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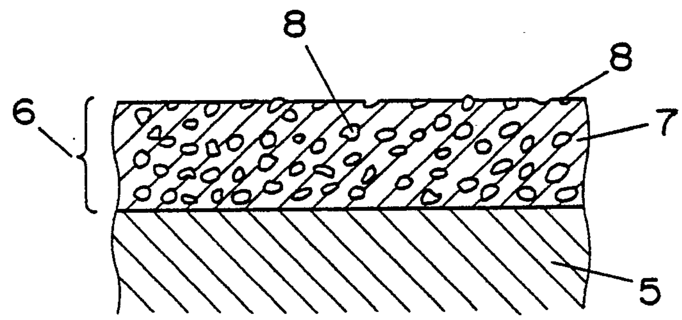
(54) **Ring for spinning machineries.**

(57) A ring (1) for use in spinning machineries such as ring spinning machines and twisting machines, makes it possible to use at a high spindle revolutionary speed of 20,000 r.p.m. The ring comprising a ring flange (5), a neck part (4), a collar (3) and a trunk part (2) having ring fitting part is provided at the surface of the slide contact part of at least the ring traveller with a composite plated layer (6) of nickel and phosphorous alloy (7) containing hard fine grains (8). The ring is further treated with heating and polishing processes to increase hardness and smoothness of the surface thereby to improve anti-wearing properties and heat-proof properties.

Fig. 2



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Ring for spinning machineries

The present invention relates to a ring for spinning machineries, used in the fine spinning of spinning work, and exhibiting excellent characteristics especially in high speed fine spinning.

Heretofore, low carbon steel is used in a ring for spinning machinery, and carburizing hardening treatment is applied thereon as a case hardening treatment. However, in the above-described ring, when the spindle of a fine spinning machine is used at high speed revolution of 20,000 r.p.m. or more, there has been such a problem that the friction resistance between the ring and the traveller increases, and the frictional heat rapidly increases to bring about the baking and blow off the traveller in an early period, to make continuous operation impossible.

In order to solve the above-described problems, such a ring in which a composite plated layer is formed with hard fine grains co-separated on the surface of the flange (such as, for example, in the USP 46 98 958) has been considered. However, when thickness of the plated layer of the composite plated layer is increased, surface roughness of the plated surface becomes coarse, and there is such a problem that a sufficient effect cannot be obtained.

The object of the present invention is to improve the anti-wearing properties of the ring and its baking resistance against the traveller, by crystallizing the nickel alloy plated on the ring surface as the matrix of the composite plated layer. According to this invention, plated layer hardness is tremendously enhanced and, at the same time, the adhering force of hard fine grains to the nickel alloy as the matrix is strengthened.

Furthermore, another object of the present invention is to improve the sliding properties of the traveller by exposing hard fine grains 5 to 40 % in an area percentage on the surface of the ring which the traveller contacts to and and slides on, and by making the surface roughness less than Ra 0.2 µm.

In order to attain the above-described object, the present inventors have carried out researches in connection with plating and surface finishing to be applied to the ring surface. As a result, the present invention has been achieved.

Fig. 1 is a partly broken sectional diagram showing an embodiment of the ring for use in a spinning machine according to the present invention.

Fig. 2 is the enlarged view diagram for the essential part of the ring for use in a spinning machine according to the present invention.

Fig. 3 is a curve showing the relationship between the heat treatment temperature and the hardness of the nickelphosphorous alloy coated layer.

Fig. 4a is a curve showing the surface roughness of the composite plated layer after the polishing process.

Fig. 4b is a curve showing the surface roughness of the composite plated layer after the polishing process.

Fig. 5a is an explanatory diagram showing the surface state of the composite plated layer before the polishing process, and Fig. 5b is an explanatory diagram showing the surface state after the polishing process.

Fig. 6 is a curve showing the relationship between the spindle revolution number and the index of the wear resistance, and

Fig. 7 is a curve showing the relationship between the distance from the surface of the ring according to the present invention and the Vickers hardness thereof.

In the following, explanation will be given on embodiments of the present invention with reference to the drawings.

A steel material (S15 CK) of cylindrical shape was cut and processed to form a ring 1 (Fig. 1), and the ring was subjected to carburizing hardening and surface treatment.

The above-described ring had such a structure that it had a collar 3 on the external circumferential surface of the cylindrically shaped trunk part, and further, had a ring flange 5 on which the ring traveller slides, at the top of the ring neck part 4.

The above-described ring 1 was, after being subjected to the pre-treatment of the plating such as degreasing and acid cleaning on at least the surface of the ring flange 5, was covered by forming a composite plated layer 6 dispersed and separated with silicon carbide as a co-separating substance in the matrix of a nickel-phosphorous alloy 7. (Fig. 2)

The composite plated layer 6 was formed by electroless plating with the dispersion of the silicon carbide 8 of a particle size of 1 µm as hard fine grains in such an amount that its content becomes approximately 4 % by weight, in the matrix of the nickel-phosphorous alloy 7.

The ring 1 on which the composite plated layer 6 was formed was subjected to heat treatment in a heat treating furnace at the heat treating temperature of 400 °C for about 1 hour to crystallize the nickel-phosphorous of the matrix. Due to this crystallization, the composite plated layer could obtain the high hardness of HV 1000. Moreover, the closely adhering properties of the co-separating substance, silicon carbide, to the matrix was strengthened.

The ring flange 5 to which the ring traveller of the ring 1 subjected to heat treatment contacts and slides was formed by subjecting it to the polish processing by use of lapping to be formed to have the thickness of the composite plated layer of 30 µm. By carrying out polish processing, hard fine grains were exposed on the surface of the ring flange 5, and the flange was finished to become a smooth surface with the surface roughness off less than 0.2 µm.

By carrying out the polishing process in such a manner as described above, a part of the hard fine grains was polished, or was dropped off to let the surface of the ring become smooth.

In Figs. 4a and 4b shown are the data of the surface roughness before and after the polishing process. Also, in Fig. 5a, the surface state of the ring flange 5 before the polishing process is shown, and in Fig. 5b, the surface state of the ring flange after the polishing process is shown. The most outside surface of the composite plated layer 6 shows the co-existance state of the hard fine particles of the silicon carbide 8 exposed in the matrix, nickel-phosphorous alloy 7.

The most preferable substance as the hard fine particles which is co-separated in the composite plated layer 6, is silicon carbide 8 having high hardness, large anti-chemical properties and anti-wearing properties, and good thermal conductivity. The ring 1 on which the above-described composite plated layer 6 is formed has such an advantage that it easily radiates the friction heat gererated in the time when the ring traveller runs on the ring flange, and elongates the life of the traveller.

Although silicon carbide has been used as the hard fine particles, at least one kind or two or more kinds of tungsten carbide, boron nitride, or aluminium oxide can be also used. Also, the particle diameter of the hard fine particles is preferably in the range of 0.2 µm to 3 µm, and when it is less than 0.2 µm, the anti-wearing properties of the ring are inferior, and when it exceeds 3 µm, hard fine particles drop out from the composite plated layer, and the radiation of the friction heat becomes bad, to shorten the life of the traveller, and together with that, to lower the anti-wearing properties of the ring remarkably.

The content percentage of the hard fine particles included in the matrix of the composite plated layer is 2 to 15 % by weight. When the content percentage is less than 2 %, the anti-wearing property of the ring is inferior, and when it exceeds 15 %, the rate of occupation of the hard fine particles on the surface of the composite plated layer becomes large, and the sliding properties of the ring traveller deteriorates resulting in early traveller baking early, and the frequent yarn cut. The area percentage of the particles in the surface and in the cross section of the ring flange is observed to be 5 to 40 % preferably 10 to 30 %. The area percentage of the silicon carbide described in the above-described embodiment was 19.5 % in the cross section, and 25.6 % in the surface. When the area percentage of the silicon carbide is less than 5 %, the anti-wearing property of the ring deteriorates, and when it exceeds 40 % the sliding property of the ring traveller deteriorates to cause the baking of the traveller at an early time and frequent yarn cuttings.

Although the thickness of the composite plated layer 6 was taken as 30 µm, the thickness of 5 to 35 µm is preferable, and when it is less than 5 µm, the anti-wearing properties at the spindle revolution of more than 20,000 r.p.m. deteriorate , and when it exceeds 35 µm, the treating time of the composite plating becomes extremely long to make the production cost of the ring high.

It is more desirable that the thickness of the composite plated layer is taken as 16 to 35 µm, since the life in the high speed spinning can be prolonged.

The heat treatment conditions of the ring 1 formed with the composite plated layer 6 were such that the heat treatment time at the heat treatment temperature of 400 °C was about 1 hour, but the heat treatment may be effected at the heat treatment temperature of 320 to 420 °C and for the heat treatment time of about 1 to 2 hours.

By effecting heat treatment under the above-described heat treating conditions, high hardness of the coated layer hardness of Hv 900 to 1200 could be obtained and moreover, could obtain the mother material hardness of Hv 500 to 550 from the surface of the ring to the depth of about 0.3 mm, and the anti-wearing properties of the ring could be improved (Figs. 3 and 7).

The hardness of the mother material immediately below the composite plated layer is preferably at Hv 500 to 650.

The suface of the ring on which the ring traveller contacts and slides was polish processed to make the surface roughness of the surface of the ring becomes less than Ra 0.2 µm. When the surface roughness of the composite plating exceeds 0.2 µm in Ra, the running of the ring traveller is disturbed, and high speed operation becomes unable to be carried out. As described above, by making the surface roughness be less than Ra 0.2 µm, not only the running of the ring traveller was made smooth, but also the friction resistance of the ring traveller in the high speed revolution zone of the spindle revolution was reduced, since it made the hard fine particles having high hardness and excellent anti-wearing properties be exposed on the most external surface of the composite plated layer to form the coexistence state with the matrix.

For the nickel alloy to be used as the matrix, nickel-phosphorous alloy, nickel-tungsten-phosphorous alloy, and the like are used.

Comparative test was carried out by using the ring (A) for spinning machine of the present invention, the ring (B) for spinning machine obtained by effecting case hardening carburizing hardening to the conventional low carbon steel, and the conventional ring (C) which was subjected to the above described composite plating and having the surface roughness of Ra 0.4 µm.

Test conditions:

Yarn: ester/cotton 45's

Ring: 3.2 mm F 41 mmϕ x 57.5 mmϕ

Ring traveller: YS-2/hf 11/10 (nickel plated material)

Spindle revolution number: 16,000 to 30,000 r.p.m.

In Fig. 6 are shown the friction resistance indices of the ring traveller and the ring at the revolution number of each spindle under the above-described spinning conditions.

Up to the spindle revolution of 16,000 to 18,000 r.p.m., there is no large difference between the ring (A) of the present invention and the conventional rings (B) and (C), and no remarkable difference could be perceived in the friction resistance indices also.

When the spindle revolution number exceeded 18,000 r.p.m., the friction resistance indices rose remarkably in the conventional ring (B), but in the ring of the present invention, there was perceived no abrupt rise, and the rise was slow. Further, when the revolution of the conventional ring (B) becomes more than 22,000 r.p.m., the friction resistance indices rapidly rise, and when it is more than 24,000 r.p.m., the baking and wear of the ring traveller proceeds to make the continuous spinning impossible. Also, in the conventional ring (C), frictional indices rapidly rise at the high speed revolution zone of more than 24,000 r.p.m. to increase the number of yarn cut remarkably. In the ring (A) of the present invention, even in the high speed revolution zone of the spindle revolution of 24,000 to 30,000 r.p.m., no rapid rise of the index was seen, and a stabilized low friction resistance indices were shown, and the wear of the ring traveller were almost not generated, and continuous spinning could be carried out (Fig. 6).

In the present invention, a composite plated layer is formed by making hard fine particles as a co-separating substance and the nickel-phosphorous containing nickel alloy as a matrix, and the hardness of the matrix is made be Hv 900 to 1200, and hard fine particles are exposed on the surface thereof, and the surface roughness is made be less than Ra 0.2 µm, so that the ring traveller shows good fit even in the super high speed revolution zone of the spindle revolution of more than 24,000 r.p.m., and stabilized continuous operation can be carried out. Moreover the baking of the ring traveller is prolonged.

Since hard fine particles are exposed on the contact surface to the ring traveller in such an amount that it becomes 5 to 40 % in area percentage, the anti-wearing properties of the ring is improved, and the life of the ring is prolonged.

By carrying out the plating pretreatment sufficiently, and by effecting heat treatment after the plating treatment, the peel out of the composite plated layer does not occur, and the performance of the ring can be maintained for a long period.

Further, since the hardness of the ring mother material immediately below the composite plated layer is made as Hv 500 to 650, there is such excellent effects that the wear amount of the ring is little, the life of the ring is prolonged, and the like.

Claims

1. A ring for use in a spinning machinery in which hard fine particles are provided as a co-separating substance on the surface of a flange contacting to a traveller, and a composite plated layer having, as a matrix, a nickel alloy containing nickel and phosphorous, wherein hardness of the matrix of the composite plating is set at Hv 900 to 1200 by heat treatment, hard fine particles are exposed on the surface contacting to the traveller in an area percentage of 5 to 40 % by polishing process, and roughness of the surface is less than 0.2 µm in the center line mean roughness (Ra).

2. A ring for use in a spinning machinery as claimed in claim 1, wherein said hard fine particles comprise at least one kind of the materials of silicon carbide, tungsten carbide, boron nitride, and aluminium oxide.

3. A ring for use in a spinning machinery as claimed in claim 1, wherein content ratio of the hard fine particles in said composite plating is 2 to 15 % by weight.

4. A ring for use in a spinning machinery as claimed in claim 1, wherein thickness of said composite plated layer is 5 to 35 µm.

5. a ring for use in a spinning machinery as claimed in claim 1, wherein hardness of the ring mother material right beneath said composite plated layer is formed to be Hv 500 to 650.

Fig. 1

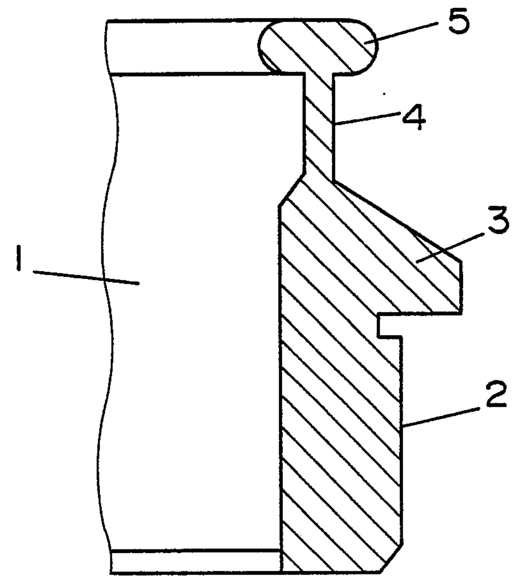


Fig. 2

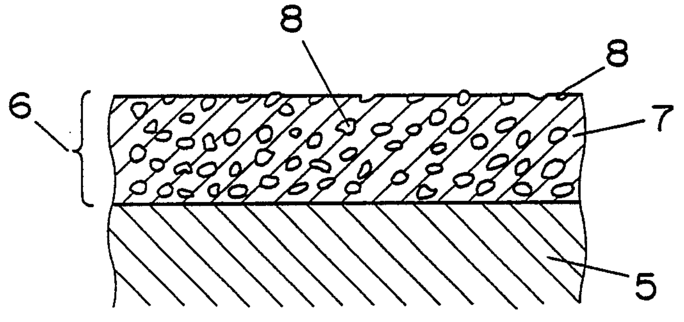


Fig. 3

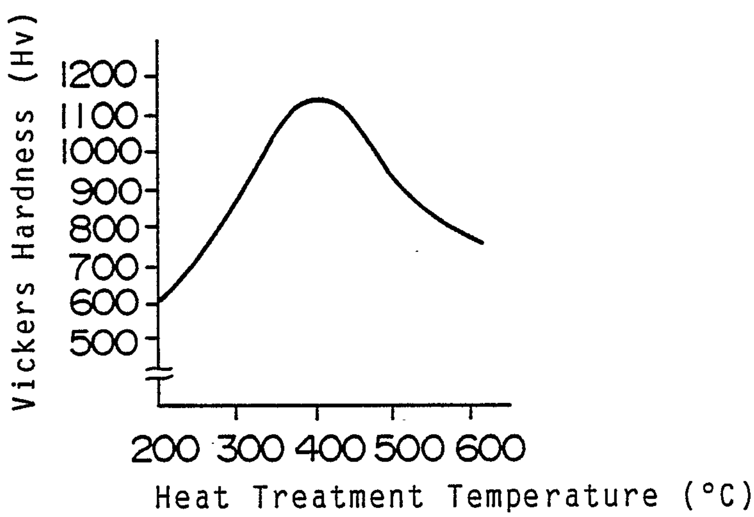


Fig. 4A Surface Roughness before Polish Processing

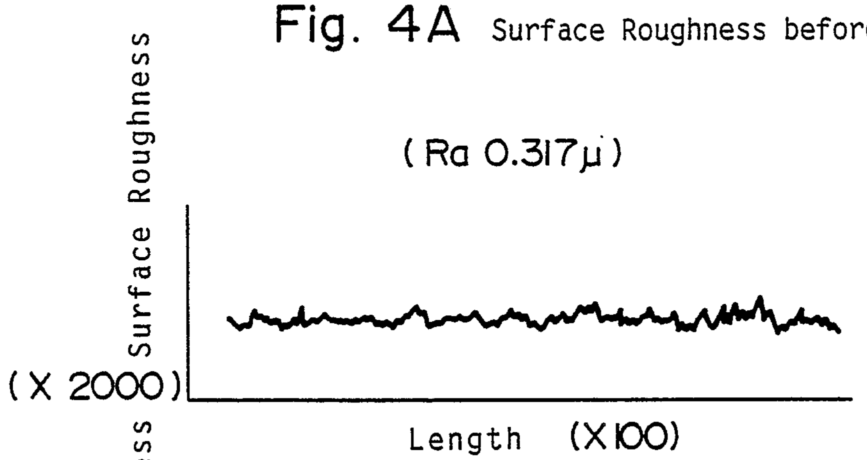


Fig. 4B Surface Roughness after Polish Processing

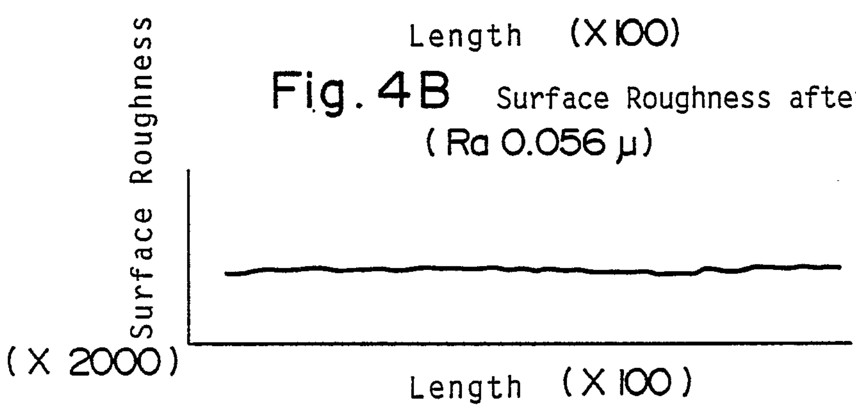


Fig. 5A

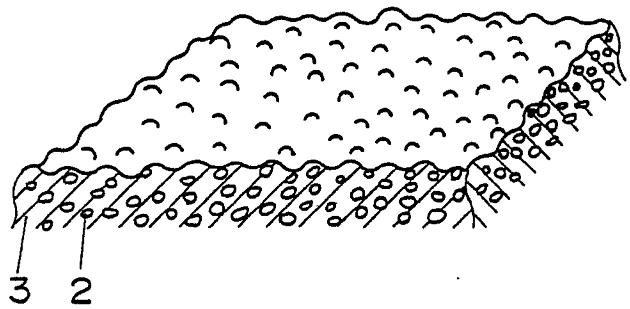


Fig. 5B

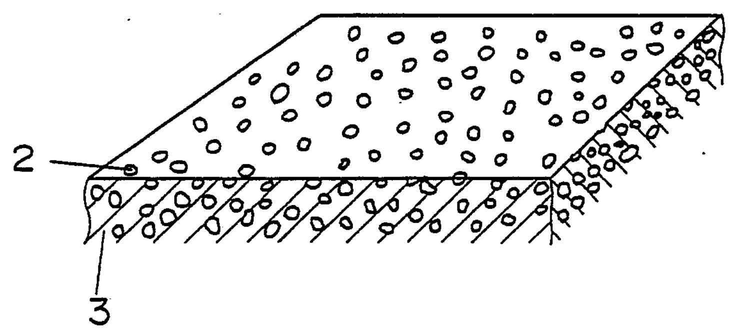


Fig. 6

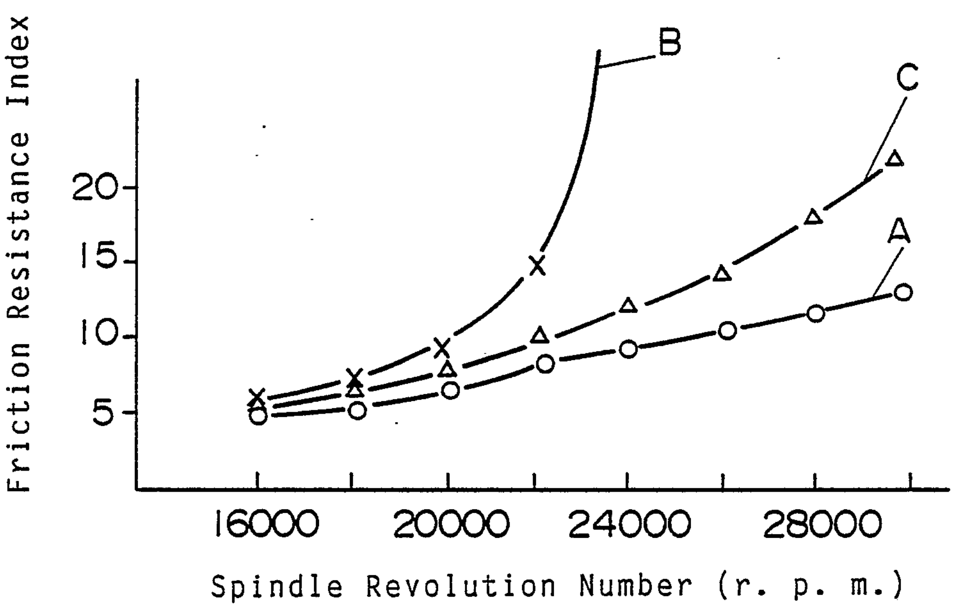
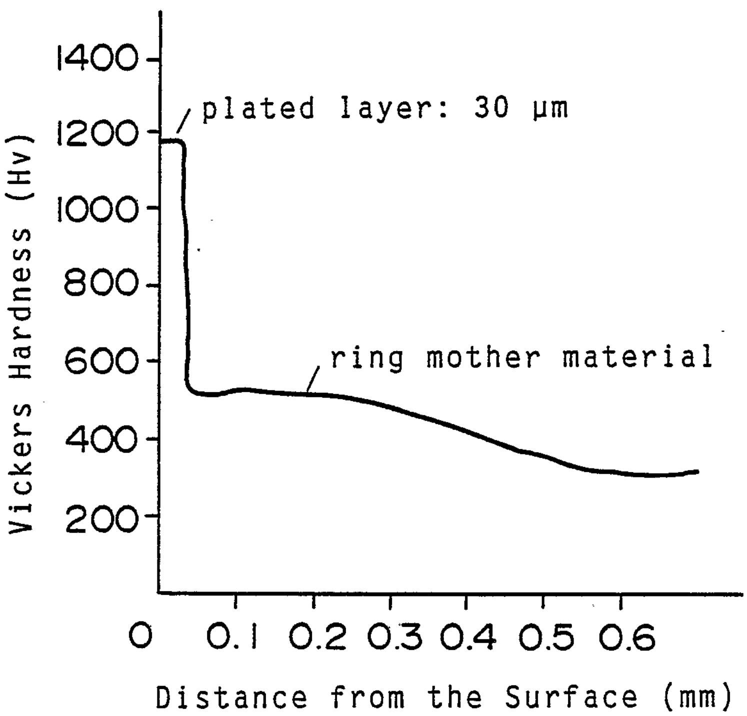


Fig. 7


1400
1200
1000
800
600
400
200
Vickers Hardness (Hv)
plated layer: 30 μm
ring mother material
0
0.1
0.2
0.3
0.4
0.5
0.6
Distance from the Surface (mm)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 11 1339

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	PATENT ABSTRACTS OF JAPAN vol. 11, no. 89 (C-411)(2536) 19 March 1987, & JP-A-61 245320 (HIROYUKI KANAI) * see the whole document * ---	1-5	D01H7/60
Y	PATENT ABSTRACTS OF JAPAN vol. 12, no. 5 (C-467)(2852) 08 January 1988, & JP-A-62 161995 (HIROYUKI KANAI) * see the whole document * ---	1-5	
Y,D	US-A-4698958 (Y.NAKANO ET.AL.) * claim 1 * ---	1-5	
A	DE-A-3026210 (HOLLINGWORTH GMBH) * page 4, line 4 - page 5, line 2 * -----	1-5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			D01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04 SEPTEMBER 1989	HOEFER W.D.

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CATEGORY OF CITED DOCUMENTS

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