.3B

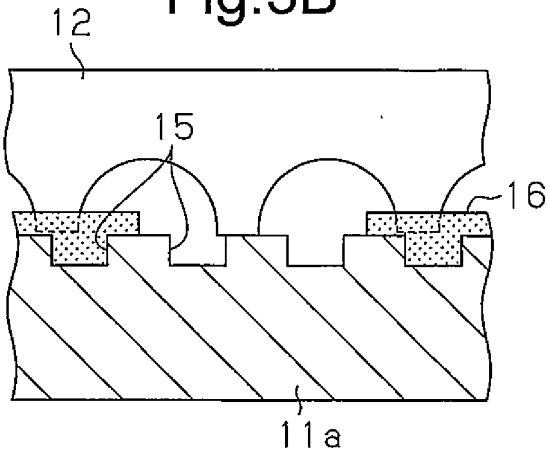


Fig.4

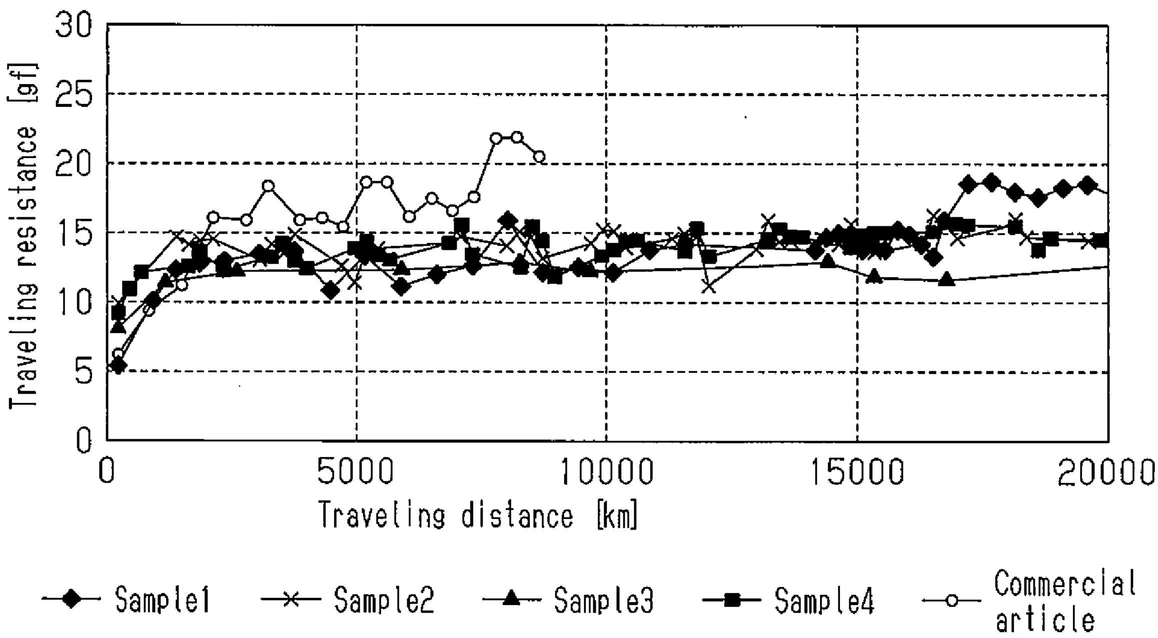


Fig.5A

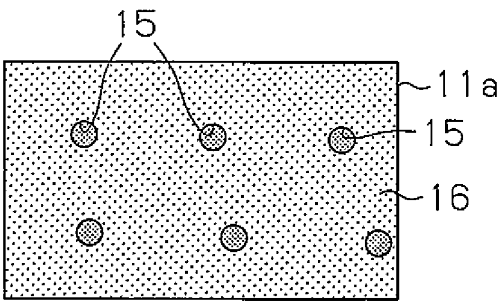


Fig.5B

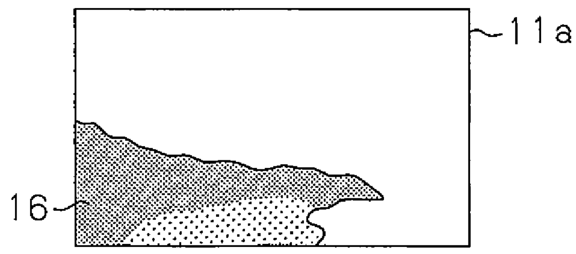


Fig.6A

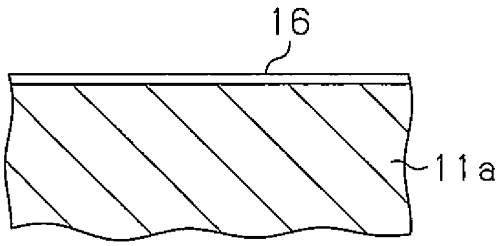


Fig.6B

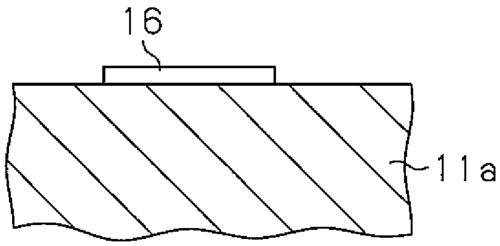


Fig.7

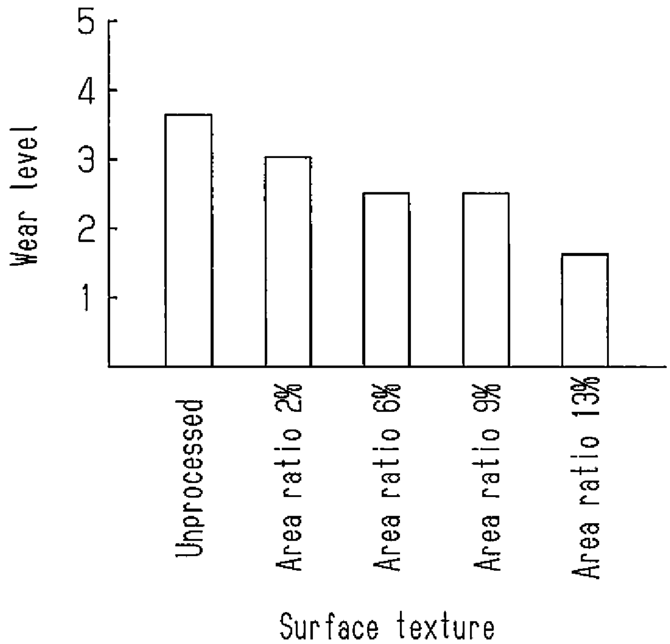


Fig.8A

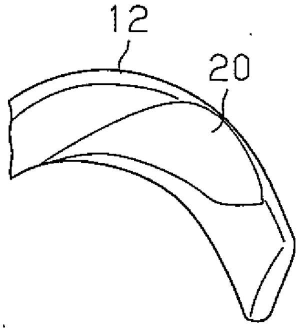
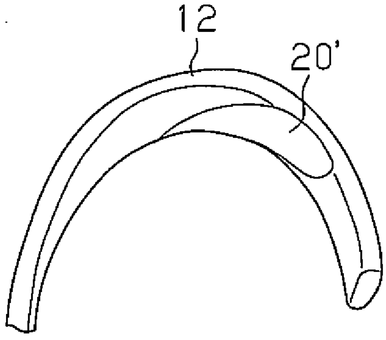


Fig.8B



REFERENCES CITED IN THE DESCRIPTION

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