

**(12) Japanese Unexamined
Patent Application Publication
(A)**

(19) Japan Patent Office (JP)

(11) Patent Application Publication No.

JP H6-62944 A

(43) Publication Date: March 8, 1994 (Heisei 6)

(51) Int.Cl. ⁵	Ident. Code	Internal Reference No.	FI	Basis for Classification
A47G	19/22	N	7137-3K	
B32B	27/10		7258-4F	
B65D	3/00	Z	6916-3E	
	3/22	B	6916-3E	
	8/04	M	6540-3E	

Examination Request: Not yet Total No. of Claims: 3 (Total 8 pages)

(21) Patent Application No.: JP H4-223972
 (22) Date of Filing: August 24, 1992 (Heisei 4)

(71) Applicant: 000003193
 Toppan Printing Co., Ltd.
 1-5-1 Taito, Taito-ku, Tokyo-to

(72) Inventor: Yoshihiro NAKAGAWA
 c/o Toppan Printing Co., Ltd. 1-5-1
 Taito, Taito-ku, Tokyo-to

(72) Inventor: Masayuki TANIGUCHI
 c/o Toppan Printing Co., Ltd. 1-5-1
 Taito, Taito-ku, Tokyo-to

(72) Inventor: Tetsuo AIZAWA
 c/o Toppan Printing Co., Ltd. 1-5-1
 Taito, Taito-ku, Tokyo-to

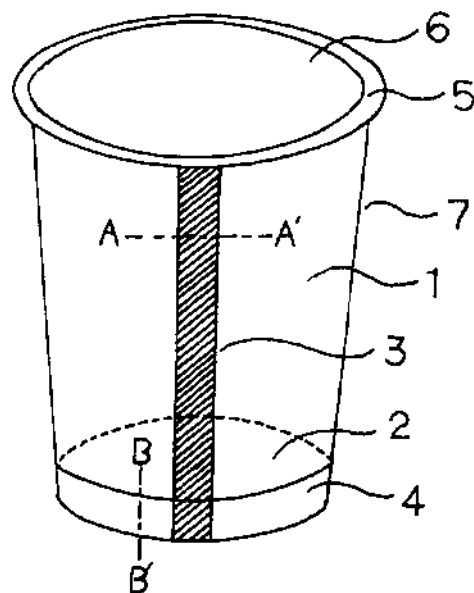
Continued on last page

(54) [Title of Invention] PAPER CUP AND MANUFACTURING METHOD THEREOF

(57) [Abstract]

[Purpose] To provide a paper cup using a biodegradable plastic that has the same performance as a conventional paper cup and has little odor, and a manufacturing method thereof.

[Constitution] A paper cup made of paper that is laminated with plastic on at least one side or both sides of the paper, wherein the plastic laminated on the paper is made of a biodegradable plastic whose main component is a biodegradable microbially produced polyester or an aliphatic polyester, and a method for sealing a side surface of the paper cup in which one or both of the plastics in the sealing part are heated and melted using hot air at 250°C or less, and then the plastic and the paper on the sealing surface are directly pressed together.



[Scope of Patent Claims]

[Claim 1] A paper cup made of paper that is laminated with plastic on at least one side or both sides of the paper, wherein the plastic laminated on the paper is made of a biodegradable plastic whose main component is a biodegradable microbially produced polyester or an aliphatic polyester.

[Claim 2] A method for manufacturing a paper cup made of paper that is laminated on one side of the paper with a biodegradable plastic whose main component is a biodegradable microbially produced polyester or an aliphatic polyester, wherein a method for sealing a side surface of the paper cup comprises heating and melting the plastic in the sealing part using hot air at 250°C or less, and then sealing by directly pressing together the plastic and a paper surface on another end of a development surface, which is a sealing part, using no medium for adhesion.

[Claim 3] A paper cup that is laminated on both sides of the paper with a biodegradable plastic whose main component is a biodegradable microbially produced polyester or an aliphatic polyester, wherein a method for sealing the side surfaces of the paper cup comprises heating and melting the plastic in one or both sides of the sealing part using hot air at 250°C or less, and then sealing by directly pressing together the plastics in the sealing surface, using no medium for adhesion.

[Detailed Description of Invention]

[0001]

[Industrial Field of Application] The present invention relates to a paper cup that is laminated with plastic. More specifically, it relates to a biodegradable paper cup.

[0002]

[Conventional Art] Paper cups, including those of the shape illustrated in FIG. 1, are often used as food containers for juices, nonalcoholic beverages, soft drinks, alcoholic beverages, ice cream, chilled desserts, yogurt, and the like in vending machines, storefront food and beverages, over-the-counter sales, or for personal use in outdoor activities, parties, and the like. However, because the contents are liquid or frozen liquid, the cups must be waterproof, and an inner surface 6 of the cup is laminated with plastic—generally polyethylene—or coated with wax.

[0003] Paper cups are usually not reused but are discarded after a single use. However, when the cups are not incinerated but instead landfilled or scattered in the natural environment as garbage, polyethylene and wax remain without decomposing, and this interferes with the inherent biodegradability of the paper, thereby shortening the lifespan of landfill sites and causing environmental pollution.

[0004] Therefore, the above problem can be solved by making the plastic laminated on the paper biodegradable as well. The inventors have also proposed a laminate that can be used for such paper cups in JP H3-249106. However, currently, although many biodegradable plastics are known, the physical properties of such plastics are significantly different from those of the polyethylene that has conventionally been used, and a paper cup having satisfactory performance cannot be obtained by conventional molding methods.

[0005] That is, in a paper cup, a sealing part 3 on a side surface

1 in FIG. 1 forms a seal between a plastic side of a sealing part 12 on a side part 10 and a paper side of the sealing part 12 on the side part 10 in the developed view illustrated in FIG. 2. Since a seal with the paper formed by heat fusing the plastic alone may not have sufficient sealing strength, in order to ensure a reliable seal, as illustrated in the cross section of FIG. 5, a medium 23 for adhesion (heat-fusing resin, lacquer, or the like; hereafter referred to as adhesive) is applied to a paper 20 side of the sealing part 12 and then a plastic 22 of the sealing part 12 is heat sealed.

[0006] However, the adhesive 23 was developed for use with polyethylene and does not provide sufficient sealing strength for any biodegradable plastic when used with a biodegradable plastic, and thus accidents in which the liquid contents leak when the paper cup is used easily occur. However, an adhesive that can be used in a biodegradable plastic when molding a paper cup has not yet been developed.

[0007] Furthermore, in the case of a paper cup, the paper 20 and the plastic 22 in the sealing part are heated and melted using hot air, and then the side surface 1 and a bottom surface 2 are sealed by pressing such together at sealing parts 3 and 4, respectively. In order to enhance the effect of the adhesive 23, hot air at 250 to 300°C is used. However, some biodegradable plastics are easily decomposed by heat. With such biodegradable plastics, when the temperature of the hot air is too high, even if a seal is formed, the plastic will decompose and the decomposition product thereof will give off an odor, making them difficult to use in food applications.

[0008]

[Problem to be Solved by Invention] The present invention was made in view of the aforementioned problem, and an object thereof is to provide a paper cup using a biodegradable plastic that has the same performance as a conventional paper cup and has little odor, and a manufacturing method thereof.

[0009]

[Means for Solving Problem] In order to solve the foregoing problem, the present invention provides a paper cup made of paper that is laminated with plastic on at least one side or both sides of the paper, wherein the plastic laminated on the paper is made of a biodegradable plastic whose main component is a biodegradable microbially produced polyester or an aliphatic polyester, and a method for sealing a side surface of the paper cup in which one or both of the plastics in the sealing part are heated and melted using hot air at 250°C or less, and then the plastic and the paper on the sealing surface are directly pressed together.

[0010] The present invention will be described in detail below. The biodegradable plastic that may be used in the present invention is a biodegradable plastic having a biodegradability equal to or greater than that of paper, and that, in addition to also having heat sealing properties, can be sealed to paper by a heat fusion method at a strength that can withstand use without the use of an adhesive. Examples of the plastic that may be used include microbially produced polyesters such as polymers of 3-hydroxybutyric acid, 4-hydroxybutyric acid, 3-hydroxyvaleric acid, and the like, and copolymers made up of two or more of

these; and aliphatic polyesters such as polymers of caprolactone, lactic acid, glycolic acid, and the like, and copolymers made up of two or more of these.

[0011] Mixtures or laminates of these biodegradable plastics may also be used, and furthermore, various non-degradable additives, polymers, and the like may be added to these biodegradable plastics as long as the weight ratio is 50% or less. Adding 50% or more of a non-degradable substance is not preferable because it significantly reduces biodegradability and can cause problems in processing.

[0012] Here, microbially produced polyester is a general term for polyesters obtained by cultivating microorganisms such as bacteria or yeast, and isolating and purifying the polyester compounds that accumulate within the cells or culture medium, and is characterized by being derived from microorganisms. Furthermore, aliphatic polyester refers to polyesters produced by chemical synthesis, in which the polymer consists only of carbon, hydrogen and oxygen atoms and does not have a cyclic structure such as in aromatic polyesters. That is, even when they are structurally identical, they may be microbially produced polyesters or aliphatic polyesters depending on the manufacturing method.

[0013] First, the method for laminating the biodegradable plastic and the paper may be an ordinary method used for laminating plastic and paper, and lamination may be performed using a method such as laminating a plastic film onto the paper, or melt extrusion coating the plastic onto the paper, but the manufacturing method illustrated in JP H3-249106, which uses melt extrusion coating without the need for an adhesive, is used. By using this lamination method, a biodegradable plastic may be laminated on one or both sides of the paper. Note that when laminating on both sides, different types of biodegradable plastics may be used on both sides.

[0014] Next, the paper cup is molded using a paper cup molding machine in the same manner as a conventional paper cup, but with some modifications to the conventional process. The process will be described below.

[0015] When molding a paper cup as illustrated in FIG. 1, first a laminate of a biodegradable plastic and paper (hereinafter referred to as plastic-laminated paper) is punched out into the shape illustrated in the developed view in FIG. 2.

[0016] When the biodegradable plastic is laminated on only one side, the plastic side of the sealing part 12 corresponding to the sealing part 3 on the side surface 1 in FIG. 1 of the punched-out side part of a laminate 10 and the plastic side of sealing parts 13 and 14 on the same plastic-laminated paper 10 corresponding to a sealing part 4 on the bottom surface 2 in FIG. 1 are heated with hot air to melt the biodegradable plastic, and at the same time, the paper side that is the other side of the sealing parts 12, 13, and 14 of the plastic-laminated paper 10 and the paper side of sealing part 12⁻ for bonding to the sealing part 12 are heated

using hot air.

[0017] Conventionally, the adhesive is applied to the paper surface of the sealing part 10⁻ before punching or before heating using hot air, and then heating using hot air is performed and the plastic-laminated paper 10 is rolled into a cylindrical shape to seal. However, in the method of the present invention, heating using hot air is performed without applying the adhesive, and then the plastic-laminated paper 10 is rolled into a cylindrical shape so that the plastic surface forms an inner surface 6, and the plastic of the sealing part 10 and the paper of the sealing part 10⁻ are directly pressed together to seal.

[0018] That is, in the cross-section of the sealing part 3 of the side surface 1 in FIG. 1 of the paper cup, as shown in FIG. 3, a plastic 21 of the sealing part 12 of the plastic-laminated paper 10 that forms a side surface in FIG. 2 and the paper 20 of the sealing part 12⁻ are sealed without the conventional adhesive 23 therebetween as illustrated in FIG. 5.

[0019] Next, in a state in which the bottom surface laminate 11 in FIG. 2 is folded at the sealing part 13⁻ so that the plastic surface is on the outside as illustrated in the cross section in FIG. 7, the bottom surface laminate is inserted into the plastic-laminated paper 10 in which the side surfaces have already been sealed to form a cylinder so that the sealing part 13 of the bottom surface of the plastic-laminated paper comes into contact with the sealing part 13⁻ of the plastic-laminated paper 11 on the bottom surface, and the bottommost part 14 of the cylindrical plastic-laminated paper 10 is folded inward, and the sealing parts 13 and 14 of the plastic-laminated paper 10 are pressed together to perform sealing by sandwiching the sealing part 14⁻ of the plastic-laminated paper 11 therebetween. In addition, when the plastic-laminated paper 10 on the side surface is wound in a cylindrical shape, the sealing parts 13 and 13⁻ overlap with the plastic-laminated paper 11 on the bottom surface in the state illustrated in FIG. 7, and then sealing of the side surface and the bottom surface may be performed.

[0020] Here, in terms of the seal on the bottom surface, as illustrated in the cross section of FIG. 6, the seal of the sealing part 14 of the laminate 10 on the side surface and the sealing part 13⁻ of the laminate 11 on the bottom surface serves as a seal between the plastic 21 and the paper 20, but the seal between the sealing part 13 of the laminate 10 on the side surface and the sealing part 13⁻ of the laminate 11 on the bottom surface serves as a seal between the plastics 21 and, when the plastic has heat sealing properties, sufficient heat seal strength is obtained. Therefore, no particular attention is required for the sealing part 14 and the sealing part 13⁻; pseudo-adhesion is sufficient, and thus no adhesive is used for this part even in the conventional method. Finally, the top curl part of the side surface 1 is shaped using a conventional method to complete the paper cup.

[0021] Furthermore, among the biodegradable plastics 21 used in the present invention, microbially produced polyester differs from other plastics in that it begins to thermally decompose at temperatures of 200°C or higher, and when the degree of decomposition is significant, an unpleasant odor occurs even though sealing is possible. Therefore, when using microbially produced polyester, in order to prevent the production of this

unpleasant odor, the temperature of the hot air used to melt the microbially produced polyester during molding is set to 250°C or lower, preferably 230°C or lower. For the same reason, the temperature of the hot air on the paper side is also set to 280°C or less, preferably 250°C or less. Aliphatic polyesters also have a lower melting point than microbially produced polyesters, and thus can be molded sufficiently under the same temperature conditions as microbially produced polyesters.

[0022] Furthermore, when paper laminated with biodegradable plastic on both sides is used, the sealing part 3 on the side surface 1 forms a seal between the plastics 21 as shown in FIG. 4, and since the plastics 21 have heat-sealing properties, sufficient seal strength can be obtained without using the adhesive 23 as is conventional. In this case, the method of molding the paper cup may be performed using the same method as the molding method described above, with one side being regarded as the paper side. However, while the aforementioned heating of the paper side using hot air is optional, in order to prevent blocking when the paper cup is stacked after molding, it is better not to heat the paper side except for a surface corresponding to the paper side of the sealing part 12 of the laminate 10 on the side surface (the surface that will become the front side 7 of the paper cup). Furthermore, when a microbially produced polyester is used, the temperature of the hot air must be kept below 250°C, preferably below 230 ° C, for the reasons mentioned above.

[0023]

[Effect] As described above, according to the method for manufacturing a paper cup of the present invention, a biodegradable plastic that has heat sealing properties and that can be sealed to paper by a thermal melting method without the use of an adhesive is used, and by molding such using the method of the present invention, a biodegradable paper cup that has the same performance as a conventional paper cup can be obtained. Furthermore, by lowering the temperature of the hot air used for sealing to such an extent that the plastic does not emit an unpleasant odor due to pyrolysis, a biodegradable paper cup free of unpleasant odors can be obtained.

[0024]

[Examples]

<Example 1> Paper cups having the shape shown in FIG. 1 were molded according to the above method without using an adhesive by means of a paper cup molding machine (PMC machine) using plastic-laminated paper in which a copolymer of 3-hydroxybutyric acid and 3-hydroxyvalerate (hereinafter indicated as P (3HB-3HV)) (manufactured by ICI, UK: "Biopole", (hydroxyvalerate content: 10%)) was laminated to a thickness of 30 μm by a T-die melt extrusion method on one side of a wound paperboard (uncoated ivory, 220 g/m²) as a biodegradable microbially-produced polyester.

[0025] The resulting paper cups were filled with a liquid leak check solution, the state of the seal was judged, and the odor was also evaluated sensually. In addition, molding was also performed by a conventional method using an adhesive (manufactured by Tosoh Corporation: Toyovine 210K). The molding conditions and evaluation results are illustrated in Table 1.

[0026]

[Table 1]

No.	Hot air temperature (°C)		Adhesive?	Liquid leakage ¹⁾	Unpleasant odor ²⁾
	Plastic side	Paper side			
1	200	230	No	0	○
2	230	250	No	0	○
3	230	280	No	0	△
4	250	230	No	0	○
5	250	250	No	0	△
6	250	280	No	0	×
7	280	230	No	0	×
8	200	230	Yes	8	○
9	230	250	Yes	5	○
10	230	280	Yes	3	△
11	250	230	Yes	5	○
12	250	250	Yes	2	△
13	250	280	Yes	1	×
14	280	230	Yes	3	×

1) Number of paper cups out of 20 found to have liquid leakage

2) ○: No problem, △: Slight unpleasant odor, ×: Obvious unpleasant odor

[0027] When molding was performed without using an adhesive and using hot air at a temperature of 250°C or less, there were no problems with either liquid leakage or odor. However, when the temperature exceeded 250°C, there were cases in which an unpleasant odor was observed and constituted a problem. In addition, in the conventional method using an adhesive, the odor was the same as when no adhesive was used, but liquid leakage occurred more frequently at lower temperatures.

[0028] <Example 2> A similar evaluation was performed using a laminate in which polycaprolactone (manufactured by Union Carbide Chemical and Plastics, USA: "Tone P-787") was laminated at a thickness of 30 μm as a biodegradable aliphatic polyester instead of P (3HB-3HV) in

Example 1. The processing conditions and evaluation results are illustrated in Table 2.

[0029]
[Table 2]

No.	Hot air temperature (°C)		Adhesive?	Liquid leakage ¹⁾	Unpleasant odor ²⁾
	Plastic side	Paper side			
1	150	170	No	0	○
2	250	280	No	0	○
3	280	280	No	0	○
4	150	170	Yes	14	○
5	250	280	Yes	2	○
6	280	280	Yes	1	○

1) Number of paper cups out of 20 found to have liquid leakage

2) ○: No problem, Δ: Slight unpleasant odor, ×: Obvious unpleasant odor

[0030] In the present example, there was no problem with odor, but the same results as in Example 1 were obtained with respect to liquid leakage.

[0031] <Example 3> The same evaluation was performed by further forming the polycaprolactone used in Example 2 on the P (3HB-3HV) side of the laminate used in Example 1 under the same conditions as in Example 2 using a laminated laminate having a thickness of 15 μ m.

[0032] The tendency regarding leakage was the same as in Example 2, and there was no problem when no adhesive was used, but in terms of odor, only Nos. 1 and 4 in Table 2 were favorable.

[0033] <Example 4> A laminate in which 30 μ m of P (3HB-3HV) was similarly laminated on a surface (paper side) of the laminate used in Example 1 on which P (3HB-3HV) was not laminated, and a laminate in which 30 μ m of poly-3-hydroxyvaleric acid (manufactured by ICI) was laminated were used. Molding was performed under the conditions of Nos. 1 to 7 illustrated in Table 1 of Example 1, and an evaluation was performed. The results were exactly the same as in Example 1.

[0034] <Example 5> A laminate in which a mixture of 30 μ m of P (3HB-3HV) and the poly-3-hydroxyvaleric acid used in Example 4 was laminated at a ratio of 1:1 on a surface (paper side) of the laminate used in Example 1 on which P (3HB-3HV) was not laminated was used. Molding was performed under the conditions of Nos. 1 to 7 illustrated in Table 1 of Example 1, and an evaluation was performed. The results were exactly the same as in Example 1.

[0035] <Biodegradability test> The paper cups formed in Examples 1 to 5 were buried in the soil of a field for three months, and the biodegradability thereof was confirmed. After

three months, a significant amount of paper remained in all paper cups, but the plastic had completely disappeared except for the sealing part, confirming that the paper cup of the present invention is biodegradable.

[0036]

[Effect of Invention] The paper cup of the present invention uses a plastic-laminated paper in which paper is laminated with a biodegradable plastic, and thus has a characteristic in which the paper does not lose its inherent biodegradability as a result of laminating with plastic, and the entirety of the paper cup product is biodegradable.

[0037] Furthermore, regarding the molding method, when a biodegradable plastic was used in the conventional molding method, sufficient performance as a paper cup was not obtained even though molding was possible. However, with the method for molding a paper cup of the present invention, that is, a molding method in which paper and plastic, or plastics are directly bonded to each other without using the adhesive used in conventional methods, satisfactory performance as a paper cup can be obtained, and a paper cup that is comparable in performance to a conventional non-biodegradable paper cup can be provided.

[0038] The biodegradable plastics that may be used in the present invention are limited, and some of these biodegradable plastics have a disadvantage in that the plastic begins to degrade at temperatures above 200°C and emits an unpleasant odor as the temperature increases. However, in the molding method of the present invention, by setting the temperature of the hot air used for heating to a temperature lower than the temperature at which an unpleasant odor is generated, a paper cup free of unpleasant odors can be obtained, and even biodegradable plastics that have been difficult to use up to now

due to odor can be used.

[0039] Note that, in order to further improve the performance or moldability of the paper cup, it is also possible to add non-degradable additives or polymers to the biodegradable plastic used in order to improve the physical properties of the biodegradable plastic, provided that this does not reduce the biodegradability or heat sealability of the biodegradable plastic.

[0040]

[Brief Description of Drawings]

[FIG. 1] A perspective view illustrating one embodiment of the paper cup of the present invention.

[FIG. 2] A developed view of FIG. 1.

[FIG. 3] A cross-sectional view of the side surface sealing part (A-A' in FIG. 1) illustrating one embodiment of the paper cup of the present invention.

[FIG. 4] A cross-sectional view of the side surface sealing part (A-A' in FIG. 1) illustrating one embodiment of the paper cup of the present invention.

[FIG. 5] A cross-sectional view of the side surface sealing part (A-A' in FIG. 1) illustrating a conventional paper cup.

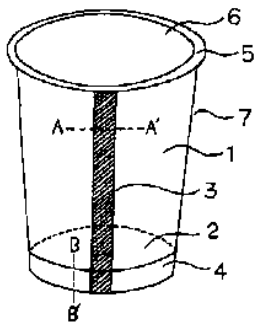
[FIG. 6] A cross-sectional view of the bottom surface sealing part (B-B' in FIG. 1) illustrating one embodiment of the of the present invention and a paper cup of the conventional art.

[FIG. 7] A cross-sectional view during molding of the laminate of the bottom surface illustrating one embodiment of the of the present invention and a paper cup of the conventional art.

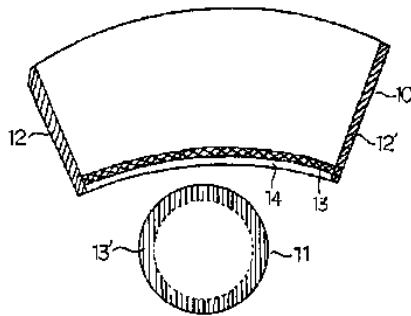
[Description of Reference Numerals]

- 1 ... Side surface
- 2 ... Bottom surface
- 3 ... Side surface sealing part
- 4 ... Bottom surface sealing part
- 5 ... To p curl
- 6 ... Inner surface
- 7 ... Outer surface
- 10 ... Side surface plastic-laminated paper
- 11 ... Bottom surface plastic-laminated paper
- 12, 12' ... Side surface sealing part
- 13, 13' ... Bottom surface sealing part
- 14 ... Bottom folding part
- 20 ... Paper
- 21 ... Biodegradable plastic
- 22 ... Polyethylene
- 23 ... Adhesive

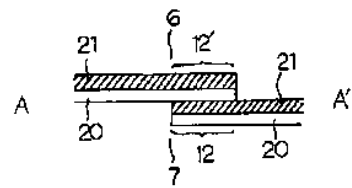
[FIG. 1]



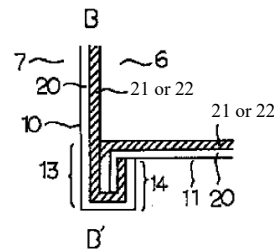
[FIG. 2]



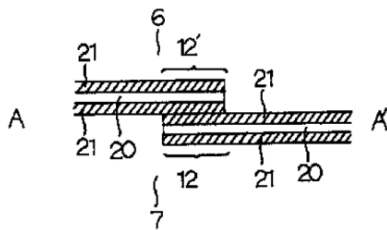
[FIG. 3]



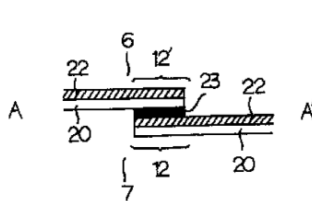
[FIG. 6]



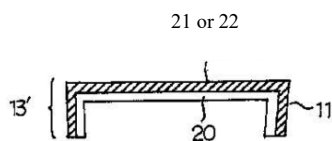
[FIG. 4]



[FIG. 5]



[FIG. 7]



Continued from front page

(72) Inventor: Kazuya Yafusa
c/o Toppan Printing Co., Ltd.
Taito, Taito-ku, Tokyo-to 1-5-1

(72) Inventor: Motoko Yoshikawa
c/o Toppan Printing Co., Ltd.
Taito, Taito-ku, Tokyo-to 1-5-1

DECLARATION OF TRANSLATOR

I, Samantha Matsunaka, hereby declare as follows:

1. I personally performed the attached translation from Japanese into English of the file named “JP_H0662944_A”.

2. The attached translation is, to the best of my knowledge, a true, full and accurate translation of the attached Japanese document.

3. I am competent to perform this translation, because I have a Bachelor’s degree in Japanese from Curtin University, a Double Master of Interpreting and Translation Studies from Monash University and Kobe City University of Foreign Studies, JLPT N1, NAATI certification, and 5 years’ worth of experience as a professional translator.

4. I declare under the penalty of perjury under the laws of the United States that the foregoing is true and correct; and further declare that I am aware that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 1001 of Title 18 of the United States Code.

Dated: 4th December 2024



Samantha Matsunaka