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(54) **INTERLEAVING PAPER FOR GLASS AND PRODUCTION METHOD THEREFOR**

(57) The purpose of the present invention is to provide glass interleaving paper capable of reducing the occurrence of glass plate tarnishing, and a production method therefor. Provided is glass interleaving paper, which includes a main component of chemical pulp, a sodium content of 0.03 to 1.0% by mass, and the glass interleaving paper has a basis weight of 10 to 300 g/m², and the chemical pulp contains hardwood pulp having a ratio of 10% by mass or more to the chemical pulp. Also provided is a production method of said glass interleaving paper

characterized in that the method includes producing the chemical pulp, papermaking, and using sodium-containing water at least one of in the producing the chemical pulp and in the papermaking. Also provided is a production method of said glass interleaving paper characterized in that the method includes producing the chemical pulp, papermaking, and adding a sodium-containing compound at least one of in the producing the chemical pulp, in the papermaking, and after the papermaking.

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Description**TECHNICAL FIELD**

5 **[0001]** The present invention relates to glass interleaving paper inserted between glass plates, and a method of producing the same.

BACKGROUND ART

10 **[0002]** In recent years, due to the versatility of glass plates, quality requirements for glass interleaving paper have become stricter. For example, in a glass substrate used for a flat panel display such as a liquid crystal display or a touch panel, fine electronic members and the like are formed on the surface of the glass substrate. For this reason, a slight scratch or contamination on the surface causes defects such as disconnection, leading to a product defect. Therefore, the surface of a glass substrate is required to have a high degree of clarity.

15 **[0003]** With the increase in size and mass production of glass substrates, glass substrates are often transported in layers for the purpose of improving transport efficiency. When glass substrates are stacked, the contact pressure between the glass interleaving paper and the glass substrates increases, which as a result increases the probability that trace components, foreign matter, and the like in the glass interleaving paper affect the glass substrates to cause contamination or defects therein. Meanwhile, with the highly precise processing on glass substrates, a higher degree of clarity is required on the surfaces of the glass substrates. Under these circumstances, the quality requirements for glass interleaving paper are becoming increasingly higher.

20 **[0004]** There are several possible causes for contamination of the glass substrate surface. Soda glass used in a glass substrate for a touch panel has a problem that if the contact period between the glass interleaving paper and the surface of the glass substrate is long, a paper surface pattern or discoloration is likely to develop on the surface of the glass substrate. Discoloration is a phenomenon in which the surface looks white and cloudy because, for example, soluble components such as sodium ions in the glass substrate and hydrogen ions derived from water and the like undergo an ion exchange reaction to erode and damage the surface of the glass substrate, or the eluted components react with an acid gas such as carbon dioxide in the air to precipitate a reaction product.

25 **[0005]** Various methods have been proposed to prevent such discoloration of the glass substrate surface. For example, Patent Literature 1 discloses glass plate interleaving paper containing zeolite as glass plate interleaving paper that suppresses the development of discoloration of the glass plate and does not cause water repellency or paper mark adhesion of the glass plate.

CITATION LIST

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Patent Literature

[0006] Patent Literature 1: Japanese Patent Application Publication No. Hei 7-41034

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SUMMARY OF INVENTION**Technical Problem**

45 **[0007]** However, the method for blending zeolite described in Patent Literature 1 has not always had a sufficient effect on discoloration.

[0008] The present invention has been made in view of the above circumstances. Specifically, an object of the present invention is to provide glass interleaving paper capable of reducing the development of discoloration of a glass plate, and a method of producing the same.

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Solution to Problem

[0009] In order to solve the above problems, the present inventor has examined the influence of metal ions on the development of discoloration, and have found that glass interleaving paper with a relatively high sodium content reduces the development of discoloration, and that when hardwood pulp is blended, discoloration tends to be less likely to develop as compared with the case where hardwood pulp is not blended. The present invention has been made based on these findings. Specifically, the present invention has the following configuration.

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(1) Glass interleaving paper including: a main component of chemical pulp, with a sodium content of 0.03 to 1.0%

by mass and a basis weight of 10 to 300 g/m², wherein the chemical pulp contains hardwood pulp having a ratio of 10% by mass or more to the chemical pulp.

(2) A method of producing the glass interleaving paper according to (1) described above, including: producing the chemical pulp, papermaking, and using sodium-containing water at least one of in the producing the chemical pulp and in the papermaking.

(3) A method of producing the glass interleaving paper according to (1) described above, including: producing the chemical pulp, papermaking, and adding a sodium-containing compound at least one of in the producing the chemical pulp, the papermaking, and after the papermaking.

(4) The method of producing glass interleaving paper according to (3) described above, wherein the sodium-containing compound is sodium sulfate.

Advantageous Effects of Invention

[0010] According to glass interleaving paper of the present invention, it is possible to reduce the development of discoloration of the glass plate. In addition, according to the method of producing glass interleaving paper of the present invention, the glass interleaving paper can be produced.

DESCRIPTION OF EMBODIMENTS

[0011] Hereinafter, the present invention is specifically described. The embodiments shown below are examples, and the present invention is not construed as being limited to these embodiments.

[0012] The glass interleaving paper of the present embodiment contains chemical pulp as a main component and sodium. Each component is described below.

(Chemical Pulp)

[0013] The glass interleaving paper of the present embodiment (hereinafter, also appropriately referred to as "interleaving paper") contains chemical pulp as a main component. Here, the phrase contains chemical pulp as a main component means that the chemical pulp exceeds 50% by mass based on the mass of the interleaving paper. The chemical pulp is preferably 70% by mass or more, and more preferably 90% by mass or more, based on the mass of the interleaving paper. The chemical pulp is a cellulose pulp produced through a chemical process, and examples thereof include kraft pulp (KP), sulfite pulp (SP), and soda pulp (AP).

[0014] Chemical pulp (wood pulp) made from wood includes softwood pulp and hardwood pulp. The present inventor has found that when hardwood pulp is blended as chemical pulp, discoloration tends to be less likely to develop as compared with the case where hardwood pulp is not blended. The reason why discoloration is less likely to develop when hardwood pulp is blended is considered as follows. Suppose glass plates and interleaving paper are stacked and stored. When the interleaving paper absorbs moisture and stretches due to the influence of a high humidity environment such as summer, wrinkles are formed, a gap is produced between the glass plate and the interleaving paper, and high humidity air comes into direct contact with the glass plate. High humidity air tends to develop discoloration, which is described later. Therefore, it is possible to suppress the development of discoloration by using paper that hardly causes wrinkles even when it absorbs moisture. Since hardwood pulp has a shorter fiber length than that of softwood pulp, increasing the amount of hardwood pulp can improve the texture of the paper to suppress the development of wrinkles due to moisture absorption, and prevent the production of gaps between the glass plate and the interleaving paper to reduce the amount of discoloration developed.

[0015] Specifically, in the interleaving paper of the present embodiment, the ratio of hardwood pulp to the chemical pulp is set to 10% by mass or more in order to reduce the amount of discoloration developed. The ratio of hardwood pulp to chemical pulp is preferably 40% by mass or more, and more preferably 70% by mass or more.

[0016] Furthermore, as the wood pulp, kraft pulp (KP) having a low content of a sticky natural resin derived from wood is suitable. Examples of chemical pulp that is not made from wood include non-wood fiber pulp made from mulberry, oriental paperbush, hemp, kenaf, and the like.

[0017] Examples of pulp other than chemical pulp include semi-chemical pulp such as semi-chemical pulp (SCP) and chemigroundwood pulp (CGP); and mechanical pulp such as ground pulp (GP), thermomechanical pulp (TMP, BCTMP), and refiner groundwood pulp (RGP). The glass interleaving paper of the present embodiment may be one or a mixture of two or more types of pulp other than chemical pulp.

[0018] Since used paper pulp generally contains a large amount of sticky foreign matter, impurities, and resin, virgin pulp is preferable rather than used paper pulp as a pulp raw material for interleaving paper.

[0019] The beating degree of the chemical pulp is preferably 200 to 700 mlcsf. Here, the beating degree is the Canadian standard freeness according to JIS P8121. By setting the beating degree of the chemical pulp in the range of 200 to

700 mlcsf, it is possible to obtain the mechanical strength and workability required for the interleaving paper. When the beating degree of the chemical pulp is less than 200 mlcsf, the density of the interleaving paper tends to be high and the cushioning property tends to be low, so that the glass surface may be easily scratched. On the other hand, when the beating degree of the chemical pulp is higher than 700 mlcsf, the paper strength is weakened, and thus there is a risk of breakage in the distribution process or producing process. The beating degree of the chemical pulp is more preferably 350 to 600 mlcsf. As for the method of beating the pulp, a known method can be used.

(Discoloration of Glass Plate)

[0020] Conventionally, the following two mechanisms have been considered as the mechanism of the discoloration of glass plates. Specifically, when water droplets adhere to the surface of a glass plate, a trace amount of sodium ions in the glass dissolve into water, sodium hydroxide is generated on the surface of the glass plate, the surface of the glass plate is eroded and roughened, and the glass plate becomes cloudy. In addition, when the water droplets on the surface of the glass plate evaporate, sodium ions react with carbon dioxide in the air to generate sodium carbonate and sodium hydrogen carbonate, which adhere to the surface of the glass plate and make the glass plate cloudy.

[0021] In the case of the above-mentioned conventional discoloration, the white turbidity of the glass plate can be confirmed by using a fluorescent lamp having a general brightness. However, it has become clear that there is a type of minute (micro) discoloration different from the above-mentioned conventional discoloration in a glass substrate for a touch panel or the like. This minute discoloration cannot be seen unless it is inspected in a dark room using a high-brightness lamp. In a glass substrate or the like for a touch panel, fine electronic members or the like are formed on the surface of the glass substrate. Therefore, even a minute discoloration that cannot be visually recognized unless it is inspected in a dark room using a high-brightness lamp is a problem because it causes defects such as disconnection, leading to a product defect.

(Sodium)

[0022] The present inventor has found that when the interleaving paper contains a predetermined amount of sodium, the above-mentioned minute discoloration tends to be less likely to develop. That is, the interleaving paper of the present embodiment has a sodium content of 0.03 to 1.0% by mass. When the sodium content is 0.03% by mass or more, the amount of discoloration developed can be reduced. On the other hand, when the sodium content exceeds 1.0% by mass, there is a concern that sodium salts may precipitate in the interleaving paper and contaminate the glass plate. The content of sodium in the interleaving paper is more preferably 0.05 to 0.5% by mass, and further preferably 0.1 to 0.3% by mass. The sodium content in the interleaving paper can be specified by measuring the ash content of the interleaving paper and further measuring the sodium content in the ash content by fluorescent X-ray analysis.

[0023] Although it is necessary to wait for further research to clarify the cause and mechanism of the glass plate causing the above-mentioned minute discoloration, it is thought that the cause is the ion exchange reaction between sodium in the glass and hydrogen ions in water. Then, it is considered that the minute discoloration is caused by the following mechanism.

[0024] A soda glass plate is usually used as the glass substrate for a touch panel. The soda glass plate has a scratch-preventing protective film made of sulfate on the surface of the glass plate. The scratch-preventing protective film is formed by spraying sulfurous acid gas onto the surface of the glass plate during the production of the glass plate to react sodium in the glass plate with sulfurous acid gas, thereby generating sodium sulfate on the surface of the glass plate. When sulfurous acid gas is sprayed, sodium in the glass plate bleeds (moves) near the surface, and thus the amount of sodium is deficient near the surface of the glass plate. It is presumed that this causes minute discoloration.

[0025] However, when the content of sodium in the interleaving paper is high, it has the effect of suppressing the sodium ions in the glass plate from bleeding (moving) to the interleaving paper. Furthermore, it also has the effect of transferring the sodium ions in the interleaving paper to the sodium-deficient portion near the surface of the glass plate through the scratch-preventing protective film made of sodium sulfate. As a result, the abundance of sodium ions in the glass plate is stabilized, suppressing the ion exchange reaction between sodium ions and hydrogen ions in the interleaving paper or in water vapor in the air. It is presumed that this reduces the development of discoloration without increasing the abundance of hydrogen ions in the glass plate.

[0026] As a method of controlling the content of sodium in the interleaving paper to 0.03 to 1.0% by mass, there are a method (first method) including using sodium-containing water in at least one of a producing step of the chemical pulp and a papermaking step, and a method (second method) including adding a sodium-containing compound in at least one step of a producing step of the chemical pulp, a papermaking step, and a post-papermaking step.

[0027] In the first method, by appropriately controlling the sodium content in the water used in at least one step of the producing step of the chemical pulp and the papermaking step, it is possible to adjust the sodium content in the finally obtained interleaving paper. Sodium is a component generally contained in water. So-called soft water has a relatively

low sodium content, and hard water contains a relatively large amount of sodium. The hardness of the sodium-containing water is preferably 70 to 500 (mg/l), and more preferably 120 to 400 (mg/l). In addition, the electrical conductivity of water is preferably 14 to 100 mS/m, and more preferably 24 to 33 mS/m. The sodium-containing water may be used in both the producing step of the chemical pulp and the papermaking step, or may be used in either step. When sodium is dissolved in the water used for the producing step of the chemical pulp or the papermaking step, in the chemical pulp, the carboxy groups contained therein can form salts with metal ions to retain sodium inside. In addition, since the paper is produced by drying wet paper, a certain amount of sodium in the water can be retained.

[0028] Examples of the second method include a method (internal addition method) that adds a sodium-containing compound to the raw materials in at least one step of the producing step of the chemical pulp and the papermaking step, a method (watering method) that uses water in which a sodium-containing compound is dissolved and dispersed in at least one step of the producing step of the chemical pulp and the papermaking step, a method (coating method) that coats the surface of the interleaving paper with an aqueous solution in which a sodium-containing compound is dissolved and dispersed in the post-papermaking step, and the like. Among these, a coating method capable of containing sodium more efficiently is preferable.

(Sodium Sulfate)

[0029] In the second method, sodium sulfate (Glauber's salt, Na_2SO_4) is preferable as the sodium-containing compound. Sodium sulfate may be used as a raw material for glass.

[0030] The amount of sodium sulfate added to the interleaving paper is preferably 0.03 to 1.5% by mass, more preferably 0.05 to 1.0% by mass, and further preferably 0.1 to 0.6% by mass. If the amount of sodium sulfate added exceeds 1.5% by mass, sodium sulfate particles may precipitate on the surface of the glass plate, causing a problem.

[0031] As described above, by specifying the ratio of hardwood pulp to chemical pulp and the content of sodium in the interleaving paper, it is possible to reduce the development of discoloration of the glass plate.

(Papermaking Chemical)

[0032] As the papermaking chemicals used for papermaking of the interleaving paper, various known chemicals can be used as long as the glass surface is not contaminated. Examples of papermaking chemicals include paper strength enhancers such as polyacrylamide, water resistant agents such as polyamide polyamine epichlorohydrin, softeners, antistatic agents, defoamers, slime control agents, fillers, and dyes. Since all of these papermaking chemicals have a risk of contaminating the glass plate, it is preferable that the total amount is 0.1% by mass or less even when added.

(Method of Producing Glass Interleaving Paper)

[0033] The method of producing the interleaving paper is not particularly limited, and the papermaking it possible by selecting appropriate papermaking conditions using various papermaking machines. Specific examples of the paper-making machine include a Fourdrinier former, a twin wire former, a cylinder former, and an inclined former. The layer structure of the interleaving paper may be a single layer or multi-layer structure. As a method of controlling the sodium content in the interleaving paper to 0.03 to 1.0% by mass, the above-mentioned first method or second method can be used.

(Characteristics of Glass Interleaving Paper)

[0034] It is preferable that the basis weight of the interleaving paper is small because the mass during transportation is small, but if it is too small, sufficient cushioning cannot be imparted to the glass plate. On the other hand, it is preferable that the basis weight of the interleaving paper is large to some extent in terms of cushioning, but if it is too large, the mass during transportation becomes large, which is not preferable. Considering the balance between cushioning and transportability as well as the applications, the basis weight of the interleaving paper is 10 to 300 g/m². In addition, the more preferable basis weight of the interleaving paper is 30 to 80 g/m².

[0035] The thickness of the interleaving paper is preferably 25 to 250 μm from the viewpoint of cushioning and workability. In addition, the density of the interleaving paper is preferably 0.4 to 1.2 g/cm³.

[0036] The pH (JIS P 8133-2) of the interleaving paper is preferably neutral.

[0037] The interleaving paper of the present embodiment is suitably used for protecting the glass substrate in the case of stacking, storing, and transporting multiple glass substrates for a flat panel display such as a glass substrate for a touch panel, a liquid crystal display, an organic electroluminescence display, and a plasma display.

Examples

[0038] Hereinafter, the present invention is described in detail with reference to Examples, but the present invention is not limited thereto. Note that the numerical value indicating the composition is a numerical value (% by mass) based on the mass of the solid content or active ingredients. In addition, unless otherwise specified, the paper made was processed according to JIS P8111 and then subjected to measurement and evaluation test.

(Examples 1 to 4 and Comparative Examples 1 and 2)

[0039] The materials used in the Examples and Comparative Examples are as follows.

Leaf bleached kraft pulp (LBKP): commercially available leaf bleached kraft pulp
Needle bleached kraft pulp (NBKP): commercially available needle bleached kraft pulp
Sodium sulfate: Tosoh Corporation, anhydrous neutral sodium sulfate

[0040] The electric conductivity of the water was measured using a portable electric conductivity meter ES-51 manufactured by HORIBA in accordance with JIS K 0130: 2008.

[Example 1]

[0041] Paper was made with a Fourdrinier paper machine using water with an electrical conductivity of 25 mS/m without adding papermaking chemicals and using a virgin pulp slurry (beating degree 450 mlcsf) having 80% of commercially available LBKP (hardwood bleached kraft pulp) and 20% of commercially available NBKP (softwood bleached kraft pulp) as the raw material pulp. After the papermaking, it was dried to obtain glass interleaving paper having a basis weight of 40 g/m². The sodium content of the obtained glass interleaving paper was 0.05%.

[Example 2]

[0042] Glass interleaving paper was obtained in the same manner as in Example 1 except for applying a sodium sulfate solution with a size press so that the amount of sodium sulfate added to the interleaving paper was 0.3% using water with an electrical conductivity of 3 mS/m. The sodium content of the obtained glass interleaving paper was 0.10%.

[Example 3]

[0043] Glass interleaving paper was obtained in the same manner as in Example 2 except that the amount of sodium sulfate added to the interleaving paper was 0.5%. The sodium content of the obtained glass interleaving paper was 0.18%.

[Example 4]

[0044] Glass interleaving paper was obtained in the same manner as in Example 3 except for using a virgin pulp slurry (beating degree 450 mlcsf) having 40% of commercially available LBKP (hardwood bleached kraft pulp) and 60% of commercially available NBKP (softwood bleached kraft pulp) as the raw material pulp. The sodium content of the obtained glass interleaving paper was 0.18%.

[Comparative Example 1]

[0045] Glass interleaving paper was obtained in the same manner as in Example 2 except that sodium sulfate was not added. The sodium content of the obtained glass interleaving paper was 0.01%.

[Comparative example 2]

[0046] Glass interleaving paper was obtained in the same manner as in Example 3 except for using a virgin pulp slurry (beating degree 450 mlcsf) having 100% of commercially available NBKP (softwood bleached kraft pulp) as the raw material pulp. The sodium content of the obtained glass interleaving paper was 0.18%.

(Evaluation Details)

[0047] The evaluation details of the obtained glass interleaving paper are as follows.

<Sodium Content in Interleaving Paper>

[0048] The ash content of the glass interleaving paper was determined according to JIS P8251. The sodium content (% by mass) in the obtained ash content was obtained from the measured value of the mass concentration using a fluorescent X-ray analyzer (JSX-3600M, manufactured by JEOL Ltd.). The sodium content m (% by mass) in the glass interleaving paper was determined by the following formula (1)

$$m = a \times b \dots (1),$$

where

m : sodium content (% by mass)

a : ash content (% by mass) of the glass interleaving paper

b : sodium content in the ash content (% by mass)

<Evaluation of Discoloration of Glass Plate>

[0049] A 200 mm × 200 mm touch panel glass plate was placed on a 210 mm × 210 mm glass interleaving paper, and three sets of this combination were alternately stacked, and then a weight of 1 kg was placed thereon to apply pressure, which was allowed to stand in an environment of a temperature of 50°C and a humidity of 90% RH for 4 days to prepare a sample. After washing the surface of the glass plate with water and drying it, a high-brightness lamp was irradiated in a dark room to observe white turbidity on the surface of the glass plate ($n = 3$). The discoloration of the glass plate was evaluated according to the following criteria. A was judged to be acceptable.

A: no cloudiness

B: partly cloudy

C: cloudy

[Table 1]

	LBKP (%)	NBKP (%)	Electrical Conductivity of Water (mS/m)	Amount of Sodium Sulfate Added (% by Mass)	Sodium Content (% by Mass)	Evaluation of Discoloration
Example 1	80	20	25	0	0.05	A
Example 2	80	20	3	0.3	0.10	A
Example 3	80	20	3	0.5	0.18	A
Example 4	40	60	3	0.5	0.18	A
Comparative Example 1	80	20	3	0	0.01	C
Comparative Example 2	0	100	3	0.5	0.18	B

[0050] Table 1 shows the evaluation results of Examples 1 to 4 and Comparative Examples 1 and 2. The glass interleaving papers of Examples 1 to 4 were excellent in terms of discoloration of the glass plate. On the other hand, the glass interleaving papers of Comparative Examples 1 and 2 were inferior in terms of discoloration of the glass plate.

Claims

1. Glass interleaving paper comprising:

a main component of chemical pulp; and
a sodium content of 0.03 to 1.0% by mass,

wherein the glass interleaving paper has a basis weight of 10 to 300 g/m², and
the chemical pulp contains hardwood pulp having a ratio of 10% by mass or more to the chemical pulp.

2. A method of producing the glass interleaving paper according to claim 1, the method comprising:

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producing the chemical pulp;
papermaking; and
using sodium-containing water at least one of in the producing the chemical pulp and in the papermaking.

- 10 3. A method of producing the glass interleaving paper according to claim 1, the method comprising:

producing the chemical pulp;
papermaking; and
15 adding a sodium-containing compound at least one of in the producing the chemical pulp, in the papermaking,
and after the papermaking.

4. The method of producing the glass interleaving paper according to claim 3, wherein the sodium-containing compound
is sodium sulfate.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/033410

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. D21H27/00(2006.01)i, B65D85/48(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)

Int.Cl. D21H27/00, B65D85/48

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

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2019

Registered utility model specifications of Japan 1996-2019

Published registered utility model applications of Japan 1994-2019

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 7-101483 A (ASAHI GLASS CO., LTD.) 18 April 1995, example 1, claim 1 (Family: none)	1-4
A	JP 6-316432 A (ASAHI GLASS CO., LTD.) 15 November 1994, examples, claim 1, paragraph [0001] (Family: none)	1-4
A	JP 2013-212939 A (AVANSTRATE INC.) 17 October 2013, example 1, paragraphs [0039], [0042], claims (Family: none)	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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Date of the actual completion of the international search
12.09.2019Date of mailing of the international search report
01.10.2019Name and mailing address of the ISA/
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Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/033410

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2014-95163 A (OJI HOLDINGS CORPORATION) 22 May 2014, example 1, claims 1, 5 (Family: none)	1-4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP HEI741034 A [0006]