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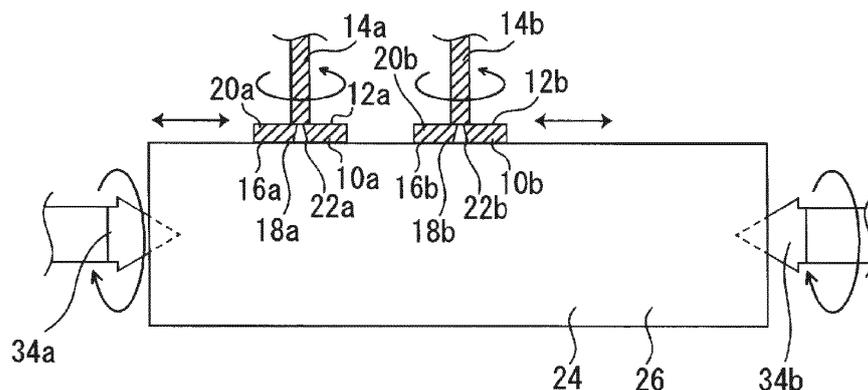
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(54) **ROLL POLISHING ROTATING GRINDSTONE, AND ROLL POLISHING DEVICE AND METHOD**

(57) Provided are a roll polishing rotary grinding stone and a roll polishing device and method which are configured to stably perform roll polishing without making the surface roughness of a surface to be processed non-uniform by preventing polishing debris to be generated during polishing from being accumulated in a recess at a center of a polishing surface of the roll polishing rotary grinding stone body. The roll polishing rotary grinding stone includes: a rotary grinding stone body having a rotary shaft mounted on a back end face and a polishing

surface formed on a front end face; and a recess formed at a center of the front end face of the rotary grinding stone body, the roll polishing rotary grinding stone being configured to perform vertical polishing with respect to a surface of a roll by bringing the polishing surface into contact with the surface of the roll, in which the recess is formed into a tapered recess in which an inner peripheral surface of the recess is increased in diameter from the back end face of the rotary grinding stone body toward the front end face of the rotary grinding stone body.

**FIG.1**



## Description

### Technical Field

**[0001]** The present invention relates to a roll polishing rotary grinding stone to be used for roll polishing, a roll polishing device, and a roll polishing method, using the roll polishing rotary grinding stone.

### Background Art

**[0002]** Hitherto, as a grinding stone to be used for polishing a roll, such as a gravure plate-making roll, a rolling roll, or a conveyance roll, there has been given a rotary grinding stone. A roll polishing rotary grinding stone is configured to polish the surface of the roll by rotating the roll and by rotating the rotary grinding stone while bringing a polishing surface of a front end face of the rotary grinding stone having a substantially annular shape into abutment against the surface of the roll.

**[0003]** In the roll polishing rotary grinding stone described above, a grinding stone having a polishing function is bonded to a front end face of a rotary grinding stone body instead of an outer periphery of the body, and the polishing surface of the front end face of the rotary grinding stone that is rotating as described above is brought into abutment against the surface of the roll to polish the surface of the roll. Such polishing is also called vertical polishing.

**[0004]** In gravure printing, minute recesses (gravure cells) are formed in a gravure plate-making roll (gravure cylinder) in accordance with plate making information to make a plate surface, and an ink is filled in the gravure cells and transferred to a material to be printed. In a general gravure plate-making roll, plate making (making of a plate surface) is completed through the processes involving providing a copper-plating layer (plate material) for forming a plate surface to a surface of a hollow roll made of a metal such as aluminum or iron or a reinforced resin such as a carbon fiber reinforced resin (CFRP), forming a large number of minute recesses (gravure cells) in the copper-plating layer in accordance with plate making information by etching, and then forming, on the surface of the copper-plating layer, a surface hardening coating layer such as chromium plating for enhancing a withstand print force of the gravure plate-making roll.

**[0005]** The gravure plate-making roll having the copper-plated layer formed thereon as described above is subjected to roll polishing through use of a rotary grinding stone.

**[0006]** Further, when the gravure plate-making roll is manufactured, roll polishing using the rotary grinding stone is performed also for finish polishing such as mirror polishing that is performed with respect to the gravure plate-making roll. As such roll polishing rotary grinding stone, there are given examples in Patent Document 1 and Patent Document 2. Further, as a roll polishing device including a roll polishing rotary grinding stone, there

is given an example in Patent Document 3.

**[0007]** Further, roll polishing is used also for polishing a roll made of a metal, such as a rolling roll or a conveyance roll.

5 **[0008]** A related-art roll polishing rotary grinding stone is illustrated in FIGS. 6. The related-art rotary grinding stone 100 illustrated in FIGS. 6 is a roll polishing rotary grinding stone, which includes a rotary grinding stone body 104 having a rotary shaft mounted on a back end face 108 and a polishing surface 112 formed on a front end face 106 and a through hole 102 formed at a center of the rotary grinding stone body 104 and is configured to perform vertical polishing with respect to a surface of a roll by bringing the polishing surface 112 into contact with the surface of the roll. The through hole 102 has an inner peripheral surface 110 that has the same diameter from the back end face 108 of the rotary grinding stone body 104 to the front end face 106 thereof. That is, the through hole 102 has a straight inner diameter.

10 **[0009]** During the roll polishing, the polishing surface of the roll polishing rotary grinding stone and the surface of the roll are scraped off by polishing to generate polishing debris. However, the related-art roll polishing rotary grinding stone has a problem in that polishing debris to be generated during the polishing is accumulated in a recess being a through hole portion at the center portion of the roll polishing rotary grinding stone during the polishing of the roll, and the accumulated polishing debris is brought into contact with the surface of the roll to make the surface roughness of a surface to be processed non-uniform, with the result that it is required to frequently check and clean the through hole portion.

### Prior Art Documents

#### Patent Documents

#### **[0010]**

40 Patent Document 1: JP 3105512 U  
Patent Document 2: JP 2000-24935 A  
Patent Document 3: JP 2000-127005 A  
Patent Document 4: WO 2011/125926

#### 45 Disclosure of the Invention

#### Problems to be solved by the Invention

50 **[0011]** The present invention has an object to provide a roll polishing rotary grinding stone, a roll polishing device, and a roll polishing method, with which roll polishing can be stably performed without making the surface roughness of a surface to be processed non-uniform by preventing polishing debris to be generated during polishing from being accumulated in a recess at a center of a polishing surface of the roll polishing rotary grinding stone.

### Means for Solving Problems

**[0012]** In order to solve the above-mentioned problem, a roll polishing rotary grinding stone according to the present invention is a roll polishing rotary grinding stone including: a rotary grinding stone body having a rotary shaft mounted on a back end face and a polishing surface formed on a front end face; and a recess formed at a center of the front end face of the rotary grinding stone body, the roll polishing rotary grinding stone being configured to perform vertical polishing with respect to a surface of a roll by bringing the polishing surface into contact with the surface of the roll, wherein the recess is formed into a tapered recess in which an inner peripheral surface of the recess is increased in diameter from the back end face of the rotary grinding stone body toward the front end face of the rotary grinding stone body.

**[0013]** As the roll, any roll made of a metal, such as a gravure plate-making roll, a rolling roll, or a conveyance roll, can be employed, but the gravure plate-making roll is preferred.

**[0014]** A roll polishing device according to the present invention is a roll polishing device including the roll polishing rotary grinding stone.

**[0015]** A roll polishing method according to the present invention is a roll polishing method, which uses the said roll polishing rotary grinding stone.

### Advantageous Effects of the Invention

**[0016]** According to the present invention, a remarkable effect can be obtained, which is capable of providing a roll polishing rotary grinding stone, a roll polishing device, and a roll polishing method in which roll polishing can be stably performed without making the surface roughness of a surface to be processed non-uniform by preventing polishing debris generated during the polishing from being accumulated in a recess at a center of a polishing surface of the roll polishing rotary grinding stone body.

### Brief Description of Drawings

#### **[0017]**

FIG. 1 is a schematic plan view for schematically illustrating a roll polishing method using one embodiment of a roll polishing rotary grinding stone according to the present invention.

FIG. 2 is a schematic side view for illustrating one embodiment of the roll polishing rotary grinding stone according to the present invention, in a state where the roll polishing rotary grinding stone is brought into abutment against a surface of a roll.

FIGS. 3 are each a view for illustrating one embodiment of the roll polishing rotary grinding stone according to the present invention, in which part (a) is a plan view, and part (b) is a side sectional view.

FIG. 4 is a side sectional view for illustrating another embodiment of a roll polishing rotary grinding stone according to the present invention.

FIG. 5 is an enlarged photograph for showing a state of a roll polishing rotary grinding stone after roll polishing in Example 1.

FIGS. 6 are each a view for illustrating a related-art roll polishing rotary grinding stone, in which part (a) is a plan view, and part (b) is a side sectional view.

FIG. 7 is an enlarged photograph for showing a state of a roll polishing rotary grinding stone after roll polishing in Comparative Example 1.

### Description of Embodiments

**[0018]** Embodiments of the present invention are described below, but these embodiments are described as examples, and hence it is understood that various modifications may be made thereto without departing from the technical spirit of the present invention. In addition, the same members are represented by the same reference symbols.

**[0019]** In FIG. 1 to FIG. 3, there are illustrated one embodiment of roll polishing rotary grinding stones 10a and 10b according to the present invention.

**[0020]** The roll polishing rotary grinding stones 10a and 10b include rotary grinding stone bodies 20a and 20b, respectively, the rotary grinding stone bodies having rotary shafts 14a and 14b mounted on back end faces 12a and 12b, respectively, and polishing surfaces 18a and 18b formed on front end faces 16a and 16b, respectively, and recesses 22a and 22b, which are formed at centers of the front end faces 16a and 16b of the rotary grinding stone bodies 20a and 20b, and are configured to perform vertical polishing with respect to a surface 26 of a roll 24 by bringing the polishing surfaces 18a and 18b into abutment against the surface 26 of the roll 24. The recesses 22a and 22b are each formed into a tapered recess 30 in which the inner peripheral surface 28 of each of the recesses 22a and 22b is increased in diameter from the back end faces 12a and 12b of the rotary grinding stone bodies 20a and 20b toward the front end faces 16a and 16b thereof. That is, the recesses 22a and 22b each have a tapered inner diameter.

**[0021]** The recesses 22a and 22b are each formed into the tapered recesses 30, and hence polishing debris, which is to be generated during the polishing, and is liable to be accumulated in the recesses 22a and 22b, is automatically discharged outside due to a centrifugal force caused by rotation of the roll polishing rotary grinding stones 10a and 10b. Therefore, the polishing debris is less liable to be accumulated in the recesses 22a and 22b, with the result that roll polishing can be stably performed without making the surface roughness of the surface of the roll, which is a surface to be processed, non-uniform by preventing the polishing debris from being accumulated in the recesses 22a and 22b. The polishing debris is generated when each polishing surface of the

roll polishing rotary grinding stones 10a and 10b is scraped off by polishing or when the surface of the roll is scraped off by polishing.

**[0022]** It is preferred that the tapered recess 30 have a taper angle of, for example, from 1° to 45°.

**[0023]** As the roll 24, an example of a gravure plate-making roll is illustrated, and an example of the roll in a state in which copper plating is formed on a surface of a hollow roll made of a metal such as aluminum or iron is illustrated. The roll 24 has a through hole 32 formed in an axial direction and is rotatably supported by chuck cones 34a and 34b.

**[0024]** In the example of FIG. 1, there is illustrated an example in which the two roll polishing rotary grinding stones 10a and 10b are provided on one side of the roll 24. In other words, the case in which one-side two-head polishing is performed is illustrated in the example of FIG. 1. However, two roll polishing rotary grinding stones may be provided on each side of the roll 24 so as to perform four-head polishing as disclosed in Patent Document 3. Further, the two roll polishing rotary grinding stones 10a and 10b illustrated in FIG. 1 can be rotated in synchronization with each other or moved in the same direction in synchronization with each other.

**[0025]** A roll polishing device including the roll polishing rotary grinding stone of the present invention is obtained by mounting the roll polishing rotary grinding stones 10a and 10b on a roll polishing device such as a known roll polishing machine for a gravure plate-making roll. As examples of the roll polishing device, there are given, for example, a grinding stone polishing device described in Patent Document 3 and a grinding stone polishing device described in Patent Document 4. A roll polishing method of the present invention is achieved by performing roll polishing through use of the roll polishing rotary grinding stones 10a and 10b.

**[0026]** In the example of FIG. 1 to FIGS. 3, there is illustrated a case in which a through hole is formed as each of the recesses 22a and 22b. However, for example, a hole that does not penetrate through a rotary grinding stone body as illustrated in FIG. 4 may be formed instead of the through hole.

**[0027]** In FIG. 4, a roll polishing rotatory grinding stone 36 includes a rotary grinding stone body 50 having a rotary shaft mounted on a back end face 40 and a polishing surface 48 formed on a front end face 38, and a recess 42 formed at a center of the front end face 38 of the rotary grinding stone body 50, and the recess 42 is formed into a tapered recess 46 in which an inner peripheral surface 44 of the recess 42 is increased in diameter from the back end face 40 of the rotary grinding stone body 50 to the front end face 38 thereof. The tapered recess 46 is a hole that is merely dented and does not penetrate through the rotary grinding stone body 50. The configurations other than that of the tapered recess 46 are the same as those of the roll polishing rotary grinding stone 10a.

**[0028]** Also in the roll polishing rotary grinding stone

36 illustrated in FIG. 4, the recess 42 is formed into the tapered recess 46, and hence polishing debris, which is to generated during the polishing, and is liable to be accumulated in the recess 42 is automatically discharged outside due to a centrifugal force caused by rotation of the roll polishing rotary grinding stone 36. Therefore, the polishing debris is less liable to be accumulated in the recess 42, with the result that roll polishing can be stably performed without making the surface roughness of the surface of the roll, which is a surface to be processed, non-uniform by preventing the polishing debris from being accumulated in the recess 42.

Example

**[0029]** The present invention is hereinafter described in more detail by referring to examples, but it is needless to say that these examples are only illustrative and not intended to be interpreted in a limited way.

(Example 1)

**[0030]** A hollow roll made of aluminum having a circumference of 600 mm and a surface length of 1,100 mm was loaded in a copper plating processing device, and the hollow roll was completely immersed in a plating solution in a copper plating bath, to thereby form a copper-plated layer of 40 μm at 20 A/dm<sup>2</sup> and 6.0 V. No nodules and pits were generated on the plated surface, and a uniform copper-plated layer serving as a base material was obtained. The surface of the copper-plated layer of the roll was polished through use of a two-head polishing machine (polishing machine manufactured by Think Laboratory Co., Ltd.) having the roll polishing rotary grinding stones of the present invention illustrated in FIG. 1 to FIGS. 3 mounted thereon, to thereby form the surface of the roll into a uniform polished surface.

**[0031]** Roll polishing was performed at a rotation number of the roll of 120 rpm, a rotation number of each of the rotary grinding stones of 800 rpm, and a feed speed of each of the rotary grinding stones of 800 mm/min. FIG. 5 is a photograph obtained by photographing the used roll polishing rotary grinding stone after polishing. As shown in FIG. 5, the accumulation of polishing debris to be generated during the polishing in a recess at a center of a polishing surface of the roll polishing rotary grinding stone body was hardly observed.

(Comparative Example 1)

**[0032]** Similarly to the manner as in Example 1, a hollow roll made of aluminum having a circumference of 600 mm and a surface length of 1,100 mm was loaded in a copper plating processing device, and the hollow roll was completely immersed in a plating solution in a copper plating bath, to thereby form a copper-plated layer of 40 μm at 20 A/dm<sup>2</sup> and 6.0 V. No nodules and pits were generated on the plated surface, and a uniform copper-

plated layer serving as a base material was obtained. The surface of the copper-plated layer of the roll was polished through use of a two-head polishing machine (polishing machine manufactured by Think Laboratory Co., Ltd.) having a related art roll polishing rotary grinding stones illustrated in FIG. 6 mounted thereon, to thereby form the surface of the copper-plated layer into a uniform polished surface.

**[0033]** Roll polishing was performed at a rotation number of the roll of 120 rpm, a rotation number of each of the rotary grinding stones of 800 rpm, and a feed speed of each of the rotary grinding stones of 800 mm/min. FIG. 7 is a photograph obtained by photographing the used roll polishing rotary grinding stone after polishing. As shown in FIG. 7, the accumulation of polishing debris to be generated during the polishing in a through hole (recess) at a center portion of the polishing surface of the roll polishing rotary grinding stone was largely accumulated.

Reference Signs List

**[0034]** 10a, 10b, 36: roll polishing rotary grinding stone of the present invention, 12a, 12b 40: back end face, 14a, 14b: rotary shaft, 16a, 16b, 38: front end face, 18a, 18b, 48: polishing surface, 20a, 20b, 50: rotary grinding stone body, 22a, 22b, 42: recess, 24: roll, 26: roll surface, 28, 44: inner peripheral surface, 30, 46: tapered recess, 32: through hole, 34a, 34b: chuck cone, 100: related art rotary grinding stone, 102: through hole, 104: rotary grinding stone body, 106: front end face, 108: back end face, 110: inner peripheral surface, 112: polishing surface.

**Claims**

1. A roll polishing rotary grinding stone, comprising:

a rotary grinding stone body having a rotary shaft mounted on a back end face and a polishing surface formed on a front end face; and a recess formed at a center of the front end face of the rotary grinding stone body, the roll polishing rotary grinding stone being configured to perform vertical polishing with respect to a surface of a roll by bringing the polishing surface into contact with the surface of the roll, wherein the recess is formed into a tapered recess in which an inner peripheral surface of the recess is increased in diameter from the back end face of the rotary grinding stone body toward the front end face of the rotary grinding stone body.

2. A roll polishing rotary grinding stone according to claim 1, wherein the roll is a gravure plate-making roll.

- 3. A roll polishing device, comprising the roll polishing rotary grinding stone of claim 1 or 2.
- 4. A roll polishing method, which uses the roll polishing rotary grinding stone of claim 1 or 2.

FIG.1

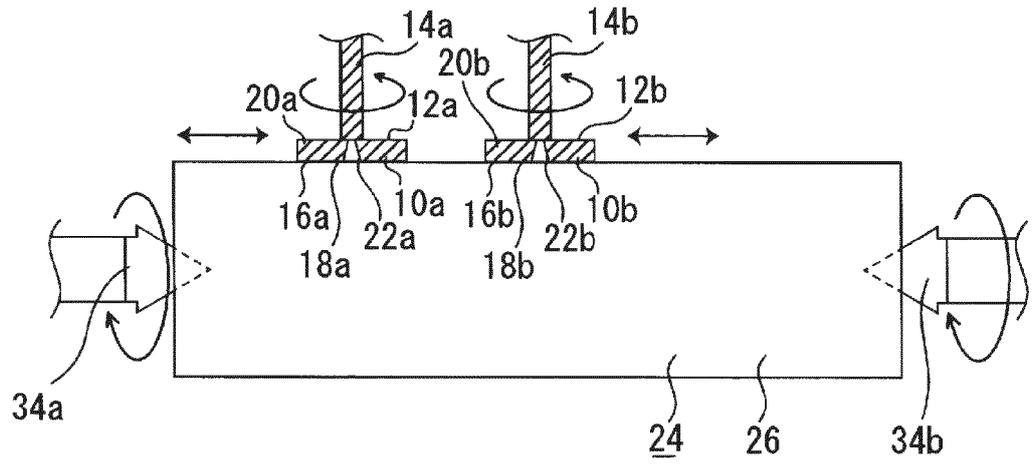


FIG.2

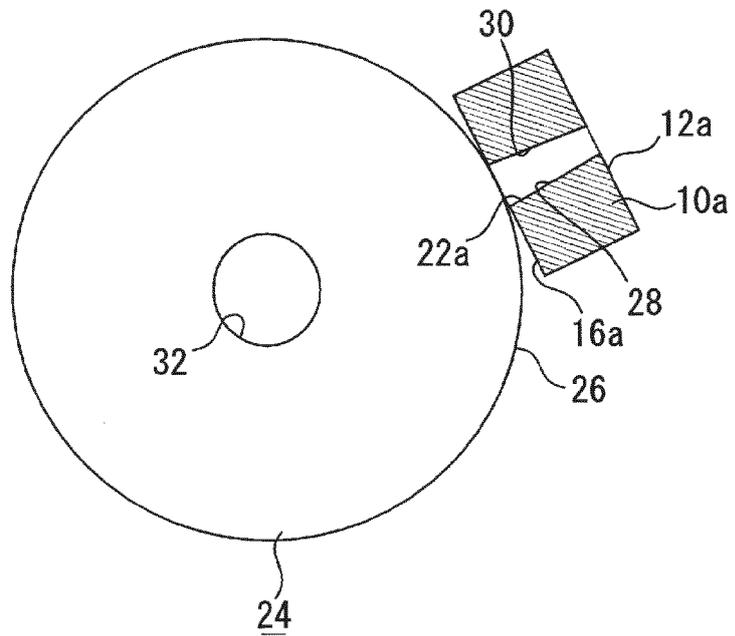


FIG.3

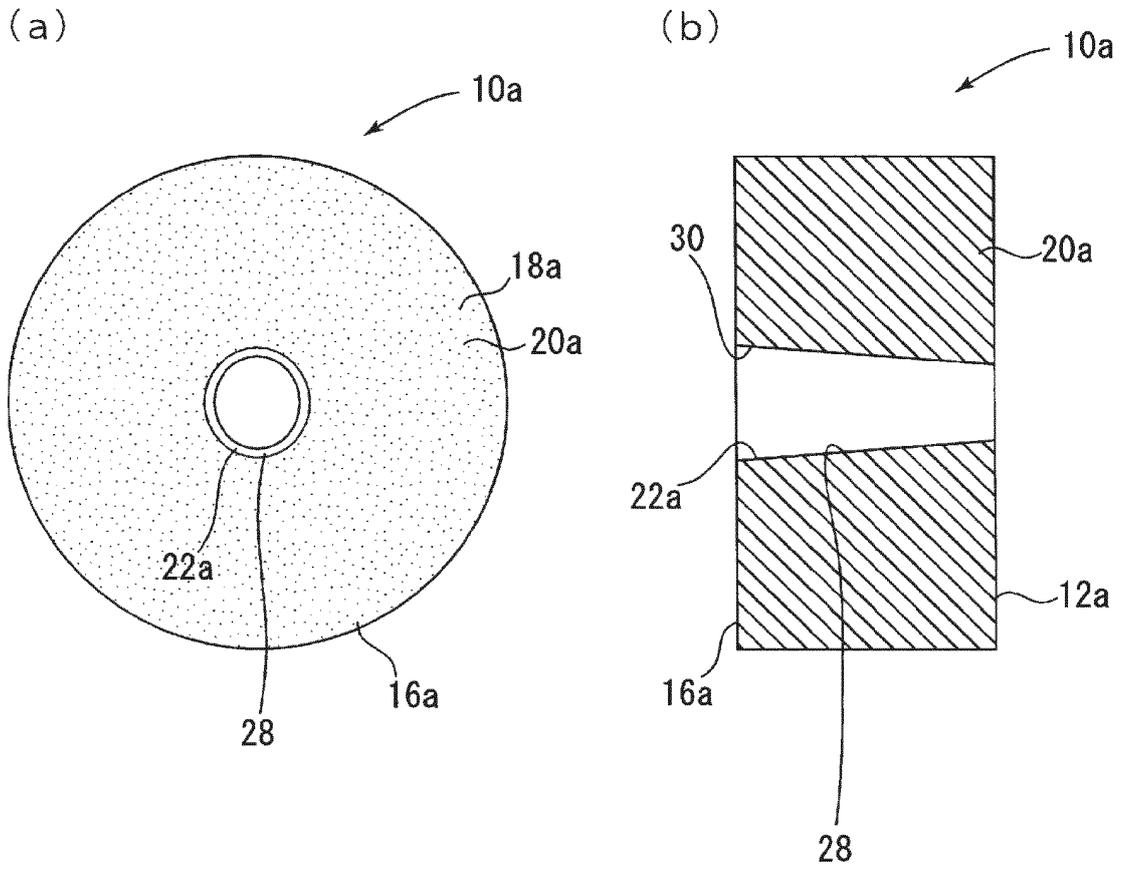


FIG.4

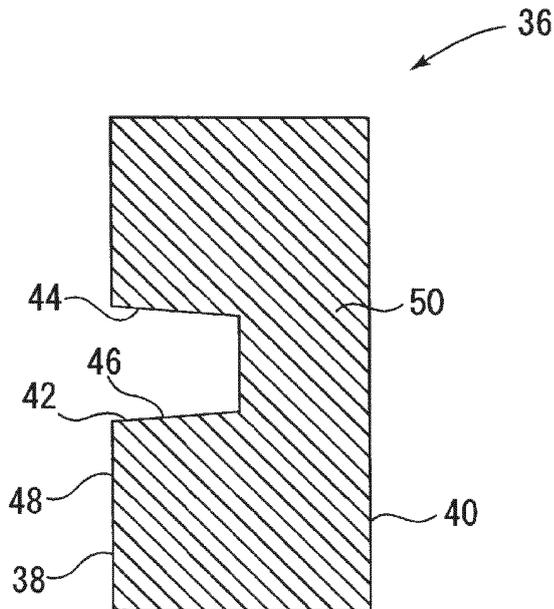


FIG.5

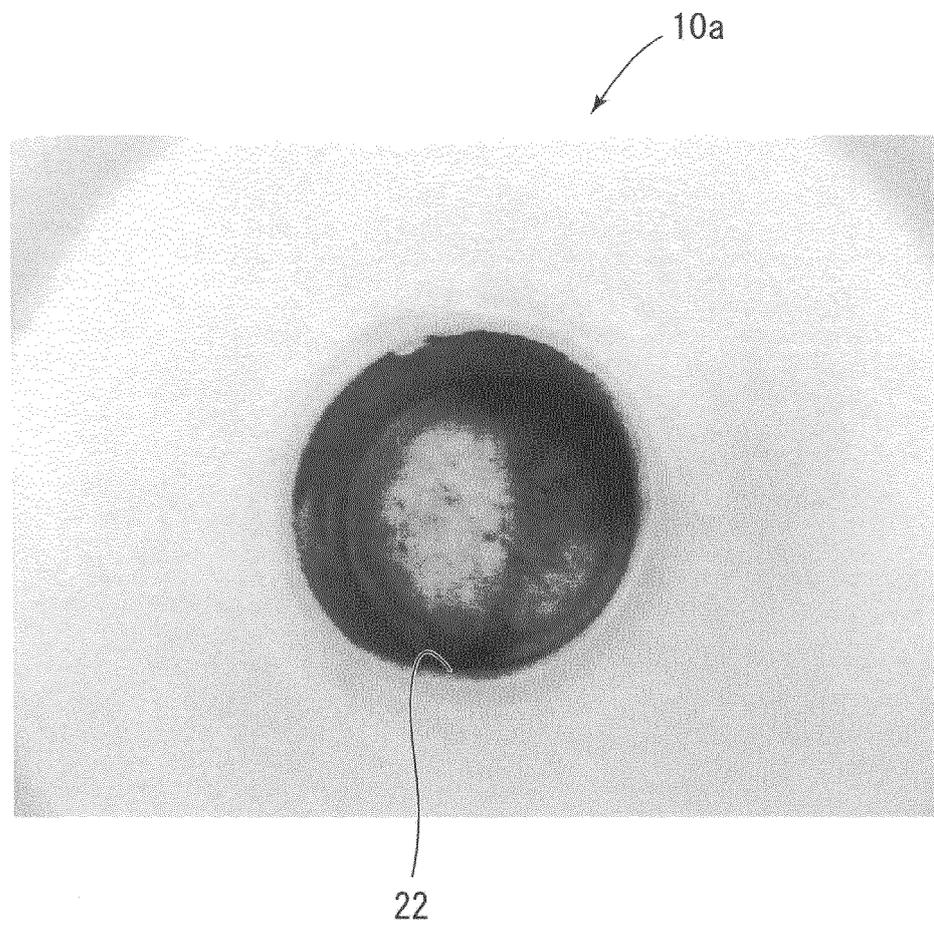


FIG.6

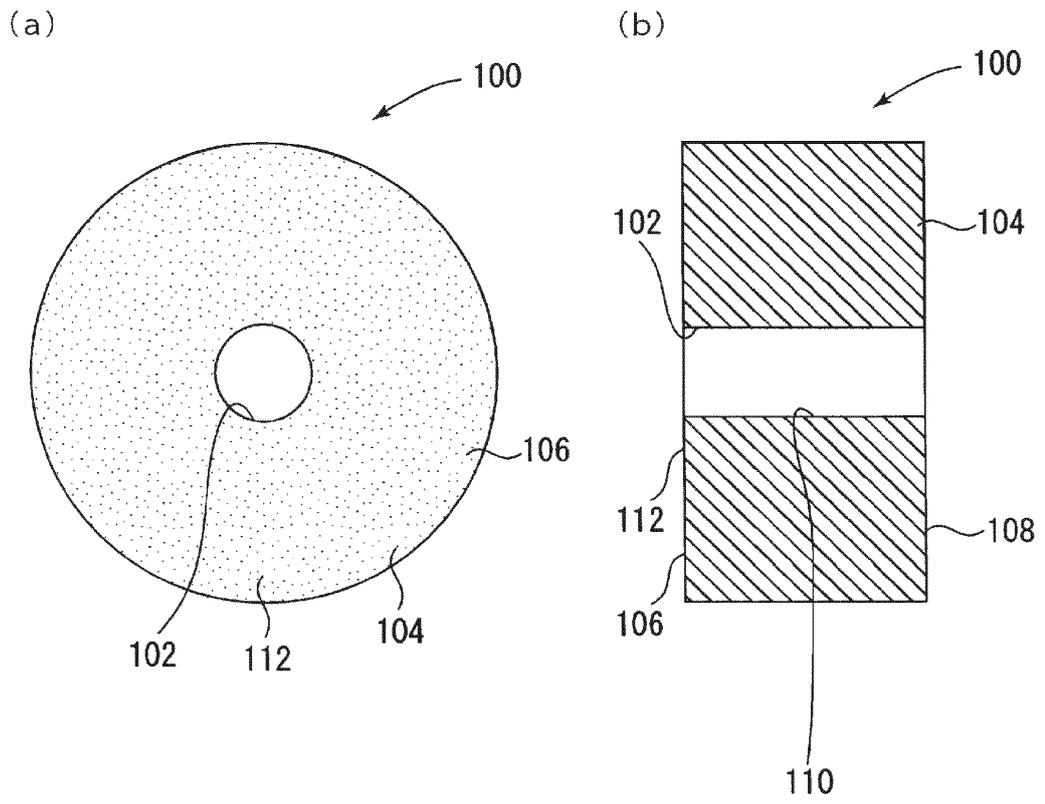
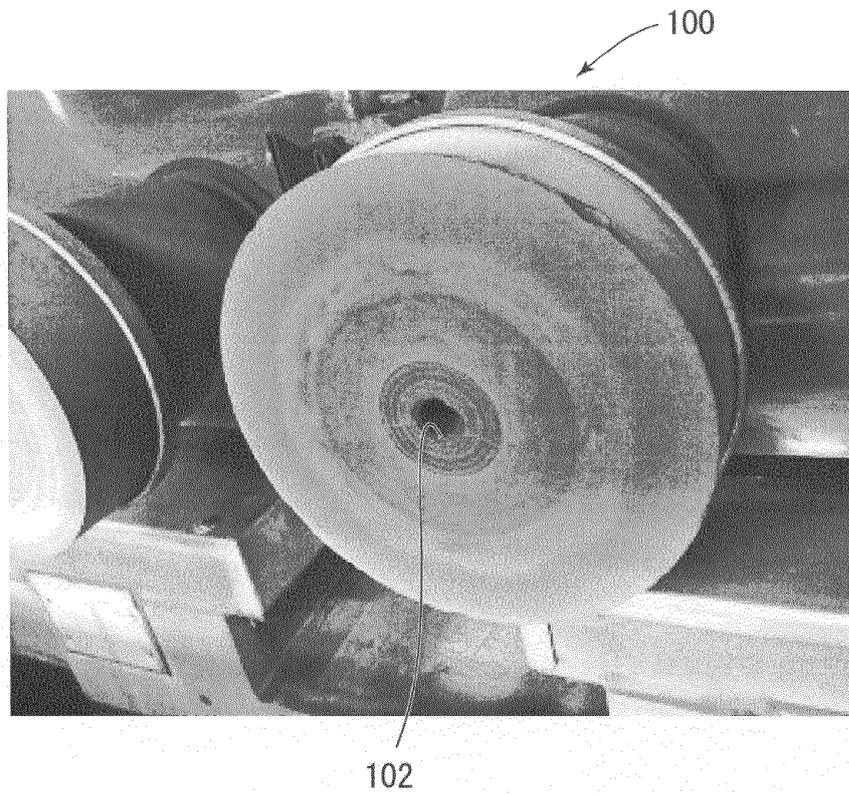


FIG.7



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/023858

## A. CLASSIFICATION OF SUBJECT MATTER

B24D7/00(2006.01)i, B24B5/04(2006.01)i, B24D7/18(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B24D7/00, B24B5/04, B24D7/18

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2017
Kokai Jitsuyo Shinan Koho	1971-2017	Toroku Jitsuyo Shinan Koho	1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2000-127005 A (Think Laboratory Co., Ltd.), 09 May 2000 (09.05.2000), paragraphs [0001] to [0013]; fig. 1, 5 (Family: none)	1-4
Y	JP 2011-25382 A (Sanko Seito Kabushiki Kaisha), 10 February 2011 (10.02.2011), paragraphs [0005] to [0007], [0011], [0027], [0036]; fig. 2 & CN 201728598 U	1-4

 Further documents are listed in the continuation of Box C. See patent family annex.

\* Special categories of cited documents:

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

31 July 2017 (31.07.17)

Date of mailing of the international search report

08 August 2017 (08.08.17)

Name and mailing address of the ISA/

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**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- JP 3105512 U [0010]
- JP 2000024935 A [0010]
- JP 2000127005 A [0010]
- WO 2011125926 A [0010]