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(54) **BRUSH ROLL**

(76) Inventor: **Setsuo Hotani**, Kaiso-gun (JP)

Correspondence Address:
WENDEROTH, LIND & PONACK, L.L.P.
2033 K STREET N. W.
SUITE 800
WASHINGTON, DC 20006-1021 (US)

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(57) **ABSTRACT**

A brush roll comprising a roll shaft; first brush filling material comprising either of a single yarn of a filament having a diameter of 0.1-2.0 mm and a collective fiber comprising 3-56 filaments made into a bundle; and second brush filling material comprising 100-3,000 filaments having a diameter of 0.005-0.05 mm made into a bundle, the first brush filling material and the second brush filling material being so arranged around an outside surface of the roll shaft that they can be distributed in such a relation as to be mixed with each other.

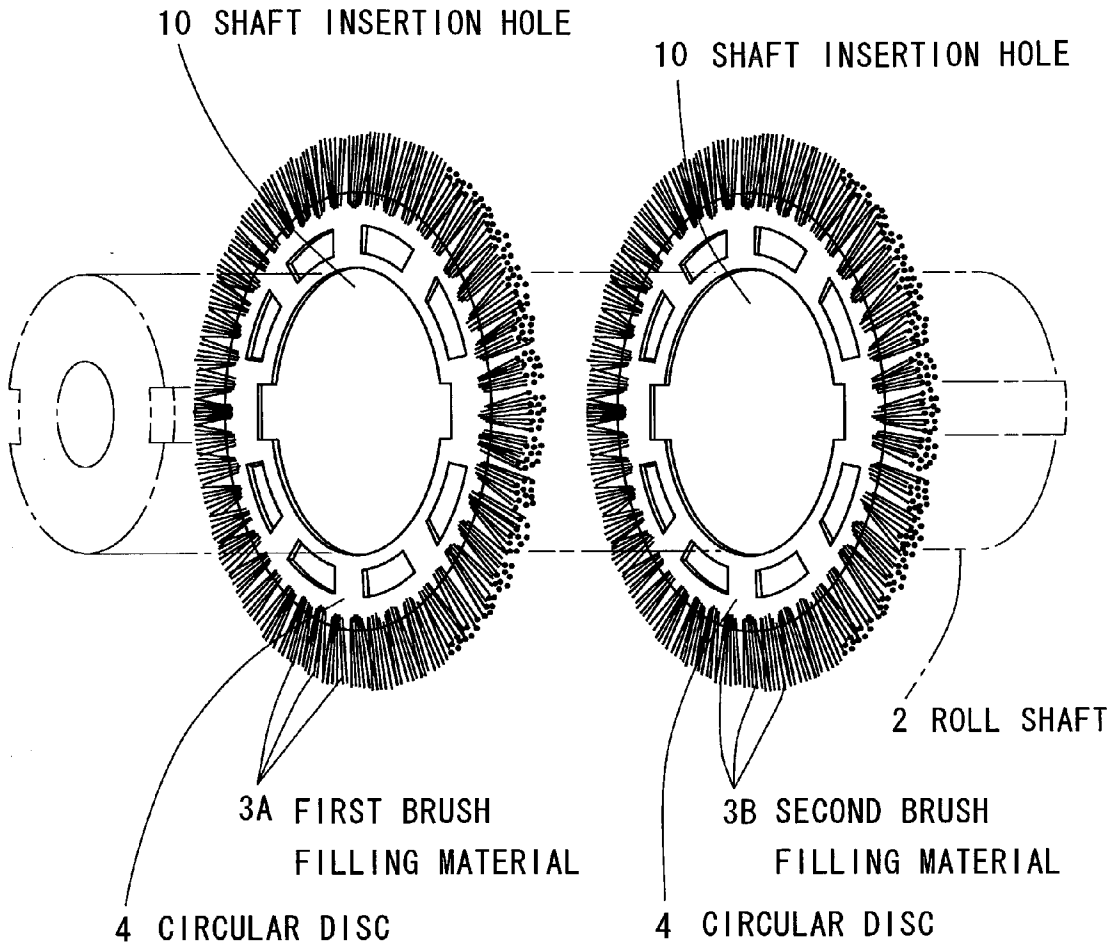


Fig. 1

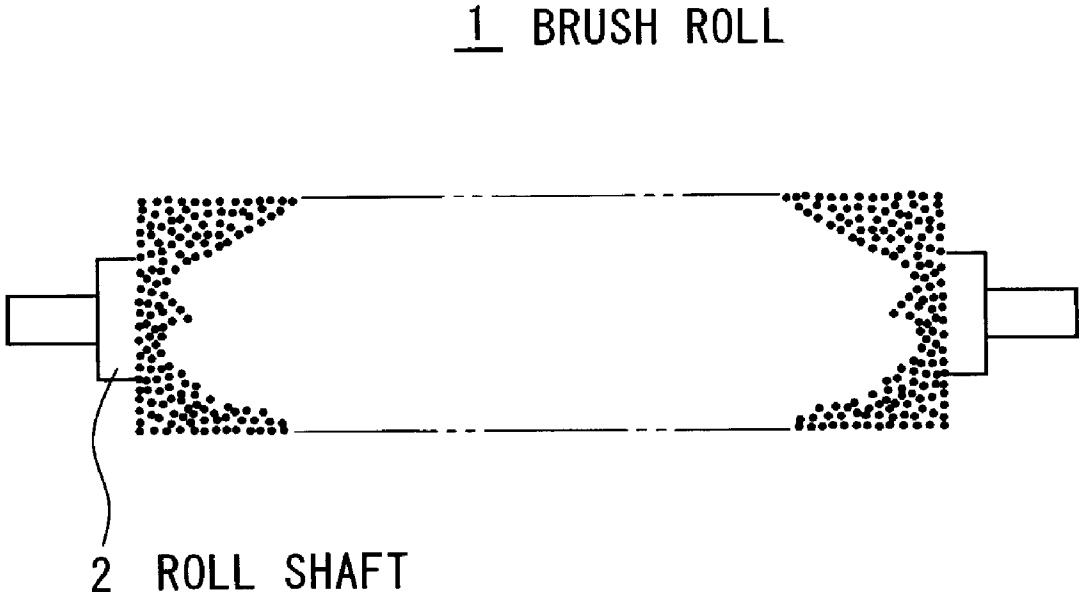


Fig. 2 (A)

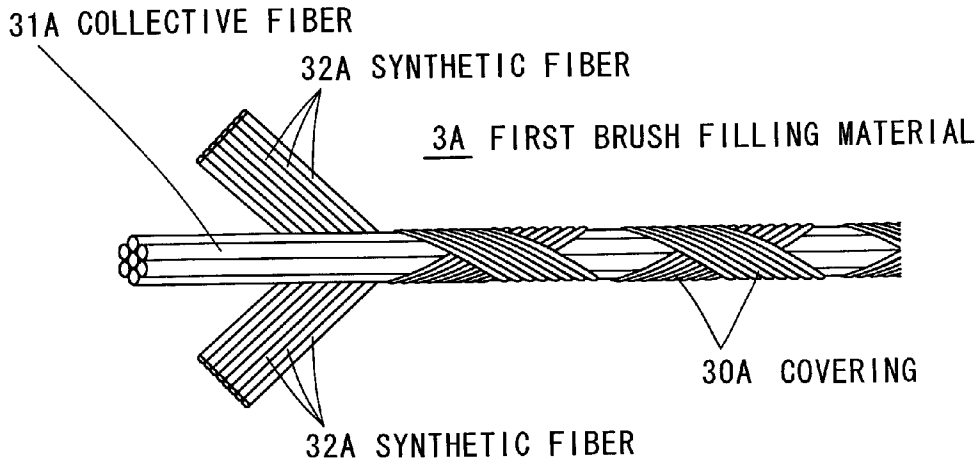

31A COLLECTIVE FIBER
32A SYNTHETIC FIBER
3A FIRST BRUSH FILLING MATERIAL
30A COVERING
32A SYNTHETIC FIBER

Fig. 2 (B)

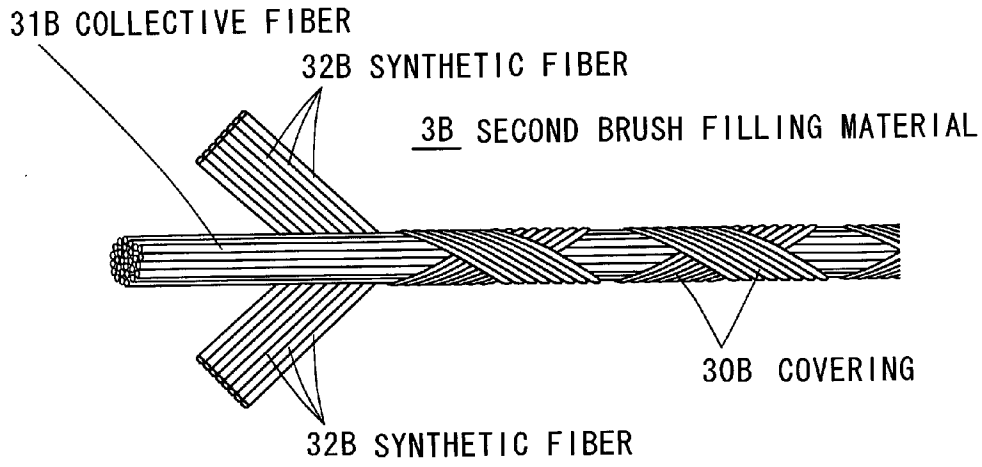

31B COLLECTIVE FIBER
32B SYNTHETIC FIBER
3B SECOND BRUSH FILLING MATERIAL
30B COVERING
32B SYNTHETIC FIBER

Fig. 3 (A)

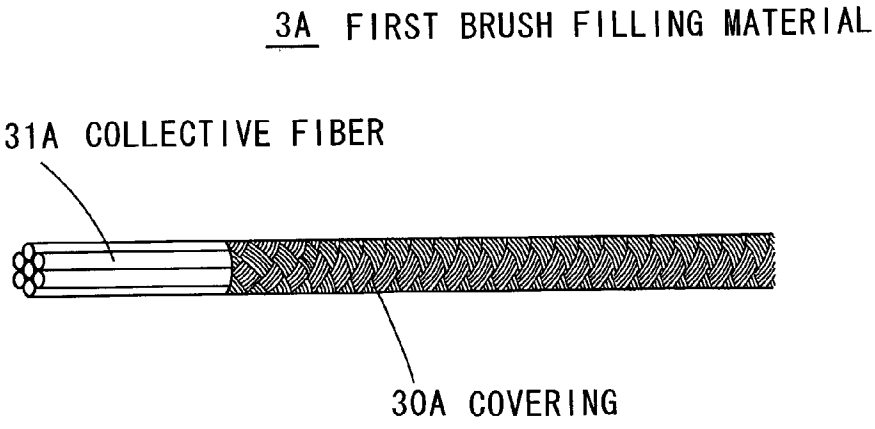

3A FIRST BRUSH FILLING MATERIAL
31A COLLECTIVE FIBER
30A COVERING

Fig. 3 (B)

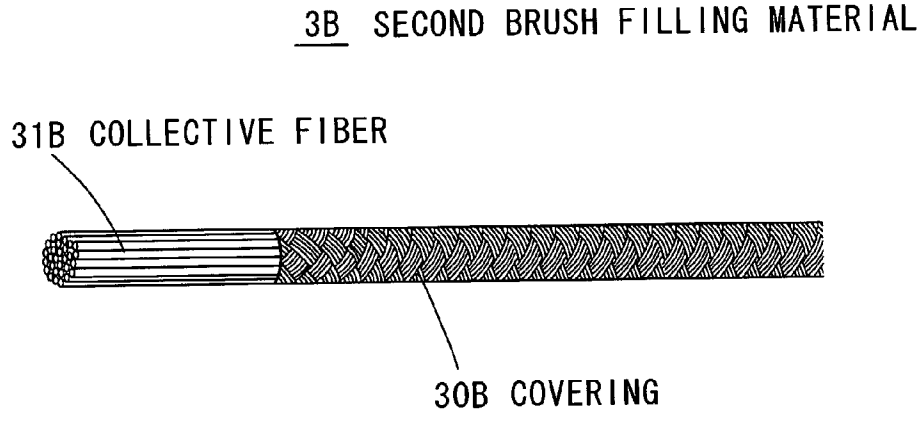

3B SECOND BRUSH FILLING MATERIAL
31B COLLECTIVE FIBER
30B COVERING

Fig. 4 (A)

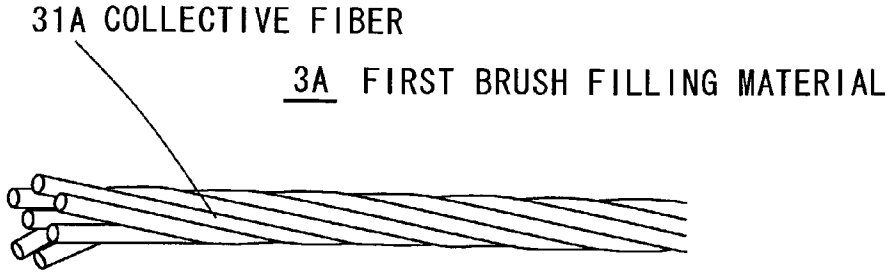

31A COLLECTIVE FIBER
3A FIRST BRUSH FILLING MATERIAL

Fig. 4 (B)

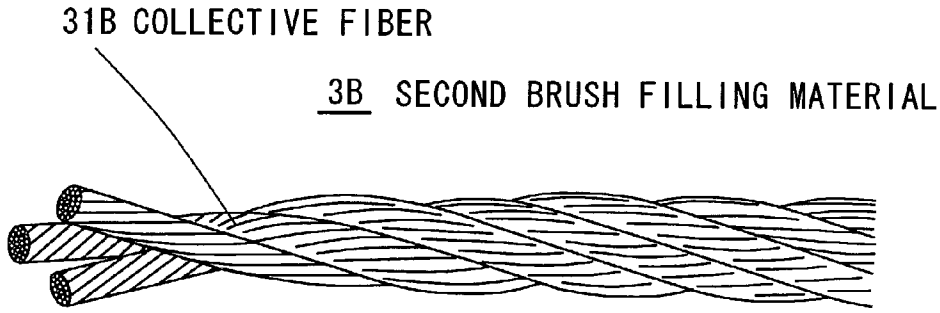

31B COLLECTIVE FIBER
3B SECOND BRUSH FILLING MATERIAL

Fig. 5

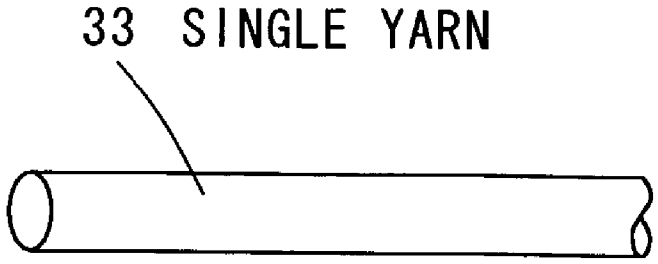

33 SINGLE YARN

Fig. 6

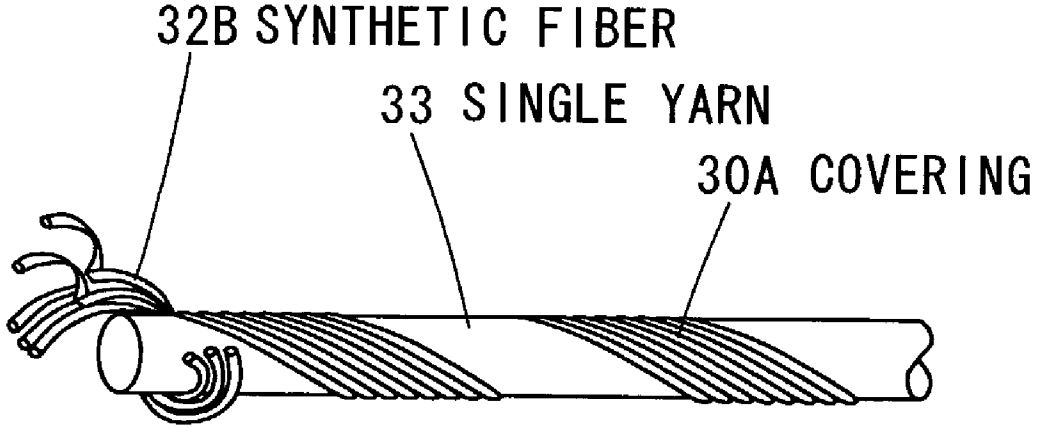

32B SYNTHETIC FIBER
33 SINGLE YARN
30A COVERING

Fig. 7

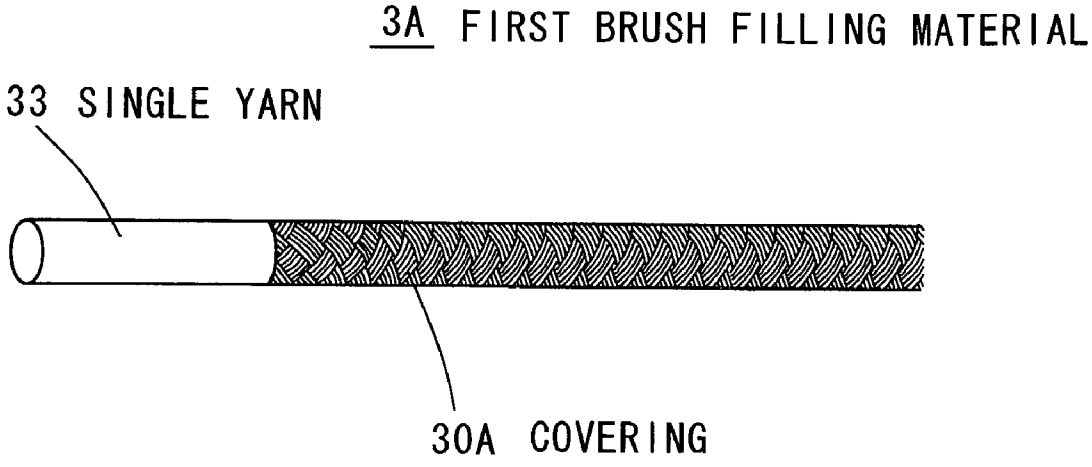

3A FIRST BRUSH FILLING MATERIAL
33 SINGLE YARN
30A COVERING

Fig. 8

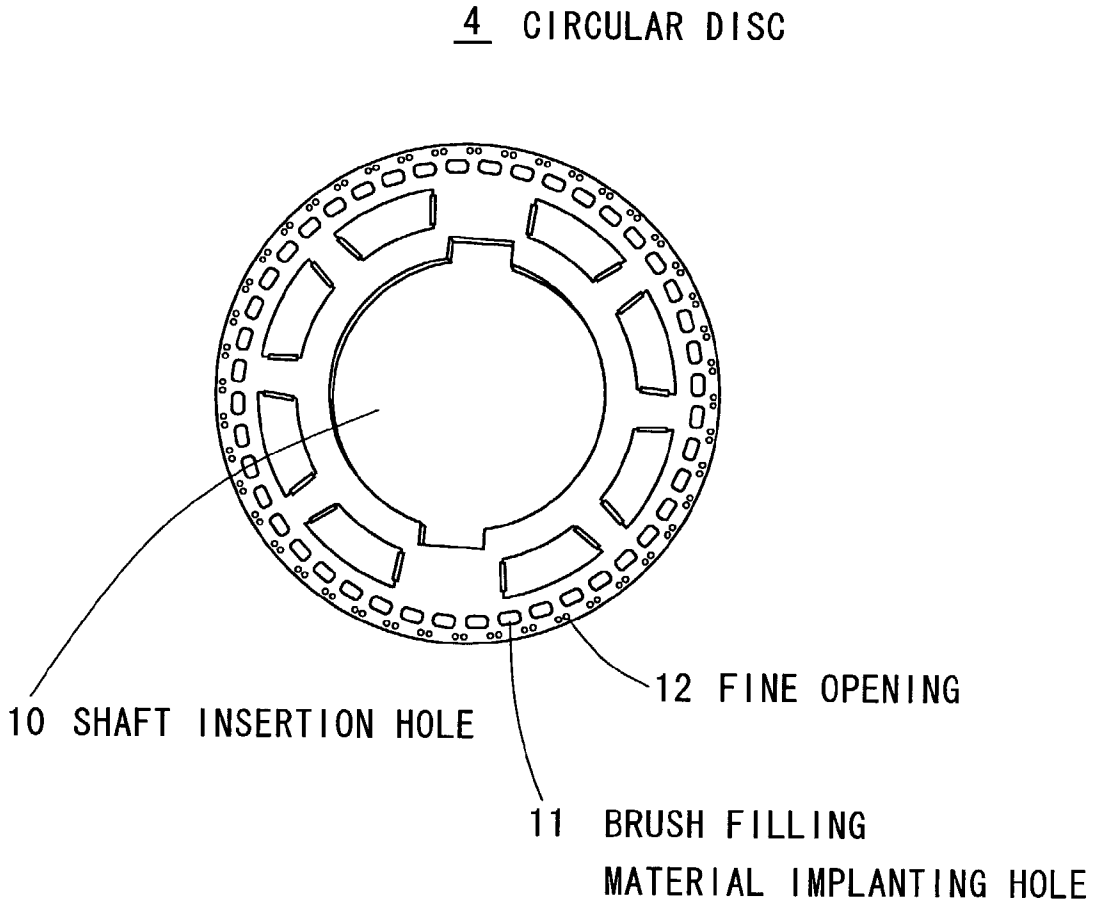

4 CIRCULAR DISC
10 SHAFT INSERTION HOLE
12 FINE OPENING
11 BRUSH FILLING MATERIAL IMPLANTING HOLE

Fig. 9

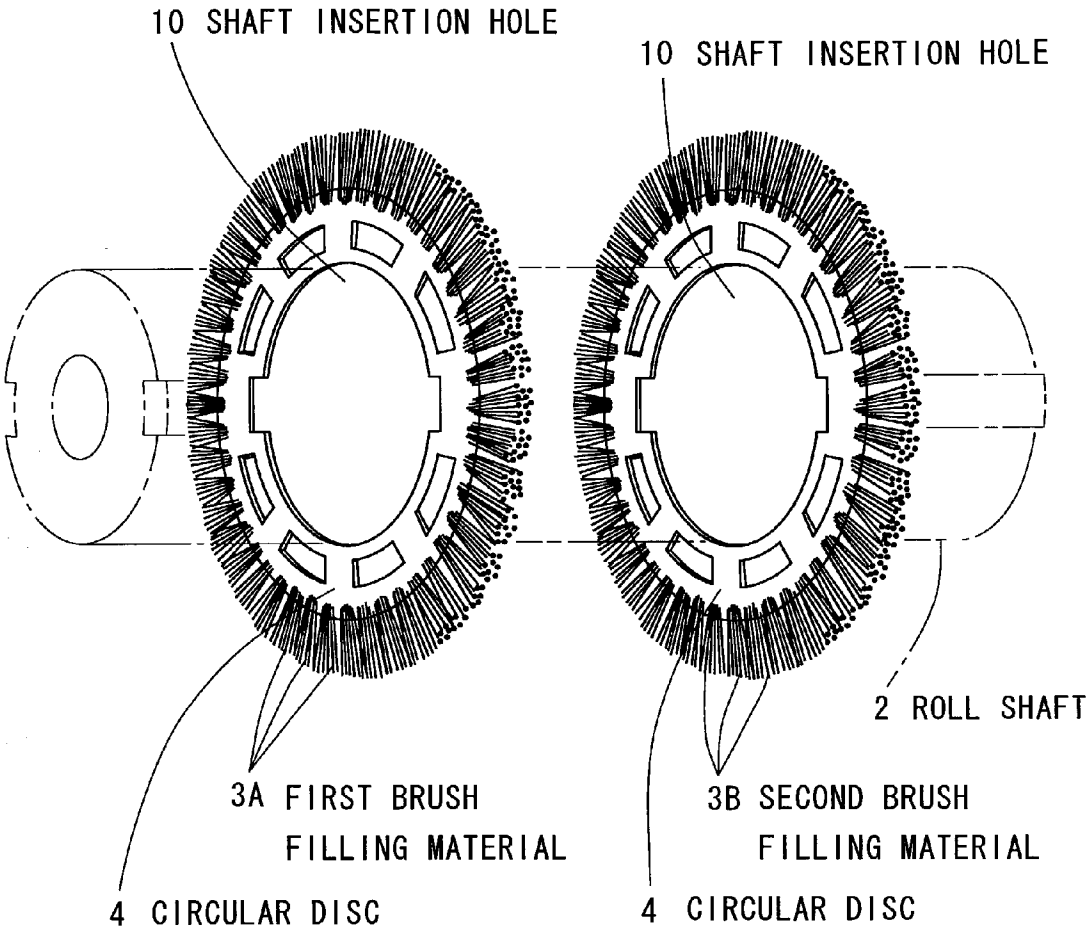

10 SHAFT INSERTION HOLE
10 SHAFT INSERTION HOLE
2 ROLL SHAFT
3A FIRST BRUSH FILLING MATERIAL
3B SECOND BRUSH FILLING MATERIAL
4 CIRCULAR DISC
4 CIRCULAR DISC

Fig. 10

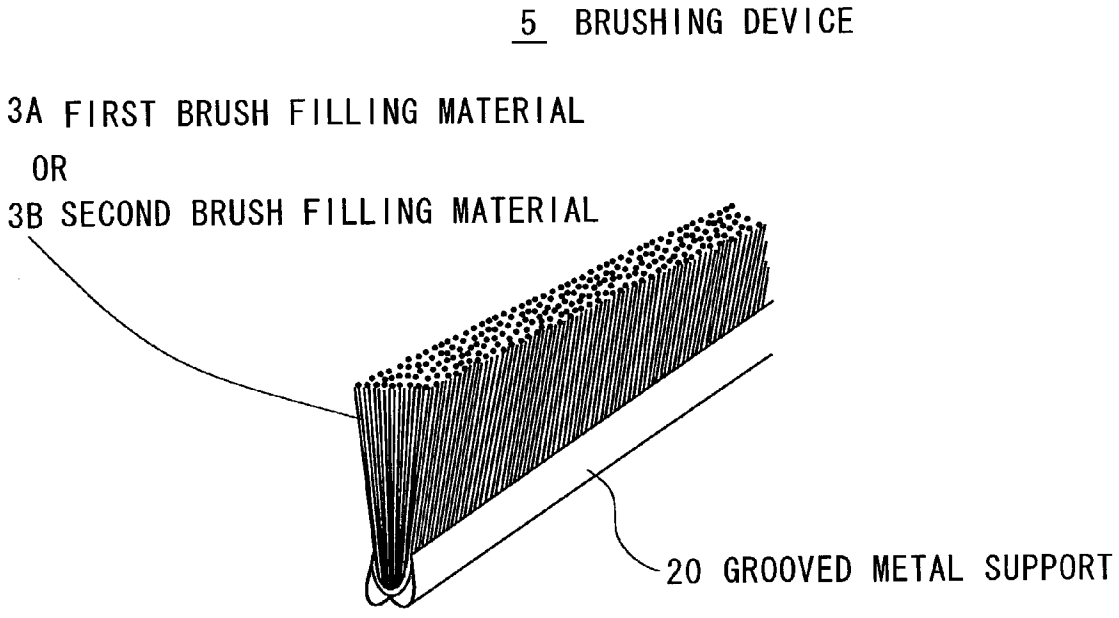

5 BRUSHING DEVICE
3A FIRST BRUSH FILLING MATERIAL
OR
3B SECOND BRUSH FILLING MATERIAL
20 GROOVED METAL SUPPORT

Fig. 11

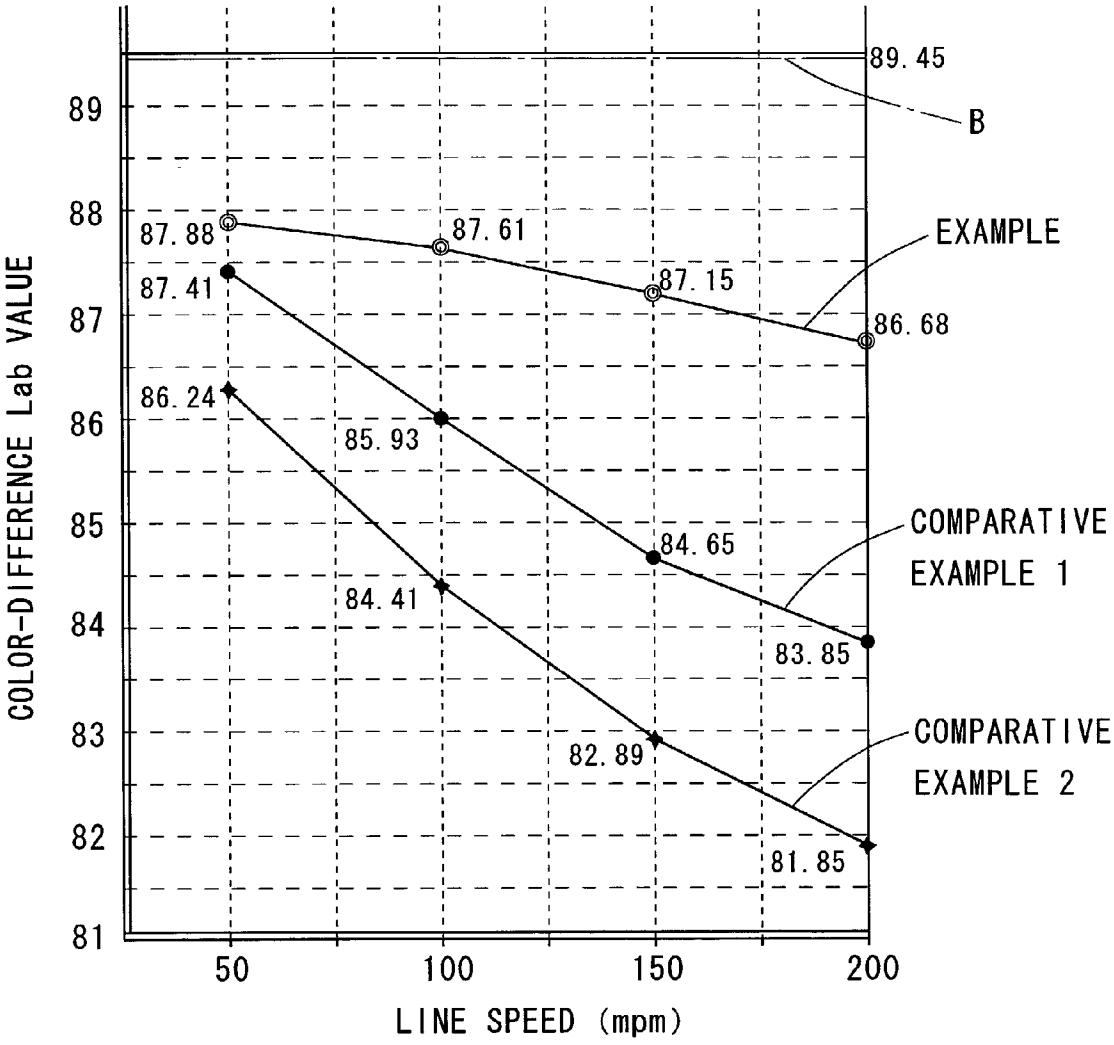

89.45
B
EXAMPLE
87.88
87.61
87.15
86.68
87.41
86.24
85.93
84.65
84.41
83.85
82.89
81.85
COMPARATIVE EXAMPLE 1
COMPARATIVE EXAMPLE 2
COLOR-DIFFERENCE Lab VALUE
89
88
87
86
85
84
83
82
81
50
100
150
200
LINE SPEED (mpm)

Fig. 12

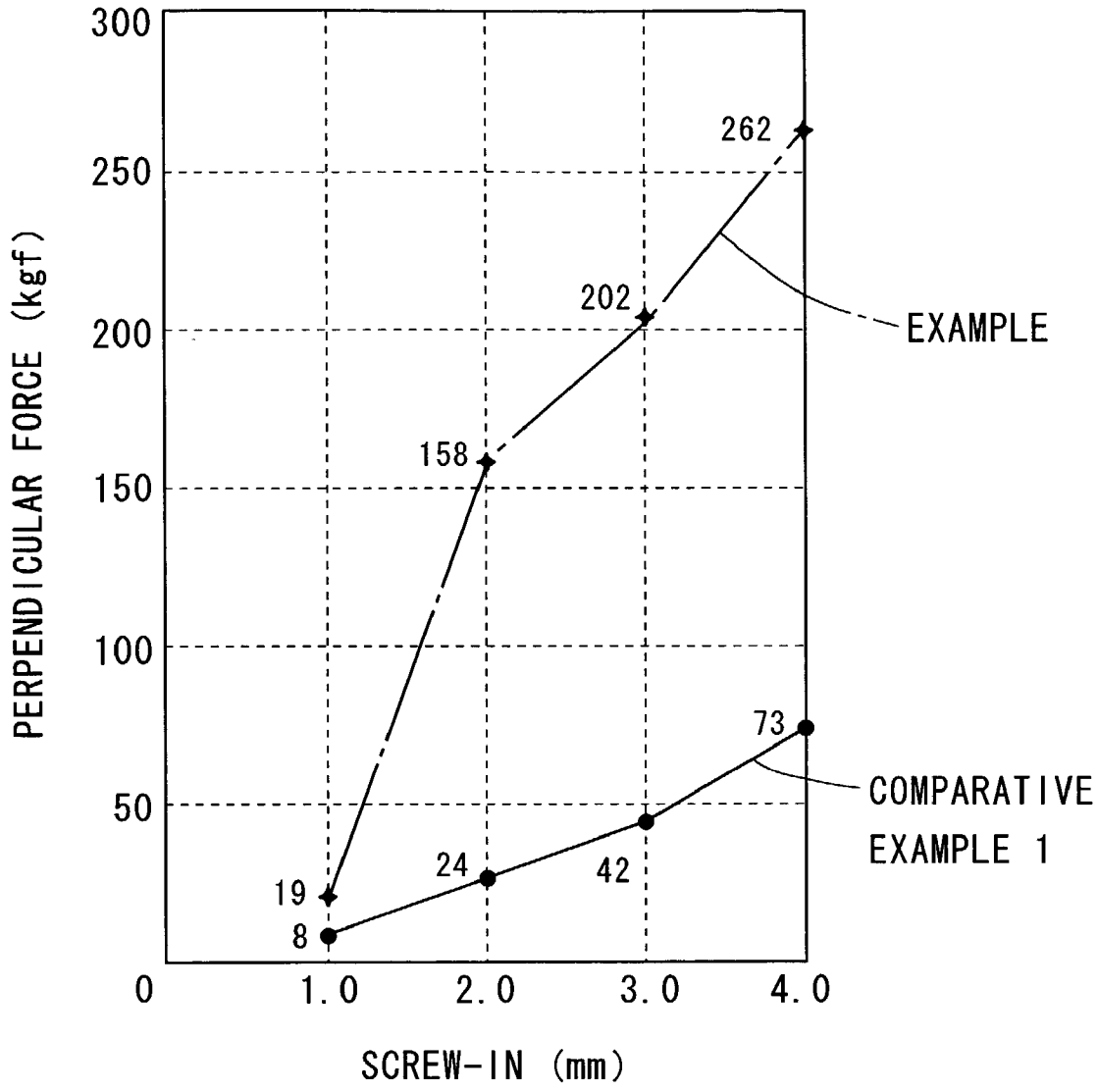

300
250
200
150
100
50
0
1.0
2.0
3.0
4.0
PERPENDICULAR FORCE (kgf)
SCREW-IN (mm)
262
202
158
19
8
24
42
73
EXAMPLE
COMPARATIVE
EXAMPLE 1

Fig. 13

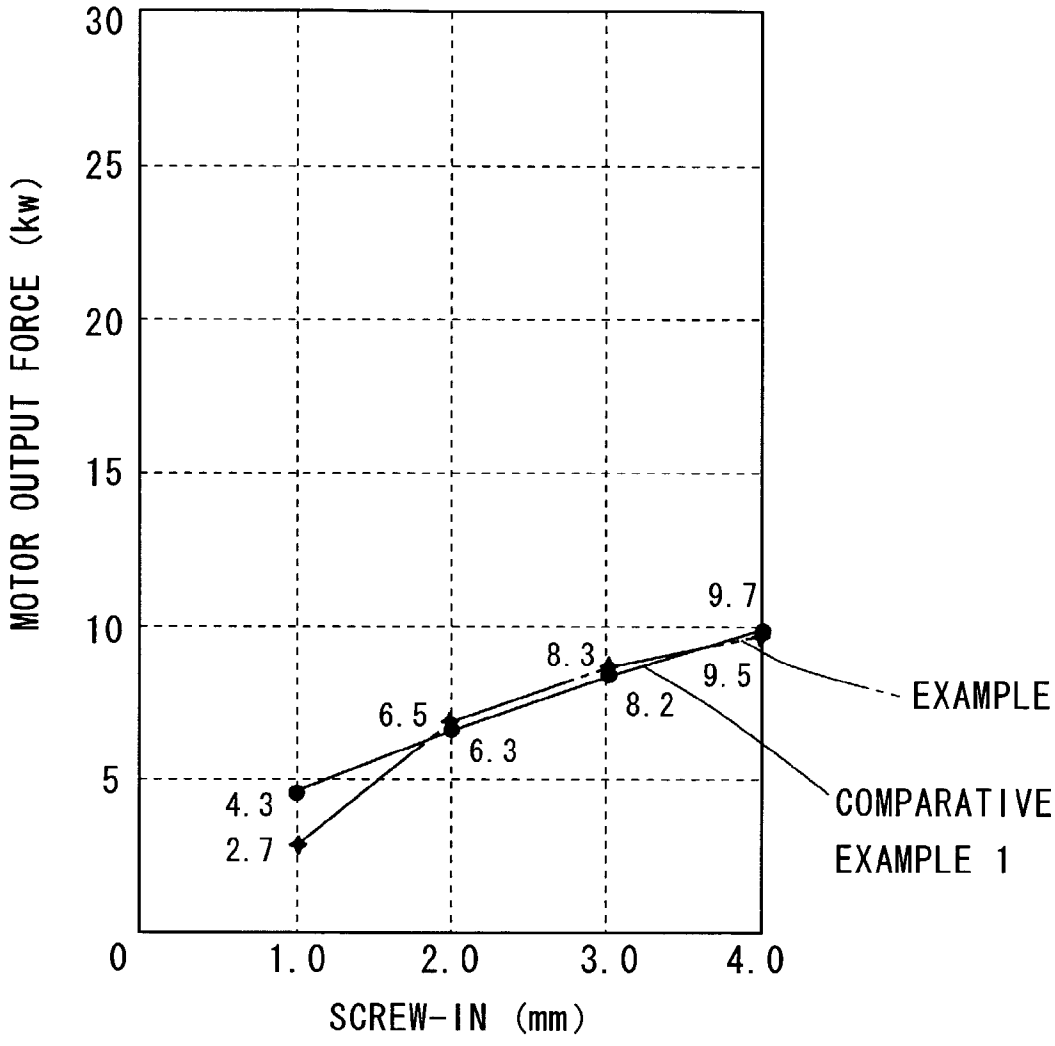

30
25
20
15
10
5
0
MOTOR OUTPUT FORCE (kw)
1.0
2.0
3.0
4.0
SCREW-IN (mm)
9.7
8.3
9.5
8.2
6.5
6.3
4.3
2.7
EXAMPLE
COMPARATIVE
EXAMPLE 1

Fig. 14

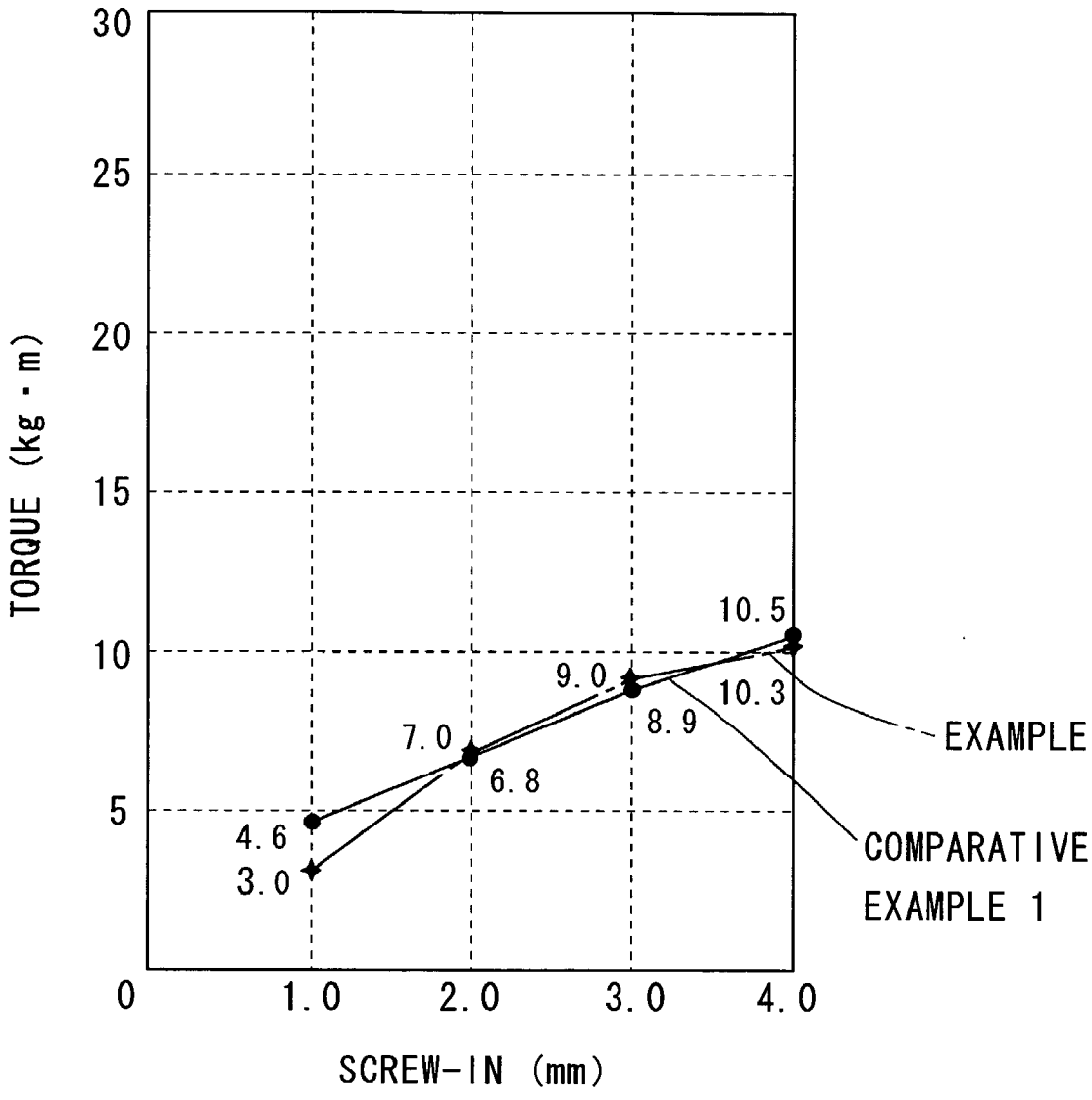
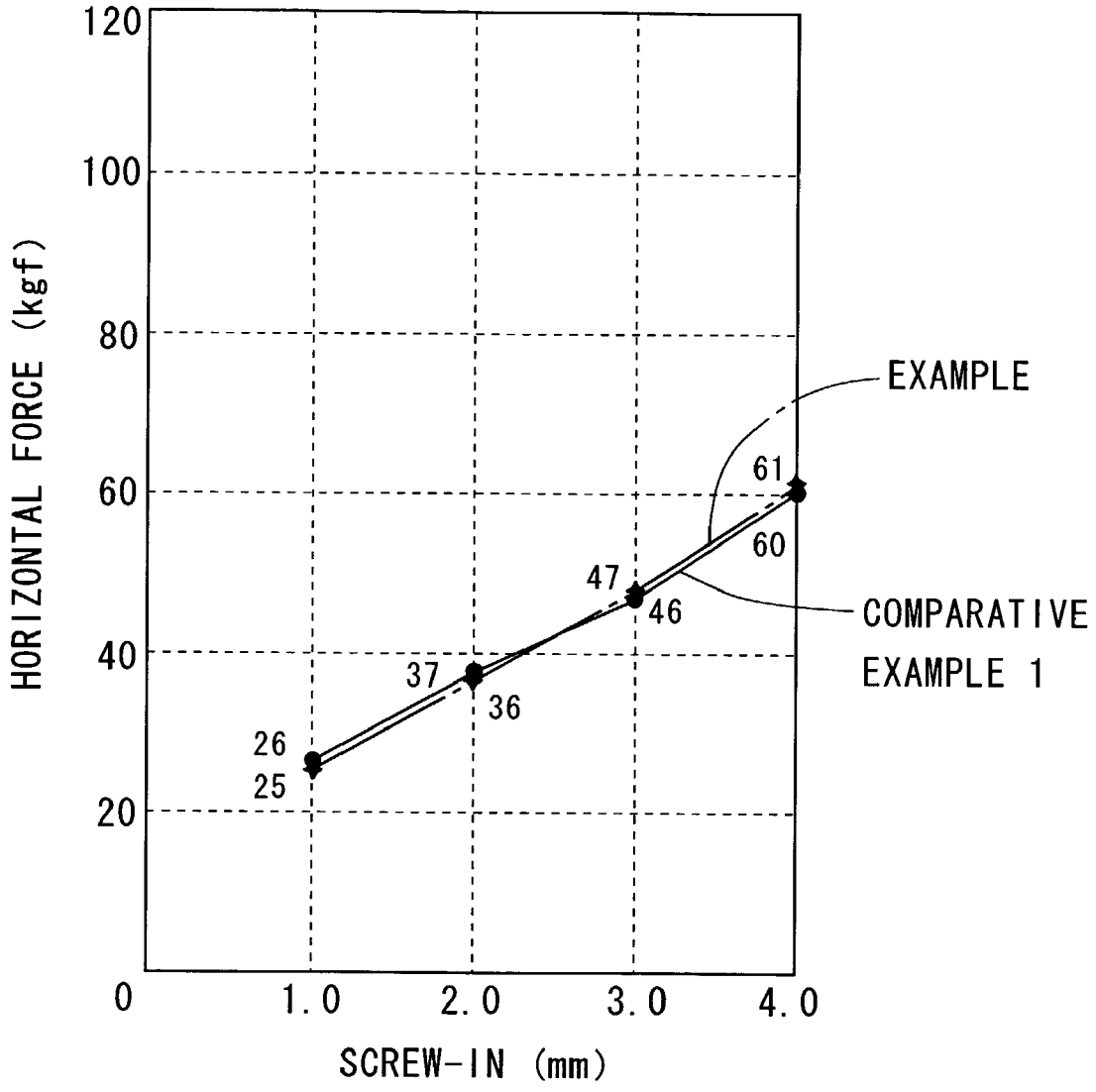

30
25
20
15
10
5
0
TORQUE (kg・m)
1.0
2.0
3.0
4.0
SCREW-IN (mm)
10.5
9.0
10.3
8.9
7.0
6.8
4.6
3.0
EXAMPLE
COMPARATIVE
EXAMPLE 1

Fig. 15


120
100
80
60
40
20
0
1.0
2.0
3.0
4.0
HORIZONTAL FORCE (kgf)
SCREW-IN (mm)
EXAMPLE
COMPARATIVE
EXAMPLE 1
61
60
47
46
37
36
26
25

BRUSH ROLL

BACKGROUND OF THE INVENTION

[0001] 1. Technical Field of the Invention

[0002] The present invention relates to a brush roll used mainly for cleaning and brushing strips in the iron manufacturing industry, for example.

[0003] 2. Description of the Prior Art

[0004] In general, this sort of brush roll uses the brush filling material consisting of fibers of the same diameter.

[0005] Even the brush rolls that are labeled as having high cleaning capabilities still leave room for improvement. In general, the existing brush rolls have the color-difference Lab value (cleaning capability index) of 85.93 for 100 meters/minute of strip line speed (the line speed of strip is usually 100 meters/minute (hereinafter it is abbreviated to "mpm")) or 83.85 for 200 mpm, which cannot be necessarily said to be high in cleaning capability. Also, the existing brush rolls have the drawback that when the line speed of more than 100 mpm is selected, the cleaning capabilities are drastically reduced.

[0006] Further, it was infeasible for the existing brush rolls to provide the high cleaning capabilities and besides the meticulous cleaning and brushing without clogging. For reference's sake, when using the brush filling material comprising fibers of a small diameter for the purpose of providing the meticulous cleaning, there arises the problem that oil, iron powders, dusts and the like adhering to the strip surfaces get into between tips of the brush filling materials of the brush roll to easily induce the clogging. On the other hand, when using the brush filling material comprising fibers of a large diameter for the purpose of providing the high cleaning capabilities, there arises the problem that rough scratch marks are produced on the strip surface.

[0007] The present invention has been made to solve the problems involved in the prior art mentioned above. It is the object of the present invention to provide a brush roll that can provide high cleaning capabilities and besides meticulous cleaning and brushing without clogging.

SUMMARY OF THE INVENTION

[0008] To solve the problems mentioned above, the present invention provides a brush roll comprising a roll shaft; first brush filling material comprising either of a single yarn of a filament having a diameter of 0.1-2.0 mm and a collective fiber comprising 3-56 filaments made into a bundle; and second brush filling material comprising 100-3,000 filaments having a diameter of 0.005-0.05 mm made into a bundle, the first brush filling material and the second brush filling material being so arranged around an outside surface of the roll shaft that they can be distributed in such a relation as to be mixed with each other. Although the ratio of the diameter of the single yarn or collective fiber used for the first brush filling material to the diameter of the collective fiber used for the second brush filling material is not limited to any particular ratio, it is preferable that the ratio is, for example, in the range of about 20:1 to about 5:1. Further preferably, the ratio is in the order of 10:1 for producing a drastic effect. The same filaments as the filaments of the brush filling material generally used for the brush roll applied to the strip cleaning in the iron manufacturing industry may be applied as the first and second brush filling materials.

[0009] The terms of "the single yarn" or "the collective fiber" of the first brush filling material and "the collective fiber" of the second brush filling material indicate the "main body" of each of the first and second brush filling materials. The same thing applies to the entire specification including claims. Some examples of the "main body" are as follows.

[0010] In the brush filling material in which a single yarn of a monofilament having a required diameter is used as a center core and which comprises the single yarn, the center core is equivalent to the main body.

[0011] In the brush filling material in which a bundle of a required number of filaments having a required diameter is used as a center core and which comprises a required number of bundles of filaments are used, the center core is equivalent to the main body.

[0012] In the brush filling material in which a bundle of a required number of filaments having a required diameter or a single yarn is used as a center core and different fiber is spirally wound around the outside of the center core and the different fiber thus wound is impregnated with resin and then solidified, the center core is equivalent to the main body.

[0013] In the brush filling material in which a bundle of a required number of filaments having a required diameter or a single yarn is used as a center core and different fibers are plaited around the outside of the center core in the form of a plaited cord and the different fibers thus plaited are impregnated with resin and then solidified, the center core is equivalent to the main body.

[0014] In the brush filling material in which a required number of filaments having a required diameter are twisted into a twisted yarn form, the filaments in the twisted yarn form is equivalent to the main body.

[0015] In the brush filling material in which a required number of filaments having a required diameter are twisted into a twisted rope form, the filaments in the twisted rope form is equivalent to the main body.

[0016] The brush roll according to the present invention provides the desirable results of providing the meticulous cleaning and brushing without clogging and besides the high cleaning capabilities in the cleaning of the strip in the iron manufacturing industry. In detail, there is provided the desirable results as follows.

[0017] In general, in order to provide the result of cleaning the strip uniformly with the brush roll, the brush filling materials are required to be generally equal in density of distribution over the entire surface of the strip to be cleaned and have the thick density corresponding to the desired cleaning result. If the filament of the brush filling material is thick, such a thick density of distribution causes the brush filling materials to fall down like dominoes by the brushing resistance when brushing and, as a result, the good cleaning result cannot be provided. On the other hand, if the filament of the brush filling material is thin, such a thick density of distribution causes the brush filling materials to be worn off like a rag and, as a result, oil, iron powders, dusts and the like adhering to the surfaces of the strip get into between the brush filling materials to easily induce the clogging.

[0018] Differently from this, according to the present invention, since the first brush filling material comprising the single yarn or collective fiber comprising a predetermined number of filaments having a predetermined thickness and the second brush filling material comprising the collective fiber comprising a predetermined number of filaments having a predetermined diameter smaller than the filament of the first brush filling material are so arranged that they can be distributed in such a pattern as to be substantially equally mixed with each other around an outside surface of the roll shaft, the second brush filling material, whose collective fiber comprising a predetermined number of filaments having a predetermined small diameter, serves as a kind of cushion to prevent the first brush filling material from falling down like dominoes. In addition, the second brush filling material serves to hold a group of the first brush filling materials in their implanted state in which the first brush filling materials are implanted with spaced from each other like a forest.

[0019] Further, since the collective fiber of the second brush filling material includes the filaments of relatively thin, the second brush filling material serves to provide the meticulous cleaning. Besides, although the collective fiber of the second brush filling material includes the filaments having the thinness as mentioned above, since the second brush filling material is distributed in such a pattern as to be substantially equally mixed with the first brush filling material comprising a predetermined number of filaments of relatively thick, the clogging between the second brush filling materials is prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] **FIG. 1** shows a front view schematically showing an external appearance of a brush roll comprising brush filling material according to the present invention;

[0021] **FIG. 2**(A) shows in perspective an example of first brush filling material of synthetic filaments used for the brush roll according to the present invention which is in the state in which the tips of the synthetic filaments are spread;

[0022] **FIG. 2**(B) shows in perspective an example of second brush filling material of synthetic filaments used for the brush roll according to the present invention which is in the state in which the tips of the synthetic filaments are spread;

[0023] **FIG. 3**(A) shows in perspective another example of the first brush filling material of the brush roll according to the present invention;

[0024] **FIG. 3**(B) shows in perspective another example of the second brush filling material of the brush roll according to the present invention;

[0025] **FIG. 4**(A) shows in perspective still another example of the first brush filling material of the brush roll according to the present invention;

[0026] **FIG. 4**(B) shows in perspective still another example of the second brush filling material of the brush roll according to the present invention;

[0027] **FIG. 5** shows in perspective yet another example of the first brush filling material of the brush roll according to the present invention;

[0028] **FIG. 6** shows in perspective a further example of the first brush filling material of synthetic filaments of the brush roll according to the present invention which is in the state in which the tips of the synthetic filaments are spread;

[0029] **FIG. 7** shows in perspective a still further example of the first brush filling material of the brush roll according to the present invention;

[0030] **FIG. 8** shows a front view of a circular disc applied in the present invention;

[0031] **FIG. 9** shows in perspective a circular disc in which the first brush filling materials are implanted and a circular disc in which the second brush filling materials are implanted, both discs of which are applied in the present invention;

[0032] **FIG. 10** shows in perspective another example of the brushing device applied in the present invention;

[0033] **FIG. 11** is a graph showing the cleaning capabilities of the brush roll according to the present invention and comparative examples 1 and 2;

[0034] **FIG. 12** is a graph representing the characteristics of perpendicular force (force acting on a sheet surface perpendicularly) in relation to screw-in (the degree of pressing force or the distance of brush roll travel from a specified position to the strip to be cleaned) of the brush roll according to the present invention and that of the comparative example 1;

[0035] **FIG. 13** is a graph representing the output power from motor in relation to the screw-in of the brush roll according to the present invention and that of the comparative example 1;

[0036] **FIG. 14** is a graph representing the torque characteristics in relation to the screw-in of the brush roll according to the present invention and that of the comparative example 1;

[0037] **FIG. 15** is a graph representing the characteristics of horizontal force (force acting on the sheet surface horizontally) in relation to the screw-in of the brush roll according to the present invention and that of the comparative example 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] In the following, certain preferred embodiments of the present invention will be described with reference to the accompanying drawings. It is to be noted that the embodiments are illustrated for purpose of illustration only and are not intended as a definition of the technical scope of the invention. The same thing applies to the examples mentioned later. In **FIG. 1**, reference numeral **1** (**FIG. 1**) designates a brush roll for cleaning a strip manufactured in the iron manufacturing industry. The reference numeral **1** is represented in the underlined form. The underlined numeral **1** shows the entirety of the brush roll. The same thing applies to the other underlined numerals.

[0039] The first brush filling material **3A** (See **FIG. 2**(A)) and the second brush filling material **3B** (See **FIG. 2**(B)) are used in combination so as to be densely placed around the outside of a roll shaft **2** of the brush roll **1**. The placement of the first brush filling material **3A** and the second brush

filling material **3**B around the outside of the roll shaft **2** can be carried out in the same manner as in the placement of the existing brush filling material, as mentioned below.

[**0040**] In this example, a circular disc **4** is used, as shown in **FIG. 8**. The disc **4** is made of a metal sheet. The disc **4** has a shaft insertion hole **10** formed at a center thereof for the roll shaft **2** to pass through; a number of brush filling material implanting holes **11** arranged in parallel around the outside thereof; and fine openings **12** formed at positions adjacent to the implanting holes **11**. After the brush filling materials are passed through the implanting holes **11** of the circular disc **4**, they are folded in U-shape at generally intermediate portions thereof so as to be oriented radially outwardly. Then, the brush filling materials at U-shaped folded portions are banded and fixed by binding members such as wires inserted to the fine openings **12**.

[**0041**] The circular disc **4**, which has around its outside edge portion the brush filling materials implanted in such a manner that a required number of brush filling materials can be densely collected at tips thereof, is fixedly fitted onto the roll shaft **2** through the shaft insertion hole **10**, as shown in **FIG. 9**. A number of circular discs **4** thus fitted on the roll shaft **2** are compressed axially and fixedly clamped to the roll shaft **2**, to thereby produce the brush roll having the configuration shown in **FIG. 1**. **FIG. 9** illustrates the circular disc **4** having the first brush filling materials **3**A implanted therein and the circular disc **4** having the second brush filling materials **3**B implanted therein are laid side by side.

[**0042**] A brushing device **5** comprising a grooved metal support **20** in which the first brush filling materials **3**A or the second brush filling materials **3**B are densely implanted may alternatively be used, as shown in **FIG. 10**. This brushing device **5** is spirally wound around the outside of the roll shaft **2** in a dense relation and fixed.

[**0043**] The first brush filling material **3**A comprises as the main constituent collective fiber **31**A comprising 3 to 56 synthetic filaments, such as polyamide filaments, having the diameter of 0.1-2.0 mm. The second brush filling material **3**B comprises as the main body collective fiber **32**B comprising 100 to 3,000 synthetic filaments, such as polyamide filaments, having the diameter of 0.005-0.05 mm.

[**0044**] The first brush filling material **3**A may be used in the form of covering **30**A. The covering **30**A is produced by a bundle of an adequate number of (e.g. seven) synthetic filaments **32**A, such as polyamide filaments, having the diameter of the order of 0.1 mm being spirally wound around the outside of a required collective fibers **31**A (See **FIG. 2**(A)) or being plaited therearound in the form of a plaited cord (See **FIG. 3**(A)), first, and, then, the synthetic filaments **32**A thus wound or plaited being impregnated with adhesive resin and then solidified (hereinafter this treatment is referred to as "resin set treatment"). While in the illustration, the covering **30**A has a double helix structure with the synthetic filaments **32**A of right-hand wind and left-hand wind, the covering **30**A may alternatively have a single helix structure with the synthetic filaments **32**A of either the right-hand wind and the left-hand wind. The collective fiber **31**A of the first brush filling material **3**A may be in the form of a twisted yarn (See **FIG. 4**(A)) or rope (See **FIG. 4**(B)) of a required number of filaments twisted. In this case, the collective fiber **31**A having the covering **30**A formed therearound as shown in FIGS. **2**(A) and **FIG. 3**(A) is also included in the first brush filling material **3**A.

[**0045**] The first brush filling material **3**A may comprise as the main body a single yarn **33** of a single synthetic filament, such as polyamide fiber, having the diameter of 0.1-2.0 mm (See **FIG. 5**). For example, the first brush filling material **3**A shown in **FIG. 5** is formed by a single yarn **33** only. Further, the first brush filling material **3**A covers those that are in the form of the covering **30**A produced by a bundle of an adequate number of (e.g. seven) synthetic filaments **32**A, such as polyamide fibers, having the diameter of the order of 0.1 mm being spirally wound around the outside of the single yarn **33** (See **FIG. 6**) or being plaited therearound in the form of a plaited cord (See **FIG. 7**), followed by the resin set treatment of the synthetic filaments **32**A thus wound or plaited. While the covering **30**A shown in **FIG. 6** has the single helix structure with the synthetic filaments **32**A of right-hand wind, for example, the covering **30**A may alternatively have the double helix structure with the synthetic filaments **32**A of the right-hand wind and the left-hand wind.

[**0046**] The second brush filling material **3**B may be used in the form of covering **30**B. The covering **30**B is produced by a bundle of an adequate number of (e.g. two hundreds and ten) synthetic filaments **32**B, such as polyamide filaments, having the diameter of the order of 0.02 mm being spirally wound around the outside of a required collective fiber **31**B (See **FIG. 2**(B)) or being plaited therearound in the form of a plaited cord (See **FIG. 3**(B)), followed by the same resin set treatment of the synthetic filaments **32**B thus wound or plaited. While in the illustration, the covering **30**B has the double helix structure with the synthetic filaments **32**B of right-hand wind and left-hand wind, the covering **30**B may alternatively have the single helix structure with the synthetic filaments **32**B of either the right-hand wind and the left-hand wind. The collective fiber **31**B of the second brush filling material **3**B may be in the form of a twisted yarn (See **FIG. 4**(A)) or rope (See **FIG. 4**(B)) of a required number of fibers twisted. In that case, the collective fibers **31**B having the covering **30**B formed therearound as shown in **FIG. 2**(B) and **FIG. 3**(B) is also included in the second brush filling material **3**B.

[**0047**] It should be noted that the resin set treatment that can offer adequate reinforcement of the coverings **30**A, **30**B wound or plaited around the collective fibers **31**A, **31**B is enough, and the degree of the fixation that can allow the first brush filling material **3**A and the second filling material **3**B to flex when brushing is enough. A variant that one of the first brush filling material **3**A and the second brush filling material **3**B is given the covering and the other is not given the covering is also covered by the present invention.

[**0048**] The first brush filling material **3**A and the second brush filling material **3**B are so arranged around the outside surface of the brush roll **1** that they can be distributed in such a relation as to be substantially equally mixed with each other. This arrangement is obtained in the following specific way. It is to be noted that the first brush filling material and the second brush filling material around the outside surface of the brush roll **1** are just required to be generally equal in density of distribution to the brush filling materials in the conventional brush roll.

[**0049**] For example, two types of circular discs, i.e., the circular disc **4** in which the first brush filling materials **3**A are implanted and the circular disc **4** in which the second filling materials **3**B are implanted are prepared, as shown in

FIG. 9. The circular discs are arranged on the roll shaft **2**, with alternating layers of the former type of disc and the latter type of disc, or with alternating layers of a group of an adequate number of discs of the former type having the first brush filling materials and a group of an adequate number of discs of the latter type having the second brush filling materials. The single circular disc **4** may be so structured that the first brush filling materials and the second filling materials are alternately implanted around the margin of the disc so as to have an adequate distribution.

[**0050**] Alternatively, two types of brushing devices, i.e., a brushing device **5** with a grooved metal support **20** in which the first brush filling materials **3**A are implanted and a brushing device **5** with a grooved metal support **20** in which the second filling materials **3**B are implanted, are prepared. These two types of brushing devices are arranged in rows on the roll shaft **2** in a screw-shaped arrangement, with the former brushing device and the latter brushing device disposed side by side alternately, or with the former brushing devices **5** in groups of adequate number arranged in rows and the latter brushing devices **5** in groups of adequate number arranged in rows. The single grooved metal support **20** may be so structured that the first brush filling materials and the second filling materials are alternately implanted along the longitudinal direction of the support so as to have an adequate distribution.

EXAMPLE

[**0051**] In the following, Example of the present invention will be described. Shown in Example is an example of the brush roll arranging a plurality of circular discs on the roll shaft. Parts of the brush roll of Example are cited below.

[**0052**] (First Brush Filling Material)

[**0053**] The first brush filling material with covering which is produced by bundles of seven polyamide fibers of the diameter of 0.1 mm being wound around a bundle of fourteen polyamide fibers of the diameter of 0.2 mm so as to have a double helix structure with the bundles of fibers of right-hand wind and left-hand wind, followed by the resin set treatment.

[**0054**] (Second Brush Filling Material)

[**0055**] The second brush filling material with covering which is produced by bundles of two hundreds and ten polyamide fibers of the diameter of 0.02 mm being wound around a bundle of six hundreds and thirty polyamide fibers of the diameter of 0.02 mm so as to have the double helix structure with the bundles of fibers of right-hand wind and left-hand wind, followed by the resin set treatment.

[**0056**] (Applicable Circular Disc **1**)

[**0057**] The applicable circular disc **1** is a disc having thirty nine implanting holes which are arranged in parallel around the margin of the periphery of the disc and in which the first brush filling materials are implanted, respectively. The implanting pattern is the same as the embodiment of the present invention mentioned above (See **FIG. 9**).

[**0058**] (Applicable Circular Disc **2**)

[**0059**] The applicable circular disc **2** is a disc having thirty nine implanting holes arranged in parallel around the margin of the periphery of the disc, the disc **2** being the same as the applicable circular disc **1**, except that the second brush filling materials are implanted in the implanting holes, respectively.

[**0060**] (Arrangement of Circular Discs)

[**0061**] The circular discs **1** and the circular discs **2** are arranged on the roll shaft, so as to alternate with each other along the axial direction of the roll shaft. Twelve discs in total (six discs for each) are used.

[**0062**] The entire construction of the brush roll and the operating conditions are cited below.

(Outer diameter of brush roll):	340 mm
(Length of brush roll):	75 mm
(Length of brush filling material	40 mm
(Length of a protrusion from edge of disc)):	
(Revolving speed of brush roll):	900 r.p.m
(Screw-In (Degree of pressure against strip	3 mm
(steel sheet) to be cleaned):	

Comparative Example 1

[**0063**] The brush roll of Comparative Example 1 put to the test is the same as the brush roll of Example, except that the brush filling material consists of the same brush filling material as the first brush filling material used in Example. In other words, only one type of circular discs having the first brush filling materials implanted around the margin of the discs are mounted on the roll shaft.

Comparative Example 2

[**0064**] The brush roll of Comparative Example 2 put to the test is the same as the brush roll of Example, except that the brush filling material comprises a single yarn of a monofilament having a diameter of 0.4 mm. In other words, only one type of circular discs each having the single yarn implanted around the margin of the discs are mounted on the roll shaft.

[**0065**] The test results on the cleaning capability of the brush roll of Example are shown in **FIG. 11**, together with the test results on the cleaning capabilities of Comparative Example 1 and Comparative Example 2. In **FIG. 11**, three sequential lines extending downwardly side by side indicate the test results of the brush rolls of Example, Comparative Example 1 and Comparative Example 2 in the order from highest to lowest, respectively. In **FIG. 11**, the chain line B in the highest level indicates a blank value of a blank adhesive tape (solid state).

[**0066**] The cleaning tests were conducted on the brush roll of Example, the brush roll of Comparative Example 1 and the brush roll of Comparative Example 2. In the cleaning tests, the upper and lower sides of the strip to be cleaned (NSC/N 2TCM strip) running at a predetermined speed were cleaned by brushing with the rotating brush roll, while spray liquid is sprayed thereto. The spray liquid used was an aqueous liquid (60° C.) comprising 2 wt % of sodium hydrate (NaOH) and 0.2 wt % of AD-2000ESP (cleaning additives available from Daido Kagaku Kogyo K.K.).

[**0067**] The strip (steel sheet) to be cleaned was wetted with the spray liquid sprayed in the spray zone 5 meter before the brushing zone with the brush roll. The strip to be cleaned was brushed with the brush roll in the brushing zone

with the brush roll, while 0.05 liter of the spray liquid per minute was sprayed to each 1 mm in width of the strip to be cleaned (width with respect to the direction orthogonal to the traveling direction of the strip). This procedure which is for a single pass of the strip, was followed for each of the three strips to be cleaned. The cleaning capability mentioned later is expressed as a mean value of the evaluation data (Lab value) obtained for the three strips to be cleaned.

[0068] Sequentially, the pressure-sensitive adhesive tapes were stuck to the surfaces of the strips to be cleaned mentioned above and then peeled off. The adhesive tapes peeled off were stuck to a white board of a prescribed brightness, to measure the spectral reflectance factors of the adhesive tapes. The spectral reflectance factors were measured with the spectrophotometer (SE2000 available from Nippon Denshoku Industries). The spectral reflectance factors are each written as a reduced value where a value of the prescribed black board is taken as 0 and a value of the prescribed white board is taken as 100. The reduced value is the color difference Lab value. For reference's sake, the color-difference Lab value of the blank adhesive tape stuck which was not stuck to any surface of the strip to be cleaned was 89.45 when measuring that blank adhesive tape stuck on the white board. Also, the color-difference Lab value of the surfaces of the strip measured after the adhesive tapes stuck to the NSC/N 2TCM strip were peeled off was 90.42.

[0069] As seen from **FIG. 11**, the color-difference Lab value of the brush roll of Example is 87.88 when the line speed (strip running speed) was 50 mpm, and also the color-difference Lab value of the brush roll of Example was kept high as 86.68 even when the line speed was 200 mpm. This shows that the color-difference values of Example are higher than the color-difference values of Comparative Examples 1 and 2, and the cleaning capability of the brush roll of Example is fairly superior to those of Comparative Examples.

[0070] Then, the other test results of the brush roll of Example are shown in FIGS. **12** to **15**. In FIGS. **12-15**, the dashed line indicates the test results of the brush roll of Example and the solid line indicates the test results of the brush roll of Comparative Example 1. The brush roll of Example put to these tests is the same as that of Example put to the test of **FIG. 11**, and the brush rolls of Comparative Example 1 put to these tests are the same as those put to the test of **FIG. 11**.

[0071] As evident from FIGS. **12-15**, the brush roll of Example is substantially the same as the brush roll of Comparative Example 1 in motor output force, torque, and horizontal force in relation to the screw-in of the brush roll and yet it is even stronger in perpendicular force than Comparative Example 1. It is understood from this that the brush roll of Example has excellent cleaning capabilities.

[0072] The present invention can be practicably embodied as mentioned above and the brush roll of the embodied form of the present invention can provide the result of providing the high cleaning capabilities for the strips manufactured in the iron manufacturing industry and besides the meticulous cleaning and brushing without clogging.

What is claimed is:

1. A brush roll comprising a roll shaft; first brush filling material comprising either of a single yarn of a monofilament having a diameter of 0.1-2.0 mm and a collective fiber comprising 3-56 filaments made into a bundle; and second brush filling material comprising 100-3,000 filaments having a diameter of 0.005-0.05 mm made into a bundle, the first brush filling material and the second brush filling material being so arranged around an outside surface of the roll shaft that they can be distributed in such a relation as to be mixed with each other.

2. The brush roll according to claim 1, wherein different fibers from the single yarn or collective fiber of the first brush filling material and from the collective fiber of the second brush filling material are spirally wound around an outside surface of the single yarn or collective fiber of the first brush filling material and/or around an outside surface of the collective fiber of the second brush filling material, to cover outside surface(s) thereof, and then the different fibers thus wound are impregnated with resin and solidified.

3. The brush roll according to claim 1, wherein different fibers from the single yarn or collective fibers of the first brush filling material and from the collective fiber of the second brush filling material are plaited around an outside surface of the single yarn or collective fiber of the first brush filling material and/or around an outside surface of the collective fiber of the second brush filling material in the form of a plaited cord and, then, the different fibers thus plaited are impregnated with resin and then solidified.

4. The brush roll according to any one of claims 1 to 3, wherein the collective fiber of the first brush filling material and/or the collective fiber of the second brush filling material are in the form of a twisted yarn or rope.

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