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(54) RING-TRAVELER SYSTEM OF RING-TYPE SPINNING MACHINE

RINGLÄUFERSYSTEM EINER RINGSPINNMASCHINE

SYSTÈME ANNEAU-CURSEUR POUR MÉTIER À FILER À ANNEAUX

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Description

[0001] The present disclosure relates to a ring-traveler system for a ring-type spinning machine.

BACKGROUND ART

[0002] When a yarn is wound on a bobbin in a ring-traveler system of a ring-type spinning machine, a traveler slides on a ring. During that time, wear or seizure due to friction is likely to occur on a sliding surface between the traveler and the ring. In recent years, the travelling speed of the traveler is increased so as to improve productivity of a ring-type spinning machine, which tends to accelerate the wear of the traveler and the ring. If the traveler and the ring wear fast, the serviceable life of a ring-traveler system becomes short, and thus parts, such as a traveler, need to be frequently replaced. In general, wear of the traveler and the ring accelerates as the friction on the sliding surface between the traveler and the ring becomes greater. For example, liquid lubricant, such as oil, may be used to reduce wear on the traveler and the ring. However, it may stain a yarn with oil.

[0003] JP 2014-29046 A discloses a ring-traveler system of a ring-type spinning machine in which liquid lubricant is not applied for sliding movement that has recesses of 400 per centimeter on a sliding surface between a traveler and a ring. It is also disclosed that the recesses are formed by micro-cracks formed on a surface of a hard chromium-plated layer. According to the ring-traveler system of the Publication, the formation of a plurality of micro-cracks on the sliding surface between the traveler and the ring offers a friction-reducing effect provided by lubrication effect of a film, which formed by fibers that is separated from yarn during spinning operation and retained by the micro-cracks. This may provide long serviceable life for the ring-traveler system.

[0004] However, it has been found out that the following problem may be posed by the above-described ring-traveler system through thorough examination of the above-mentioned Publication by the present inventors. That is, the formation of the micro-cracks of 400 cracks per centimeter or more in the sliding surface between the ring and the traveler increases the surface roughness of the sliding surface. Thus, the initial slide resistance when the traveler slides on the ring increases, with the result that a time necessary to obtain a desired friction reducing effect, that is, a running-in time increases.

[0005] US 6 360 520 B2 discloses a ring-traveler system for a ring-type spinning machine according to the preamble of claim 1.

[0006] The present disclosure, which has been made in light of the above-mentioned problem, is directed to providing a ring-traveler system for a ring-type spinning machine that permits increasing its serviceable life and reducing a running-in time.

SUMMARY

[0007] The object of the invention is achieved with a ring-traveler system for a ring-type spinning machine according to claim 1. Further advantageous developments of the invention are subject-matter of the dependent claims.

[0008] Other aspects and advantages of the disclosure will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The disclosure together with objects and advantages thereof may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

> FIGS. 1A to 1C illustrate an example of configuration of a ring-traveler system of a ring-type spinning machine, in which FIG. 1A is a perspective view of a ring, FIG. 1B is a partially enlarged perspective view of the ring, and FIG. 1C is a schematic perspective view showing a relationship between the ring and a traveler during spinning operation;
>
> FIG. 2 is a schematic view of a friction-reducing portion;
>
> FIG. 3 is a table showing the evaluation results of the conventional ring-traveler system, the ring-traveler system of the present embodiment, the ring-traveler system of the comparative examples;
>
> FIG. 4 shows a relationship between the slide resistance and the slide distance;
>
> FIG. 5 is a view showing a plated surface of the ring of the conventional ring-traveler system observed with an electron microscope;
>
> FIG. 6 is a view showing the plated surface of the ring of the present embodiment observed with the electron microscope; and
>
> FIG. 7 is a view showing traveler wear debris on the ring observed with the electron microscope.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0010] The following will describe a ring-traveler device of a ring-spinning machine according to an embodiment of the present disclosure with reference to the accompanying drawings.

[0011] FIGS. 1A to 1C show an example of configuration of a ring-traveler system of a ring-type spinning machine. FIG. 1A is a perspective view of a ring. FIG. 1B is a partially enlarged perspective view of the ring. FIG. 1C is a schematic perspective view showing a relationship between the ring and a traveler during spinning operation. The ring-type spinning machine is a type of spinning machine, such as a ring spinning machine that winds yarn by means of a traveler that slides on a ring that is supported by a ring rail and moves up and down and a ring twisting machine.

[0012] FIGS. 1A, 1B and 1C show a ring 11 and a traveler 12 that forms the ring-traveler system according to the present embodiment. The ring 11 is made of, for example, bearing steel. The ring 11 includes a flange 11a. The flange 11a is formed integrally with the ring 11 and has a T-shaped in cross section. The traveler 12 is made of, for example, oxidized spring steel. The traveler 12 has a C-shaped in cross section. The traveler 12 is mounted to the flange 11a of the ring 11.

[0013] A chromium-plated layer 13 is formed on a surface of the flange 11a of the ring 11. The chromium-plated layer 13 is preferably a hard chromium-plated layer. The chromium-plated layer 13 has, for example, a thickness of approximately 10 to 20 μm. The hard chromium-plated layer is a plated layer defined in Japanese Industrial Standard (JIS) H8615: Electroplated coatings of chromium for engineering purposes. A friction-reducing portion 14 is formed at least in an inner peripheral surface of the flange 11a of the chromium-plated layer 13 that covers the surface of the flange 11a. The friction-reducing portion 14 forms part of the chromium-plated layer 13, and reduces friction that is generated when the traveler 12 slides on the ring 11. Friction reducing mechanism of the friction-reducing portion 14 will be described later.

[0014] When a yarn is to be wound on a bobbin of the ring-type spinning machine, a yarn Y is passed through the traveler 12, as illustrated in FIG. 1C. The yarn Y is fed from a draft device (not shown), and is wound on the bobbin (not shown) through the traveler 12 during which a predetermined tension is applied to the yarn Y passed through the traveler 12. Thus, the traveler 12 is pulled by the yarn Y, and placed in contact with the flange 11a of the ring 11. With the traveler 12 in contact with the flange 11a, the traveler 12 moves in circle along the flange 11a. Thus, while the yarn Y is being wound on the bobbin, or during spinning operation, the traveler 12 slides on the ring 11.

[0015] When the traveler 12 slides on the ring 11, the traveler 12 and ring 11 are in contact with each other on a sliding surface of the traveler 12 and a sliding surface of the ring 11. Thus, both the traveler 12 and the ring 11 have the sliding surfaces, respectively. In the present embodiment, the friction-reducing portion 14 is formed in the sliding surface of the ring 11 relative to the traveler 12, as an example. More specifically, the inner peripheral surface of the flange 11a of the ring 11 is covered with the chromium-plated layer 13, and the friction-reducing portion 14 is formed in this chromium-plated layer 13. Therefore, the friction-reducing portion 14 formed in the chromium-plated layer 13 covering the inner peripheral surface of the flange 11a corresponds to the sliding surface between the ring 11 and the traveler 12 according to the present disclosure.

[0016] As shown in FIG. 2, a plurality of cracks 15 is formed in the friction-reducing portion 14 of the chromium-plated layer 13. The cracks 15 of random lengths and extending in random directions are formed in the friction-reducing portion 14. The cracks 15 preferably are formed by micro-cracks that is defined in Japanese Industrial Standards: H8615,: Electroplated coatings of chromium for engineering purposes.

[0017] According to the present embodiment, the plurality of cracks 15 formed in the friction-reducing portion 14 satisfy both of the following two conditions.

[0018] Condition 1: The plurality of cracks 15 has the average width of 0.5 μm or more and 1.5 μm or less.

[0019] Condition 2: T the average of the number of cracks 15 is less than 400 per centimeter.

[0020] For measuring the width of the cracks, for example, a microscope picture of the surface of the friction-reducing portion 14 of the chromium-plated layer 13 is taken with a microscope, and the widths of the cracks 15 may be obtained with a scale bar of the microscope.

[0021] For measuring the number of cracks, a microscope picture of the surface of the friction-reducing portion 14 of the chromium-plated layer 13 is taken with a microscope, and a straight line was drawn on the picture. The number of micro-cracks was determined by counting the micro-cracks that extend across the straight line of one centimeter length. Because the cracks have random lengths and extend in random directions the straight line may be drawn arbitrarily.

[0022] In the friction-reducing portion 14 of the chromium-plated layer 13, the width and the number of cracks of the plurality of cracks 15 are distributed in a normal distribution or a near normal distribution.

[0023] In forming the chromium-plated layer 13 in the ring 11 by chromium plating, the cracks 15 that satisfy both the above two conditions may not be formed only by chromium plating. Therefore, in the present embodiment, the formation of the cracks 15 that satisfy both the two conditions are achieved by performing electrolytic etching after the chromium-plated layer 13 is formed on the ring 11 by chromium plating.

[0024] Conditions for the electrolytic etching are determined so that the plurality of cracks 15 having the average crack width of 0.5 μm or more and 1.5 μm or less, and the average of the number of cracks less than 400 per centimeter may be formed. For example, the etching conditions may be current density and the duration of etching.

[0025] If the average crack width is less than 0.5 μm, the width of cracks 15 is excessively small relative to the particle size of wear debris that is generated on the sliding surface between the ring 11 and the traveler 12. Thus, the wear debris generated on the sliding surfaces does not smoothly fall into the cracks 15. Wear debris having relatively small particle sizes may fall into the cracks 15, but soon fills the cracks 15 because the narrow cracks 15 is capable of receiving a small amount of wear debris. On the other hand, if the average width of the cracks 15 is large, wear debris generated on the sliding surfaces smoothly falls into the cracks 15, and it secures a long time for wear debris to fill the micro-cracks (the cracks 15). However, if the average crack width exceeds 1.5 μm, protrusions and recesses on the surface of the friction-reducing portion 14 become significant due to the wide cracks 15, which is likely to cause wear on the sliding surface between the ring 11 and the traveler 12. To allow wear debris to rapidly fall into the cracks 15, the average crack width is 0.6 μm or more, and preferably 0.7 μm or more. Further, to reduce occurrence of wear on the sliding surface, the average crack width is preferably 1.3 μm or less, and more preferably 1.2 μm or less.

[0026] Regarding to the number of cracks, if the average of the number of cracks is 400 cracks per centimeter or greater, the surface roughness of the friction-reducing portion 14 increases, which increases a running-in time for the ring-type spinning machine. The surface roughness is a term that represents properties of a surface of an object. The surface roughness is quantified by the number of protrusions and recesses per unit of length on a surface of an object. That is, the larger the number of protrusions and recesses per unit of area on a surface of an object, the higher the surface roughness, and the smaller the number of protrusions and recesses per unit of area on a surface of an object, the lower the surface roughness. Thus, if the average of the numbers of cracks becomes 400 cracks per centimeter or more, the surface roughness of the friction-reducing portion 14 is increased.

[0027] The running-in time is a time necessary for the friction-reducing portion 14 to obtain a desired friction-reducing effect in a case where a yarn is wound on a bobbin by means of a new ring 11 and a new traveler 12. To reduce the running-in time, it is advantageous to make the surface roughness of the friction-reducing portion 14 low so as to reduce the initial slide resistance. The initial slide resistance is slide resistance generated when a new traveler 12 slides on a new ring 11. The initial slide resistance corresponds to, especially, the slide resistance generated within the slide distance between 0 km and 500 km. The presence of a large number of the protrusions and recesses in the surface of the friction-reducing portion 14 increases the initial slide resistance, and increase a time necessary for cellulose fibers to spread over the entire surface of the friction-reducing portion 14, that is, a time necessary to obtain a desired friction-reducing effect. The time necessary for cellulose fibers to spread over the whole surface of the friction-reducing portion 14 will be described later in the description of friction reducing mechanism. Therefore, the average of the number of cracks is preferably less than 400 per centimeter. Further, to restrict an increase in the surface roughness due to the cracks 15, the average of the number of cracks is more preferably 380 per centimeter or less, and even more preferably 370 per centimeter or less. If the average of the number of cracks becomes excessively small, however, the number of cracks 15 becomes insufficient to retain cellulose fibers, with the result that sufficient friction-reducing effect by the friction-reducing portion 14 may not be achieved. Therefore, the average of the number of cracks is preferably 250 per centimeter or more, and more preferably 300 per centimeter or more.

[0028] The following will describe the friction reducing mechanism by the friction-reducing portion 14.

[0029] According to the present embodiment, the sliding surface between the ring 11 and the traveler 12 is subjected to the sliding movement under no liquid lubrication condition. That is, no liquid lubricant is applied to the sliding surface for the sliding movement of the ring 11 and the traveler 12. In general, metal-tometal sliding contact without lubricant causes severe wear. Especially, the traveler 12 moves in circle on the ring 11 at high speed in the ring-traveler system, so that it is expected that wear rapidly progresses on the sliding surfaces between the ring 11 and the traveler 12 and seizure and severe wear occurs in a few minutes to a few hours. In actuality, however, the progress of the wear of the ring-traveler system is unexpectedly and considerably slow. In a cotton spinning machine, for example, the traveler is usually replaced with a new one at an interval of one to two weeks.
Therefore, it is thought that the sliding surface between the ring 11 and the traveler 12 are tribologically not under no-lubrication condition, but under boundary-lubrication condition. It is considered that the unexpectedly longer serviceable life of the traveler is due to the tribological boundary lubrication. Analysis by the inventors showed that a cellulose film was formed on the surface of the ring 11 on which the traveler 12 slides and such cellulose film provided the lubrication effect. For example, cellulose is included in cotton that is a material for the yarn Y. The cellulose in the film may be thought to be formed from fibers that are separated from a yarn passing through the traveler 12 during spinning operation and caught in a contact interface, that is, the sliding surface between the ring 11 and the traveler 12.

[0030] In the ring-traveler system of the present embodiment, a plurality of cracks 15 is formed in the sliding surface between the ring 11 and the traveler 12 on which the traveler 12 slides. Therefore, cellulose fibers having separated from yarn Y enter the sliding surface between the ring 11 and the traveler 12, and such fibers adhere to and retained by the cracks 15 of the sliding surface. A lubrication component (mainly, carbon) of the fibers spreads like a film. Consequently, cellulose fibers form a film on the sliding surfaces of the ring 11 and the traveler 12. Lubrication function of the film provides a friction-reducing effect. Therefore, even if liquid lubricant is not applied, friction generated on the sliding surface between the ring 11 and the traveler 12 may be reduced, and thus wear of the ring 11 and the traveler 12 is reduced.

[Present Embodiment]

[0031] For evaluation of the friction reducing effect of the friction-reducing portion 14, four different rings 11 having the cracks 15 formed under different conditions, respectively, are evaluated for the serviceable life of the parts. The evaluation results are shown in FIGS. 3 and 4.

[0032] Referring to FIG. 3, a conventional ring 11, the ring 11 according to the present disclosure, the ring 11 of the comparative example1, and the ring 11 of the comparative example 2 were evaluated, which are separately shown in the table. A surface of the conventional ring 11 was only plated with chromium. A surface of the ring 11 according to the present embodiment is plated with chromium, and then was processed by electrolytic etching under the condition where electric current = 2 A and an etching time = 120 sec. A surface of the ring 11 of the comparative example 1 was plated with chromium, and then was processed by electrolytic etching under the condition where electric current = 4 A and an etching time = 120 sec. A surface of the ring 11 of the comparative example 2 was plated with chromium, and then was processed by electrolytic etching under the condition where electric current = 4 A and an etching time = 240 sec.

[0033] FIG. 5 shows the plated surface of the conventional ring 11 observed with an electron microscope. FIG. 6 shows the plated surface of the ring 11 of the present embodiment observed with an electron microscope. FIG. 7 shows traveler wear debris on the ring 11 observed with an electron microscope. It is clear from the comparison between FIG. 5 and FIG. 6, the cracks on the plated surface of the conventional ring 11 are not clearly shown in FIG. 5, but the cracks on the plated surface of the ring 11 of the present embodiment, in contrast, are clearly shown in FIG. 6. It is thought that the reason is that dimensions of minute cracks formed by chromium plating on the surface of the chromium-plated layer 13 were increased in width and depth by electrolytic etching. Although the particle sizes of the wear debris generated on the sliding surface between the ring 11 and the traveler 12 are slightly varied, as shown in FIG. 7, the particle sizes of the wear debris tended to be similar to each other.

[0034] With regard to the average crack width, the conventional ring 11 has the average crack width of less than 0.5 μm, the ring 11 of the present embodiment has the average crack width of 0.74 μm, the ring 11 of the comparative example 1 has the average crack width of 1.07 μm, and the ring 11 of the comparative example 2 has the average crack width of 2.01 μm due to the above-described differences in the conditions for forming the cracks. With regard to the standard deviations of the crack width, the ring 11 of the present embodiment has the standard deviation of 0.26 μm, the ring 11 of the comparative example 1 has the standard deviation of 0.42 μm, and the ring 11 of the comparative example 2 has the standard deviation of 0.83 μm. With regard to the average values of the number of cracks, the conventional ring 11 has 151.5 per centimeter, the ring 11 of the present embodiment has 356.5 per centimeter, the ring 11 of the comparative example 1 has 573.8 per centimeter, and the ring 11 of the comparative example 2 has 896.9 per centimeter. With regard to the standard deviation of the number of cracks, the conventional ring 11 has the standard deviation of 51.0 per centimeter, the ring 11 of the present embodiment has the standard deviation of 56.0 per centimeter, the ring 11 of the comparative example 1 has the standard deviation of 139.0 cracks per centimeter, and the ring 11 of the comparative example has the standard deviation of 127.2 per centimeter.

[0035] The serviceable life of the parts is evaluated based on the sliding distances of the traveler 12 that moves in circle on the rings 11 in contact therewith with the rotation speed of the spindle, which determines the rotation speed of the bobbin, at 20000 rpm. The sliding distance corresponds to the distance of the traveler 12 from the start of its use until the traveler 12 comes off from the flange 11 due to wear are evaluated. As a result, with regard to the serviceable life of the parts, the sliding distance of the traveler 12 with the conventional ring 11, the sliding distance of the traveler 12 with the ring 11 of the present embodiment, the sliding distance of the traveler 12 with the ring 11 of the comparative example 1, and the sliding distance of the traveler 12 with the ring 11 of the comparative example 2 are determined to be 1890 km, 7091 km or more, 7091 km or more, and 3072 km, respectively. It is to be noted that the sliding distances of traveler 12 with the ring 11 of the present embodiment and with the ring 11 of the comparative example 1 are both 7091 km or more because the evaluation test was discontinued when slide distances of the travelers reached 7091 km.

[0036] As is obvious from the above evaluation results, the serviceable lives of the parts of the present embodiment and the comparative example are three times or more as long as the serviceable lives of the parts with the conventional ring 11. In the comparative example 1, however, the average of the number of cracks is relatively large, 573.8 per centimeter. As a result, the surface roughness of the friction-reducing portion 14 of the comparative example 1 increases, so that a running-in time increases.

[0037] In FIG. 4, the vertical axis and the horizontal axis represent the sliding resistance (gf) and the sliding distance of the traveler (km), respectively. FIG. 4 shows changes in the sliding resistance relative to the sliding distance of the traveler 12 with the conventional ring 11, with the ring 11 of the present embodiment, with the ring 11 of the comparative example 1, and with the ring 11 of the comparative example 2. The slide resistance was determined by measuring, with a load cell, a drag torque applied from the traveler 12 to the ring 11 with the ring 11 rotatably supported. As a result, according to the conventional ring 11, the slide resistance suddenly starts rising when the slide distance exceeds 1000 km and the serviceable life ends. According to the ring 11 of the comparative example 2, the slide resistance suddenly starts rising when the slide distance exceeds 2000 km, and the serviceable life of the parts ends.

[0038] According to the ring 11 of the present embodiment, on the other hand, the slide resistance does not start rising even after the slide distance exceeds 2000 km, and such tendency is maintained even after the slide distance exceeds 7000 km. According to the ring 11 of the comparative example 1, the evaluation result of the serviceable life is similar to that of the present embodiment, through the variation in the sliding resistance is greater than that of the present embodiment. However, the initial slide resistance of the present embodiments is smaller than that of the comparative example 1. It is inferred that the reason is that the average of the number of cracks in the present embodiment is smaller than that in the comparative example 1 and thus an increase in the surface roughness of the friction-reducing portion 14 of present embodiment is restricted, as compared with the comparative example 1.

[Effects of Embodiment]

[0039] The present embodiment offers the following effects.

[0040] According to the present embodiment, the plurality of cracks 15 formed on the sliding surface between the ring 11 and the traveler 12 having the average crack width of 0.6 μm or more and 1.5 μm or less. Thus, wear debris generated on the sliding surface between the ring 11 and the traveler 12 smoothly falls into the cracks 15, and it takes a long time for wear debris to fill the cracks 15. This permits improving the friction-reducing effect of the friction-reducing portion 14, and maintaining an excellent friction-reducing effect for a long time. Further, according to the present embodiment, the average of the number of cracks of less than 400 per centimeter is formed in the friction-reducing portion 14. This permits reducing the initial slide resistance by restricting an increase in the surface roughness of the friction-reducing portion 14, and reducing the time necessary for cellulose fibers to spread over the entire surface of the friction-reducing portion 14. Accordingly, the ring-traveler system of the present embodiment achieves long serviceable life of its parts and the reduction in the running-in time at the same time.

[Modifications]

[0041] The technical scope of the present disclosure is not limited to the above embodiment, but is intended to include various variation and modifications, all falling within the scope of the claims.

[0042] Although the chromium-plated layer 13 covers the flange 11a of the ring 11 in the above embodiment, the chromium-plated layer 13 may be formed so as to cover the entire surface of the ring 11 including the flange 11a.

[0043] Although the ring 11 is plated with chromium to form a chromium-plated layer 13, and then the chromium-plated layer 13 is processed by electrolytic etching in the above embodiment, the etching method need not be necessarily limited to the electrolytic etching. For example, chemical etching may be applied instead of electrolytic etching.

[0044] Although the friction-reducing portion 14 is formed on the ring 11 in the above embodiment, the friction-reducing portion 14 may be formed on the traveler 12. Further, the friction-reducing portion 14 may be formed on both the ring 11 and the traveler 12.

[0045] The material used for spinning yarn is not limited to cotton, but may be hemp, silk, wool and chemical fiber (nitrocellulose, nylon, or vinylon) and the like.

[0046] The flange 11A of the ring 11 of the ring-traveler system need not be T-shaped in cross-section. For example, the flange 11A may be formed inclined in cross-section, as shown in Fig. 4. In this case, the traveler 12 should be formed so as to match the inclined flange 11A.

Claims

1. A ring-traveler system for a ring-type spinning machine in which liquid lubricant is not applied for sliding movement, the ring-traveler system comprising:

   a plurality of cracks (15) formed in a sliding surface (14) between a ring (11) and a traveler (12), wherein an average of the number of cracks is less than 400 per centimeter,
   characterized in that
   the plurality of cracks (15) has an average crack width of 0.6 μm or greater and 1.5 μm or less.

2. The ring-traveler system for a ring-type spinning machine according to claim 1, **characterized in that** the plurality of cracks (15) has the average crack width of 0.7 μm or greater.

3. The ring-traveler system for a ring-type spinning machine according to claim 1 or 2, **characterized in that** the average of the number of cracks is 380 per centimeter or less.

Patentansprüche

1. Ring-Läufer-System für eine Spinnmaschine der Ringbauart, bei der ein flüssiges Schmiermittel für eine Gleitbewegung nicht aufgebracht wird, wobei das Ring-Läufer-System Folgendes aufweist:

   eine Vielzahl von Rissen (15), die in einer Gleitfläche (14) zwischen einem Ring (11) und einem

Läufer (12) ausgebildet sind,
wobei ein Durchschnitt der Anzahl von Rissen weniger als 400 pro Zentimeter ist,
dadurch gekennzeichnet, dass
die Vielzahl von Rissen (15) eine durchschnittliche Rissbreite von 0,6 μm oder größer und 1,5 μm oder weniger hat.

2. Ring-Läufer-System für eine Spinnmaschine der Ringbauart gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Vielzahl von Rissen (15) die durchschnittliche Rissbreite von 0,7 μm oder größer hat.

3. Ring-Läufer-System für eine Spinnmaschine der Ringbauart gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der Durchschnitt der Anzahl von Rissen 380 pro Zentimeter oder weniger ist.

Revendications

1. Système anneau-curseur pour un métier à filer à anneaux, dans lequel du lubrifiant liquide n'est pas appliqué pour le mouvement de coulissement, le système anneau-curseur comprenant :

    une pluralité de défauts de peigne (15) formés dans une surface de coulissement (14) entre un anneau (11) et un curseur (12),
    dans lequel une moyenne du nombre de défauts de peigne est inférieure à 400 par centimètre,
    caractérisé en ce que :
    la pluralité de défauts de peigne (15) a une largeur de défaut de peigne moyenne de 0,6 μm ou plus et de 1,5 μm ou moins.

2. Système anneau-curseur pour un métier à filer à anneaux selon la revendication 1, **caractérisé en ce que** la pluralité de défauts de peigne (15) a la largeur de défaut de peigne moyenne de 0,7 μm ou plus.

3. Système anneau-curseur pour un métier à filer à anneaux selon la revendication 1 ou 2, **caractérisé en ce que** la moyenne du nombre de défauts de peigne est de 380 par centimètre ou moins.

FIG. 1A

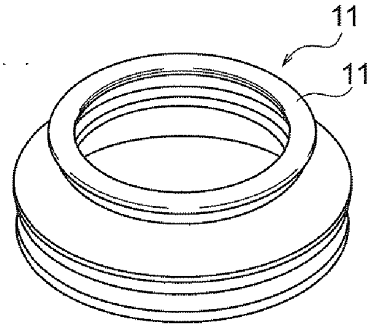


FIG. 1B

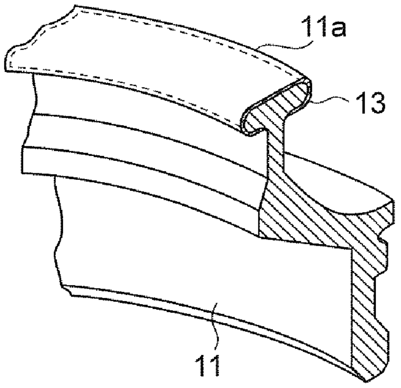


FIG. 1C

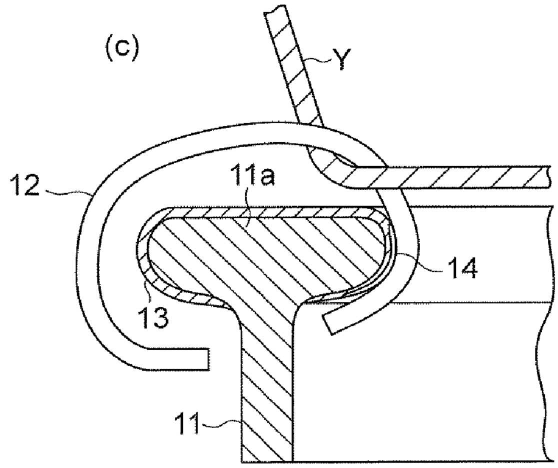


FIG. 2

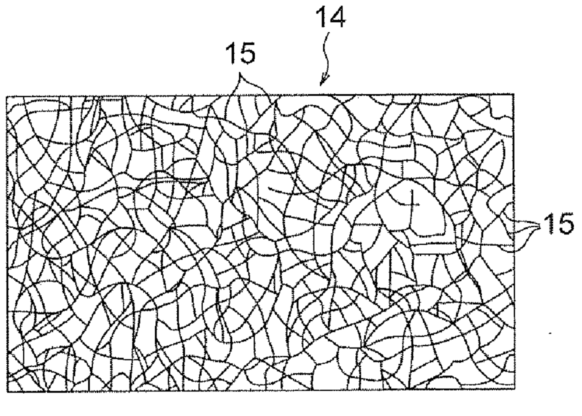


FIG. 3

		CONVENTIONAL EXAMPLE	PRESENT EMBODIMENT	COMPARATIVE EXAMPLE 1	COMPARATIVE EXAMPLE 2
CRACK WIDTH [μm]	AVERAGE	<<0.5	0.74	1.07	2.01
	STANDARD DEVIATION	-	0.26	0.42	0.83
NUMBER OF CRACKS [per centimeter]	AVERAGE	151.5	356.5	573.8	896.9
	STANDARD DEVIATION	51.0	56.0	139.0	127.2
ETCHING CONDITION	CURRENT [A]	0	2	4	4
	TIME [sec]	0	120	120	240
SERVICEABLE LIFE		1890 km	7091 km or greater	7091 km or greater	3072 km

FIG. 4

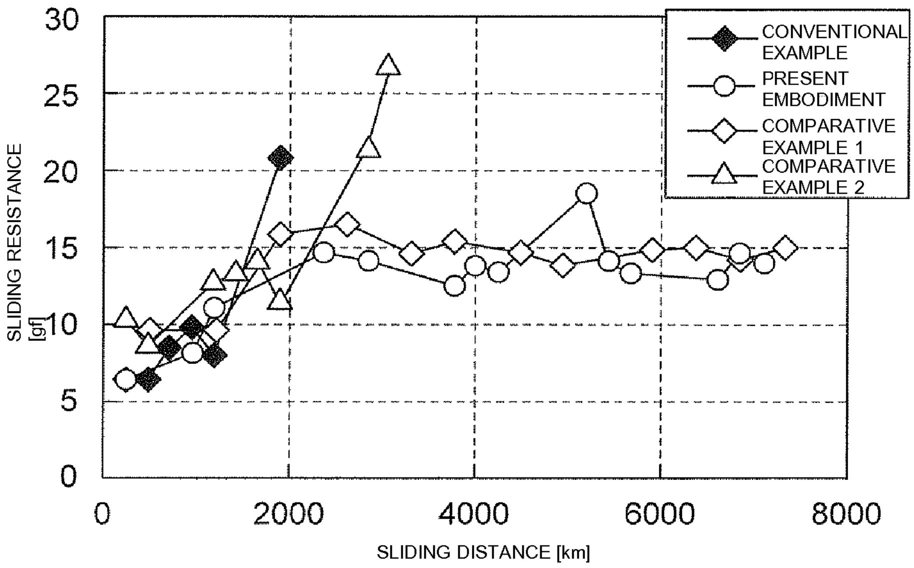


FIG. 5

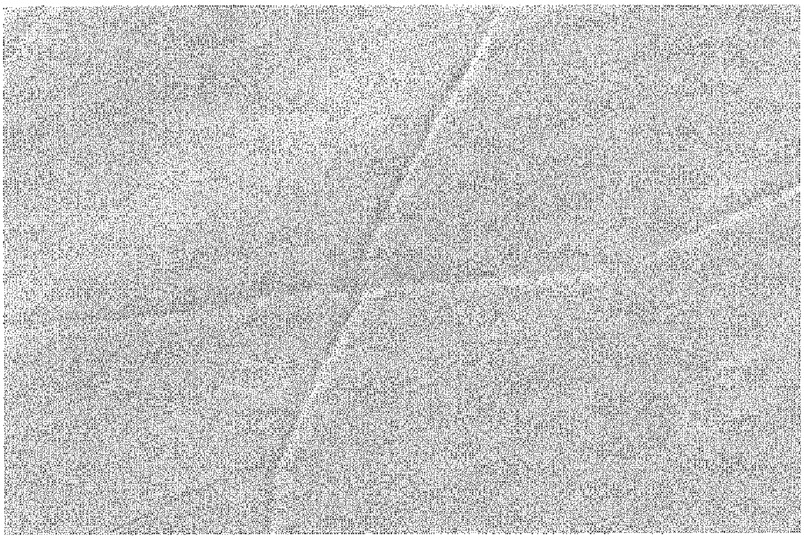


FIG. 6

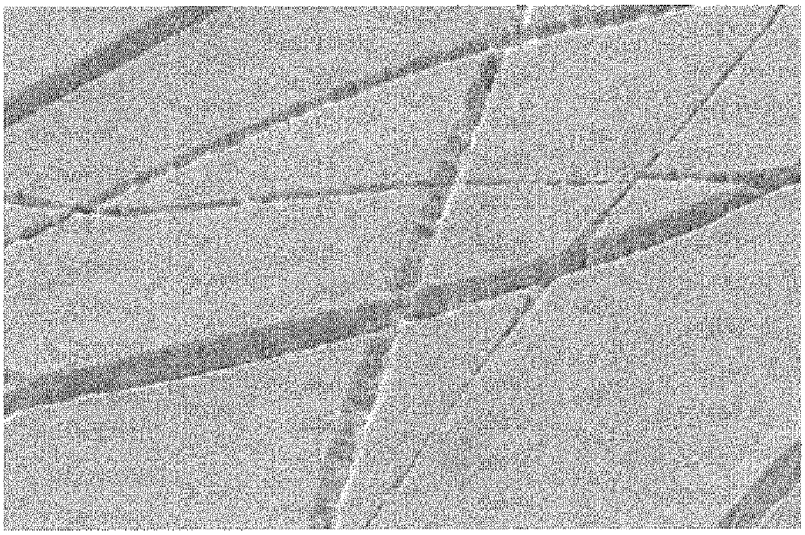
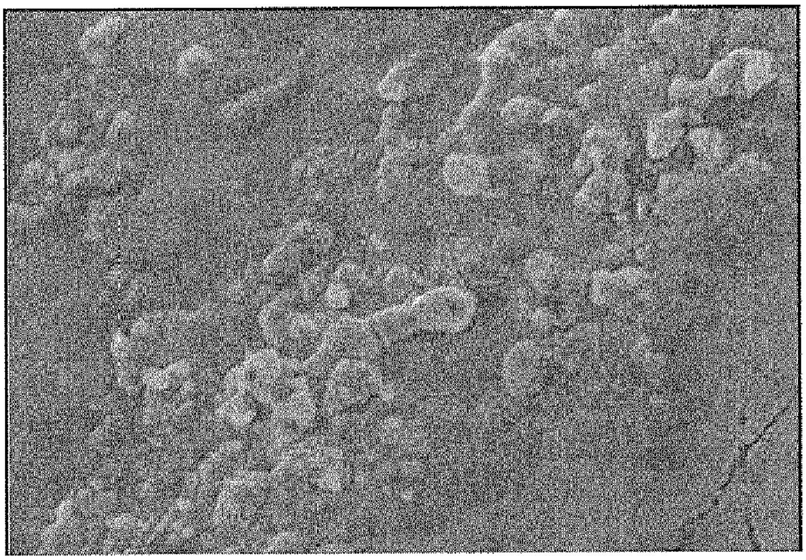


FIG. 7



REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 2014029046 A **[0003]**
- US 6360520 B2 **[0005]**