

(19)



(11)

EP 4 470 395 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

04.12.2024 Bulletin 2024/49

(51) International Patent Classification (IPC):

A24D 3/04 (2006.01)

(21) Application number: **24757862.8**

(86) International application number:

PCT/CN2024/078099

(22) Date of filing: **22.02.2024**

(87) International publication number:

WO 2024/175058 (29.08.2024 Gazette 2024/35)

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**

Designated Extension States:

BA

Designated Validation States:

GE KH MA MD TN

- **WANG, Hao**
Kunming
Yunnan 650231 (CN)
- **ZHENG, Han**
Kunming
Yunnan 650231 (CN)
- **XIE, Jiao**
Kunming
Yunnan 650231 (CN)
- **ZHANG, Jing**
Kunming
Yunnan 650231 (CN)
- **GUI, Yongfa**
Kunming
Yunnan 650231 (CN)
- **WANG, Xu**
Kunming
Yunnan 650231 (CN)
- **LI, Liwei**
Kunming
Yunnan 650231 (CN)

(30) Priority: **24.02.2023 CN 202310161142**

(71) Applicant: **China Tobacco Yunnan Industrial Co., Ltd.**

Kunming, Yunnan 650231 (CN)

(74) Representative: **Isern Patentes y Marcas S.L.**

**Avda. Diagonal, 463 Bis, 2°
08036 Barcelona (ES)**

(72) Inventors:

- **YUE, Baoshan**
Kunming
Yunnan 650231 (CN)
- **SHEN, Yanfei**
Kunming
Yunnan 650231 (CN)
- **WANG, Tao**
Kunming
Yunnan 650231 (CN)

(54) **COMPOSITE HOLLOW FILTER TIP AND MANUFACTURING METHOD THEREFOR**

(57) The present invention provides a composite hollow filter rod and a production method thereof, relating to the technical field of hollow filter rods and comprising an acetate fiber portion and a polyester fiber portion provided at the inner side of the acetate fiber portion; the acetate fiber portion is of an annular structure, the outer diameter of the polyester fiber portion is equal to the inner diameter of the acetate fiber portion, and the polyester fiber portion is provided with a hollow hole; the acetate fiber portion is molded by curing acetate fiber tows under high temperature steam heating; the polyester fiber portion is molded by curing PLA fiber tows under

the heating of heated air. The present invention is simple in structure, adopting an outside acetate fiber portion and an inside polyester fiber portion to compositely form a hollow filter rod, which not only effectively adopts the heated air such that the polyester fiber portion is effectively molded, but also increases the easy-decomposable characteristic of the PLA of the polyester fiber portion, resulting in a reduced pollution amount and a low cost of raw material. By means of the characteristic that PLA is easy to process, the hollow filter rod is more attractive and practical.

EP 4 470 395 A1

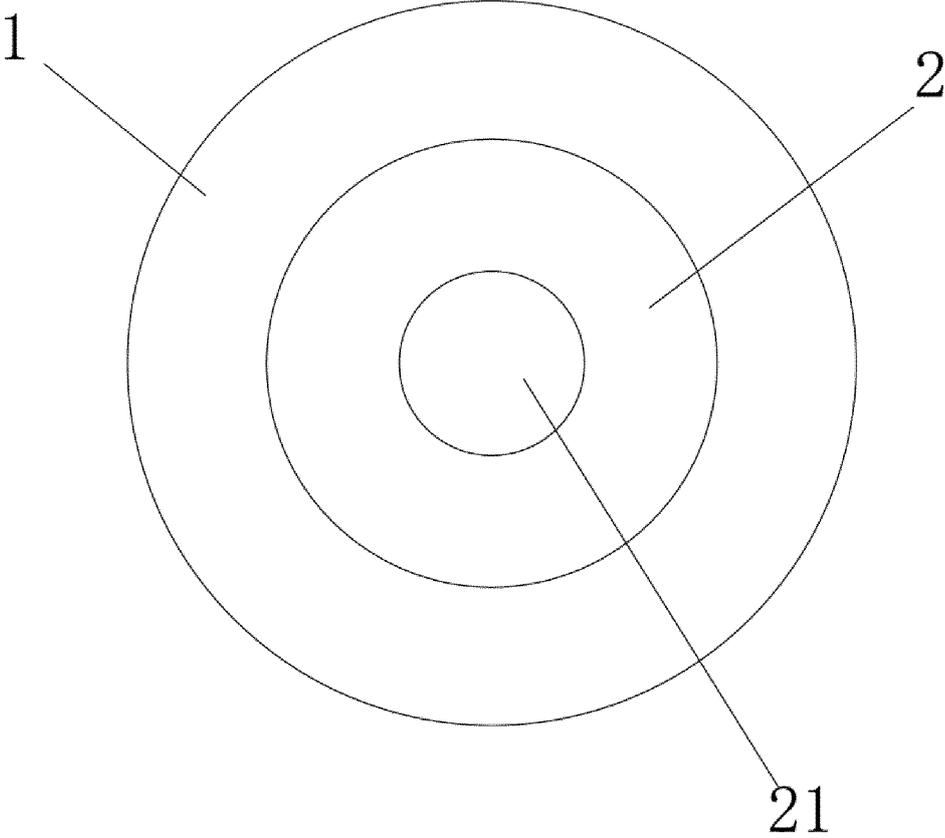


Fig. 1

Description**Technical Field**

5 **[0001]** The present invention relates to the technical field of hollow filter rods, in particular to a composite hollow filter rod and method for producing the same.

Background Art

10 **[0002]** With the increasing development of cigarette production technology, the types and appearance of cigarettes are more diversified. Cigarettes with unique shapes are more likely to be popular among people, thus resulting in the emerging of a new type of filter rod, the hollow filter rod.

[0003] It is a basically mature process to produce a pipe (hollow) filter rod with acetate fiber tows. For example, a Chinese patent CN111436650A discloses a method for producing a hollow cooling filter rod, which consists of tows, a cooling material and a curing agent. The filter rod is prepared on a wire-drawing molding machine for hollow filter rod with a corresponding mold by adopting a production process of accelerated curing by means of high temperature steam. The solid external portion of the filter rod is of a smooth cylindrical structure with certain elasticity and hardness, suitable for cigarette tipping; the internal hollow part is of a straight-through empty cavity structure having a shape similar to a bellow, providing better thermal transfer and cooling effects when smoke passes therethrough. Due to the straight-through structure in the middle part of the filter rod, the suction resistance is also very low, and when used for a novel tobacco, the atomized amount of the cigarette is a two-fold increase while the temperature is reduced, so that the experience of a smoker is satisfied. Therefore, a new solution is provided for improving the quality of the cigarette and developing novel tobacco products.

[0004] Polylactic acid (PLA) is a polymer material prepared by chemical synthesis of lactic acid fermented from starch in a renewable plant resource. PLA has good recycling, biodegradability and the following characteristics: 1. Renewable plant resources (corn, wheat, sugar beet, rice, potato, sweet potato, etc.) as well as organic wastes (corn cob or the root, stem, leaf, bark, etc. of other crops) are used as raw material, free from dependence on wood and petroleum resources, and the requirement of sustainable development is met; 2. It is fully biodegradable and will be naturally decomposed into water and carbon dioxide after a certain period of time in the natural environment, so that no environmental pollution is caused. The generated carbon dioxide produced by it is reused through plant photosynthesis, forming an eternal and closed carbon cycle system, which is a veritable "green material"; 3. The production of PLA fiber has a lower energy consumption, a polymer material with relatively low resource environmental load compared with the three kinds of synthetic fibers of polyester, nylon and acrylic; 4. It has good processability, and the tows can be produced by using a general thermoplastic resin melt spinning method.

[0005] Due to the fact that the PLA has the advantages of low price, easy degradation and no pollution compared with the acetate fiber, it is therefore very important to study the preparation of PLA filter rod. However, with respect to producing a pipe (hollow) filter rod with PLA tows, there is indeed a technology gap in the prior art.

[0006] In the production of the pipe (hollow) filter rod with the acetate fiber tows, the filter rod is made by using steam heating and rapid curing, but the pipe (hollow) filter rod usually has a round hole, and, during the molding, the pipe (hollow) filter rod with various special shapes can be made by selecting a core rod with different shapes. If molded by steam heating, steam condensation may easily occur at a bending position of the special shape. This causes unevenness in the walls of the molded hollow hole, and a more irregularly shaped filter rod.

[0007] Moreover, PLA is a thermoplastic aliphatic polyester with low glass transition temperature, and the case of rigidity and thermal collapse will occur under high temperature. In the early development of producing the pipe (hollow) filter rod with PLA tows, steam heating method is also used to trial-prepare a filter rod, but normal production cannot be carried out due to an over high steam temperature, poor effect, and an irregular shape of the filter rod.

[0008] Therefore, in order to solve the above problems, it is necessary to develop a reasonable and efficient composite hollow filter rod.

Summary

[0009] An object of the present invention is to provide a composite hollow filter rod with simple structure. The rod adopts an outside acetate fiber portion and an inside polyester fiber portion to compositely form a hollow filter rod, which not only makes the polyester fiber portion effectively molded by effectively using the heated air, but also increases the easy-decomposable characteristic of the PLA of the polyester fiber portion, resulting in a reduced pollution amount and a low cost of raw material. Utilizing the easy processing characteristic of PLA, the hollow filter rods are more attractive and practical.

[0010] For achieving the aforesaid purpose, the present invention is implemented by adopting the following technical

solutions:

A composite hollow filter rod, comprises an acetate fiber portion and a polyester fiber portion provided at the inner side of the acetate fiber portion;

The acetate fiber portion is of an annular structure, the outer diameter of the polyester fiber portion is equal to the inner diameter of the acetate fiber portion, and the polyester fiber portion is provided with a hollow hole;

The acetate fiber portion is molded by curing acetate fiber tows under high temperature steam heating;

The polyester fiber portion is molded by curing PLA fiber tows under the heating of heated air.

[0011] Preferably, in the present invention, the outer side of the acetate fiber portion is provided with a wrapping paper.

[0012] Preferably, in the present invention, the inner side wall of the wrapping paper is coated with an activated carbon layer.

[0013] Preferably, in the present invention, the shape of the hollow hole comprises the shapes of a peach heart, a square, a circle, and a plum flower.

[0014] Preferably, in the present invention, the number of the hollow holes is at least one.

[0015] Preferably, in the present invention, the PLA fiber tows are a tow structure of shell-core.

[0016] Preferably, in the present invention, the content of the L-lactic acid monomer in raw material for producing the PLA fiber tows is 90% or more.

[0017] The present invention further provides a method for producing the composite hollow filter rod, comprising the following steps:

S1: inserting a first inner core into a molding cavity;

S2: transporting acetate fiber tows into the molding cavity, feeding steam into the molding cavity, and heating and curing the acetate fiber tows to obtain an acetate fiber portion;

S3: after the acetate fiber portion is cooled, drawing out the first inner core, and inserting a second inner core into the molding cavity;

S4: transporting PLA fiber tows into the inner side of the acetate fiber portion in the molding cavity, feeding heated air into the molding cavity, and heating and curing the PLA fiber tows to obtain a polyester fiber portion.

[0018] Preferably, in the present invention, when performing step S2, the temperature of the fed steam is in a range of 140°C to 170°C.

[0019] When performing step S4, the temperature of the fed heated air is in a range of 65°C to 85°C.

[0020] Preferably, in the present invention, when performing step S3, the outer diameter of the second inner core is smaller than the outer diameter of the first inner core.

[0021] The composite hollow filter rod and the production method thereof of the present invention have the following beneficial effect: it is simple in structure, the rod adopts an outside acetate fiber portion and an inside polyester fiber portion to compositely form a hollow filter rod, which not only makes the polyester fiber portion effectively molded by the heated air, but also increases the easy-decomposable characteristic of the PLA of the polyester fiber portion, resulting in a reduced pollution amount and a low cost of raw material. Utilizing the easy processing characteristic of PLA, the hollow filter rods are more attractive and practical.

Brief Description of Drawings

[0022]

Fig. 1 is a cross-section view of an embodiment of a composite hollow filter rod according to the present invention;

Fig. 2 is a cross-section view of another embodiment of a composite hollow filter rod according to the present invention;

Fig. 3 is a flow schematic diagram of the method for producing the composite hollow filter rod according to the present invention;

[0023] In the figures: 1. acetate fiber portion; 11. wrapping paper; 12. activated carbon layer; 2. polyester fiber portion; 21. hollow hole.

Detailed Description of Embodiments

[0024] Specific examples of the present invention are as follows, which further describe the technical solutions of the present invention, but the present invention is not limited to these examples.

[0025] Various exemplary embodiments of the present invention will now be described in detail with reference to the figures. It should be noted that the relative arrangement and steps of modules and steps set forth in these examples do not limit the scope of the invention unless specifically stated otherwise.

[0026] Meanwhile, it should be understood that, for ease of description, the processes in the figures are not performed separately, but rather are performed in multiple steps that intersect with each other.

[0027] In the description of the present invention, it should be clarified that the orientation or position relationship indicated by the terms of "center", "upper", "lower", "left", "right", "vertical", "horizontal", "inner", "outer", etc., are based on the orientation or position relationship shown in the figures, or are the orientation or position relationship in which the product of the present invention is conventionally placed when used. It is intended only to facilitate the description of the present invention and to simplify the description, not to indicate or imply that the devices or elements referred to must have a particular orientation or must be constructed and operated in a particular orientation, and is therefore not to be construed as a limitation of the present invention. In addition, the terms "first", "second", etc., are merely used to differentiate descriptions, and are not to be construed as indicating or implying relative importance.

[0028] The following description of at least one exemplary embodiment is in fact merely illustrative, and in no way serves as any limitation on the invention and its application or use.

[0029] Techniques, methods, and systems known to those skilled in the relevant art may not be discussed in detail, but where appropriate, techniques, methods and systems should be considered part of this description.

Embodiment I: As shown in Fig. 1, a composite hollow filter rod, comprises an acetate fiber portion 1, and a polyester fiber portion 2 which provided at the inner side of the acetate fiber portion 1;

The acetate fiber portion 1 is of an annular structure, the outer diameter of the polyester fiber portion 2 is equal to the inner diameter of the acetate fiber portion 1, and the polyester fiber portion 2 is provided with a hollow hole 21;

The acetate fiber portion 1 is molded by curing acetate fiber tows under high temperature steam heating;

The polyester fiber portion 2 is molded by curing PLA fiber tows under the heating of heated air.

[0030] In the present invention, the hollow filter rod can be produced by adopting the structure of an outside of acetate fiber portion 1 and an inside of polyester fiber portion 2, such that outside acetate fiber portion 1 has mature process, and inside polyester fiber portion 2 can effectively reduce pollution, have cheap raw material, and improve the suction taste.

[0031] The heating and molding process of acetate fiber portion 1 is relatively perfect, that is, curing and molding the acetate fiber tows under the heating of high temperature steam. However, there is a gap in the processes of the heating and molding PLA, most of heating process for hollow filter rods of acetate fiber adopts steam heating, and the steam temperature can reach more than 170°C. Due to the fact that PLA is a thermoplastic aliphatic polyester with low glass transition temperature, and that the situation of rigidity and thermal collapse will occur under high temperature condition, it will get an extremely poor molding effect when producing the hollow filter rods of PLA by using high temperature steam heating.

[0032] After a plurality of experiments and learnings thereof, it is found that the temperature for the heating production of the PLA hollow filter rod is required to be less than 100°C. Then, the steam will condense into water, making it impossible to use steam heating. So the PLA fiber tows are heated by adopting the means of heating the air, and finally the PLA fiber tows are cured and molded.

[0033] Heating air to a predetermined temperature followed by contacting the heated air with PLA fiber tows that are fed to a molding machine set after loosening, and heating and curing the PLA fiber tows to complete the preparation of the PLA filter rod.

[0034] In this way, the acetate fiber portion 1 on the outside is molded by heating with high temperature steam, and the inside polyester fiber portion 2 is molded by heating with hot air, such that the composite hollow filter rod is obtained.

[0035] Preferably, the composite hollow filter rod is molded and prepared with a molding production device that comprises a molding cavity, and an inner core is provided in the molding cavity. When a first inner core is inserted into the molding cavity, transporting the loosened acetate fiber tows into the molding cavity, feeding steam into the molding cavity, and heating and curing the acetate fiber tows to obtain the acetate fiber portion. Then drawing out the first inner core,

inserting a thinner second inner core, transporting the loosened PLA fiber tows into the inner side of the acetate fiber portion in the molding cavity, feeding heated air into the molding cavity, and heating and curing the PLA fiber tows to obtain the polyester fiber portion.

[0036] After the entire polyester fiber portion is cooled, drawing out the second inner core, and drawing out the composite hollow filter rod.

[0037] Wherein, parameters for loosening and molding in producing acetate fiber portion 1 are as follows:

Table 1.1 Main process parameters to produce the acetate fiber filter rod

Item	Unit	Technical parameter
Tows specification	Den	5.8Y26000 d × 2
Production speed	M/min	<70
Rolling force for loosening	MPa	0.1/0.25/0.25
Fluffing ratio		1.25-1.3
Adding amount of triacetin	%	20 ± 1
Steam pressure	MPa	0.1
Total steam temperature	°C	170 ± 10
Separate steam temperature	°C	>105
Temperature of heat-insulating rubber hose	°C	180 ± 10
Auxiliary iron temperature	°C	155 ± 10
Cloth belt tightening pressure	MPa	0.3/0.15

[0038] The above production process of the acetate filter rod is very mature.

[0039] Moreover, when producing polyester fiber portion 2, the air feeding to the molding cavity needs to be pure and at a predetermined temperature, so it is necessary to filter the air with a filter device to ensure that it meets the standard of pure air, and then to heat and feed the heated air into the molding cavity.

[0040] The aforesaid predetermined temperature, i.e., the temperature for heating PLA, that is, the temperature range of the air reaching the molding cavity after heating, is in the range from 65°C to 85°C.

[0041] The effect of different hot air temperatures on the molding and production of the filter rod, as well as the physical indicators and appearance of the filter rod were investigated, and the results are as follows:

Table 2.1 Effect of different hot air temperatures on PLA molding (24.0 mm × 120 mm)

The Temperature of the hot air	Production condition	Filter rod condition
50 °C	Abnormal	Un-molded filter rod with low hardness
60 °C	Abnormal	Un-molded filter rod with low hardness
65 °C	Basically normal	Filter rod with good roundness and good coaxiality, and normal hardness
70 °C	Normal	Filter rod with good roundness and good coaxiality, and normal hardness
80 °C	Normal	Filter rod with good roundness and good coaxiality, and normal hardness
85 °C	Normal	Filter rod with good roundness and good coaxiality, and normal hardness
90 °C	Average performance	Filter rod with poor roundness and poor coaxiality
100 °C	Abnormal	Filter rod with bad roundness and bad coaxiality

[0042] That is to say, with respect to the production of the pipe (hollow) filter rod with the PLA tows, when the temperature of the hot air is below 60 °C, there may be poor production of a deformed filter rod of poor roundness and low hardness due to the fact that rapid curing of the filter rod is unable to be implemented during the molding. When the temperature of the hot air is 65°C~85°C, the production is normal, and the indicators and appearance of the filter rod meet the requirement. When the temperature of the hot air exceeds 90 °C, the production condition becomes worse, wherein the roundness and coaxiality of the filter rod become worse. Therefore, the hot air temperature of 65°C~85°C is suitable to produce the pipe (hollow) filter rod, which is much lower than the high temperature steam temperature used in the production of the acetate fiber filter rod.

[0043] It should be noted that the PLA fiber tows to be fed at the molding cavity preferably ranges from 30000 d × 2 ~ 33000 d × 2 (equivalent to 60000-66000 d).

[0044] The effect of different hot air temperatures on the molding and production of the filter rod, as well as the physical indicators and appearance of the filter rod were investigated, and the results are as follows:

Table 1.2 Molding condition of PLA tows with different total denier (24.0 mm × 120 mm)

Parameters of the Tows	Production condition	Filter rod condition
9.95Y43000 d	Abnormal	Un-molded filter rod with bad roundness and bad coaxiality, and low hardness
6.0Y26000 d × 2	Basically normal	Filter rod with bad roundness and low hardness
6.94Y30000 d × 2	Normal	Filter rod with good roundness and good coaxiality, and normal hardness
7.64Y33000 d × 2	Normal	Filter rod with good roundness and good coaxiality, and normal hardness
8.1Y35000 d × 2	Average performance	The parameters of the filter rods are highly variable
8.56Y37000 d × 2	Poor wire feeding and abnormal	The parameters of the filter rods are very variable

[0045] That is to say, with respect to the production of a pipe (hollow) filter rod with the PLA tows, when the total denier of the tows is below 26000 d × 2 (i.e. 52000 denier), there may be poor production of a filter rod of bad roundness and low hardness. When the total denier of the tows is 30000 d × 2 ~ 33000 d × 2 (equivalent to 60000 ~ 66000 d), the production is normal, and both the parameters and appearance of the filter rod meet the requirement. When the total denier of tows is more than 35000 d × 2 (i.e. 70000 denier), the production becomes worse, and the parameters of the filter rod become variable. Therefore, the PLA tows having a specification of 30000 d × 2 ~ 33000 d × 2 (equivalent to 60000 - 66000 d) are suitable to produce the pipe (hollow) filter rod.

[0046] Moreover, a feeding hole for adding triacetin is provided on the molding cavity during the production of the hollow filter rod of PLA, since it is required to add triacetin to the PLA fiber tows to improve the molding effect.

[0047] The effect of different application amounts of triacetin on the molding and production of the filter rod, as well as the physical indicators and appearance of the filter rod were investigated, and the results are as follows:

Table 1.3 Effect of different application amounts of triacetin on the molding (24.0mm x 120 mm)

Added amount of triacetin (%)	Production condition	Filter rod condition
8	Basically normal	Un-molded filter rod with low hardness
10	Basically normal	Un-molded filter rod with low hardness
12	Normal	Filter rod with good roundness and good coaxiality, and normal hardness
14	Normal	Filter rod with good roundness and good coaxiality, and normal hardness
16	Normal	Filter rod with good roundness and good coaxiality, and normal hardness
18	Average performance	The parameters of the filter rods are highly variable
20	Normal	The parameters of the filter rods are very variable

[0048] That is to say, with respect to the production of the pipe (hollow) filter rod with the PLA tows, when the application amount of triacetin is below 10%, the production situation is acceptable, but there may be un-molded filter rods of low hardness after the molding. When the added amount of triacetin is 12%~16%, the production is normal, and the parameters and appearance of the filter rods meet the requirement. When the added amount of triacetin exceeds 18%, the production becomes worse, and the parameters of the filter rod becomes variable. Therefore, the added amount of triacetin of 12%-16% is suitable to produce the pipe (hollow) filter rod of PLA.

[0049] The composite hollow filter rod and the production method thereof of the present invention are simple in structure. The rod adopts an outside acetate fiber portion and an inside polyester fiber portion to compositely form a hollow filter rod, which not only makes the polyester fiber portion effectively molded by the heated air, but also increases the easy-decomposable characteristic of the PLA of the polyester fiber portion, resulting in a reduced pollution amount and a low cost of raw material. Utilizing the easy processing characteristic of PLA, the hollow filter rods are more attractive and practical.

[0050] Embodiment II, as shown in Figs. 1 and 2, is merely one embodiment of the present invention. On the basis of Embodiment I, in the composite hollow filter rod of the present invention, the outer side of the acetate fiber portion 1 is

provided with a wrapping paper 11 for further covering and shielding after acetate fiber portion 1 is molded.

[0051] Also, the inner side wall of the wrapping paper 11 is coated and provided with an activated carbon layer 12, which can not only effectively filter a certain amount of smoke in the smoking section, and but also prevents impurities in the air outside the filter rod from entering the filter rod.

[0052] Moreover, that shape of the hollow hole 21 comprises a shape of peach heart, a square, a circle, and a plum flower. Precisely, the shape of the cross-section of the second inner core comprises a shape of a peach heart, a pentagram, a circle, and a plum flower, and even other special-shaped structures, so that the molded PLA fiber filter rod has a hollow hole 21 with a corresponding shape.

[0053] Obviously, the number of the hollow holes 21 is at least one, that is, a plurality of hollow holes may be provided in polyester fiber portion 2.

[0054] Finally, the PLA fiber tows are of shell-core tow structure, and the content of the L-lactic acid monomer in raw material for producing the PLA fiber tows is 90% or more, so that the crystallinity of the PLA fiber is ensured, and the thermal stability of the sized tows is high. Triacetin may be further added into raw material of the PLA, and tows are swelled and bound under the effect of the triacetin to obtain well-bound PLA tows with the shell-core structure.

[0055] It should be noted that the first inner core is firstly fed into the molding cavity to perform the heating and molding of the acetate fiber portion, and when the temperature drops, the second inner core is then fed into the molding cavity to perform the heating and molding of the PLA fiber portion.

[0056] Here, the second inner core is with a hollow cavity, the outer side wall of the second inner core is provided with a first through hole, and the second inner core is a heated air inlet passage, and then passing through the first through hole to reach in the molding cavity to heat polyester fiber portion 2.

[0057] Of course, the first inner core is a cylindrical member with a compact structure.

[0058] In this way, when the first inner core feeds into the molding cavity to perform the heating and molding of the acetate fiber portion, the acetate fiber portion can be regarded as a concentric annular structure, and the molding effect may not be affected by the steam present as water droplets deposited at the bending position. On the contrary, when the second inner core feeds into the molding cavity to perform the heating and molding of the PLA fiber portion, since the air feeds is pure air, there is no need to worry about air accumulation at the special-shaped second inner core part, and good molding effect can still be ensured.

[0059] Embodiment III as shown in Fig. 3, the present invention further provides a method for producing the composite hollow filter rod in all the aforesaid embodiments, comprising the following steps:

S1: inserting a first inner core into a molding cavity;

S2: transporting loosened acetate fiber tows into the molding cavity, feeding steam into the molding cavity, and heating and curing the acetate fiber tows to obtain an acetate fiber portion;

S3: after the acetate fiber portion is cooled, drawing out the first inner core, and inserting a second inner core into the molding cavity;

S4: transporting the loosened PLA fiber tows into the inner side of the acetate fiber portion in the molding cavity, feeding heated air into the molding cavity, and heating and curing the PLA fiber tows to obtain a polyester fiber portion;

S5: after the polyester fiber portion is cooled, drawing out the second inner core, and taking out the composite hollow filter rod.

[0060] Here, when performing step S2, the temperature of the fed steam is in a range of 140°C to 170°C.

[0061] Correspondingly, the temperature of the fed heated air is in a range of 65°C to 85°C.

[0062] Moreover, when performing step S3, the outer diameter of the second inner core is smaller than the outer diameter of the first inner core.

[0063] The composite hollow filter rod and the production method thereof of the present invention are simple in structure. The rod adopts an outside acetate fiber portion and an inside polyester fiber portion to compositely form a hollow filter rod, which not only makes the polyester fiber portion effectively molded by the heated air, but also increases the easy-decomposable characteristic of the PLA of the polyester fiber portion, resulting in a reduced pollution amount and a low cost of raw material. Utilizing the easy processing characteristic of PLA, the hollow filter rods are more attractive and practical.

[0064] The present invention may not be limited to the aforesaid specific embodiments, and various modifications and variations may be available in the present invention. Any amendments, equivalent substitution, improvement, etc., made to the above embodiments according to the technical essence of the present invention shall be contained in the scope of protection of the present invention.

Claims

1. A composite hollow filter rod, **characterized in that**, comprising an acetate fiber portion (1) and a polyester fiber portion (2) provided at the inner side of the acetate fiber portion (1);

the acetate fiber portion (1) is of an annular structure, the outer diameter of the polyester fiber portion (2) is equal to the inner diameter of the acetate fiber portion (1), and the polyester fiber portion (2) is provided with a hollow hole (21);

the acetate fiber portion (1) is molded by curing acetate fiber tows under high temperature steam heating; the polyester fiber portion (2) is molded by curing PLA fiber tows under the heating of heated air.

2. The composite hollow filter rod according to claim 1, **characterized in that**, the outer side of the acetate fiber portion (1) is provided with a wrapping paper (11).

3. The composite hollow filter rod according to claim 2, **characterized in that**, the inner side wall of the wrapping paper (11) is coated with an activated carbon layer (12).

4. The composition hollow filter rod according to claim 1, **characterized in that**, the shape of the hollow hole (21) comprises the shapes of a peach heart, a square, a circle, and a plum flower.

5. The composite hollow filter rod according to claim 1, **characterized in that**, the number of the hollow holes (21) is at least one.

6. The composite hollow filter rod according to claim 1, **characterized in that**, the PLA fiber tows are a tow structure of shell-core.

7. The composite hollow filter rod according to claim 1, **characterized in that**, the content of the L-lactic acid monomer in raw material for producing the PLA fiber tows is 90% or more.

8. A method for producing the composite hollow filter rod according to anyone of claims 1-7, **characterized in that**, comprising the following steps:

S1: inserting a first inner core into a molding cavity;

S2: transporting acetate fiber tows into the molding cavity, feeding steam into the molding cavity, and heating and curing the acetate fiber tows to obtain an acetate fiber portion;

S3: after the acetate fiber portion is cooled, drawing out the first inner core, and inserting a second inner core into the molding cavity;

S4: transporting PLA fiber tows into the inner side of the acetate fiber portion in the molding cavity, feeding heated air into the molding cavity, and heating and curing the PLA fiber tows to obtain a polyester fiber portion.

9. The method for producing the composite hollow filter rod according to claim 8, **characterized in that**,

when performing step S2, the temperature of the fed steam is in a range of 140°C to 170°C;

when performing step S4, the temperature of the fed heated air is in a range of 65°C to 85°C.

10. The method for producing the composite hollow filter rod according to claim 8, **characterized in that**, when performing step S3, the outer diameter of the second inner core is smaller than the outer diameter of the first inner core.

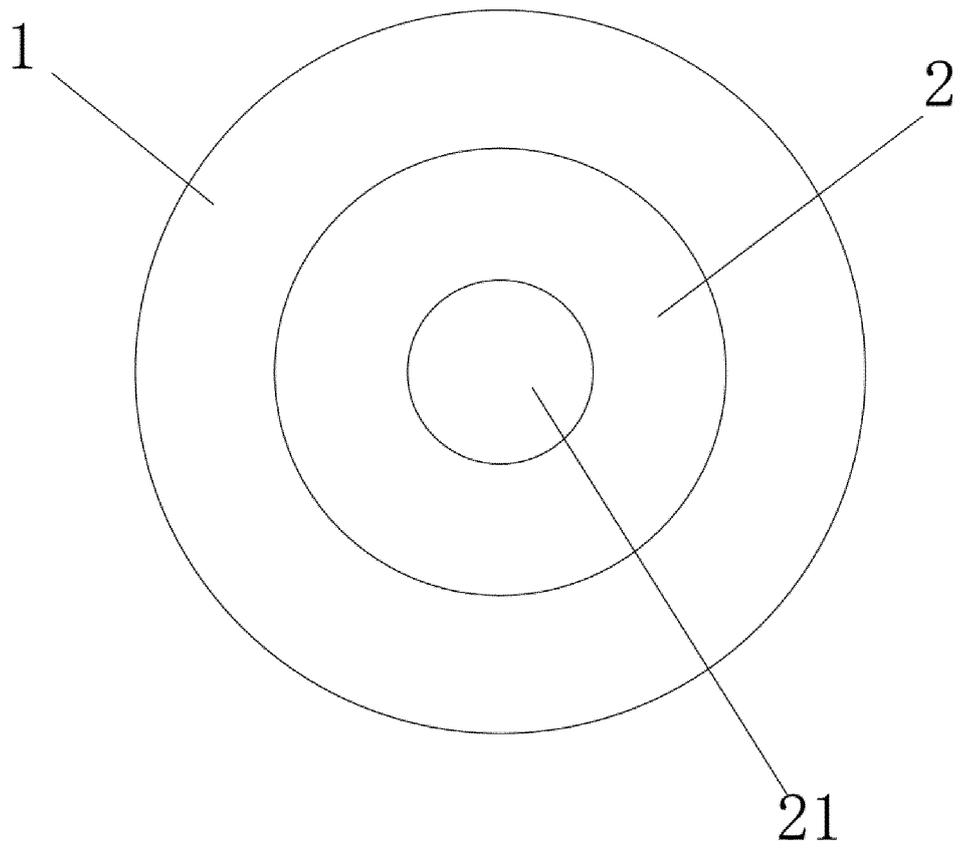


Fig. 1

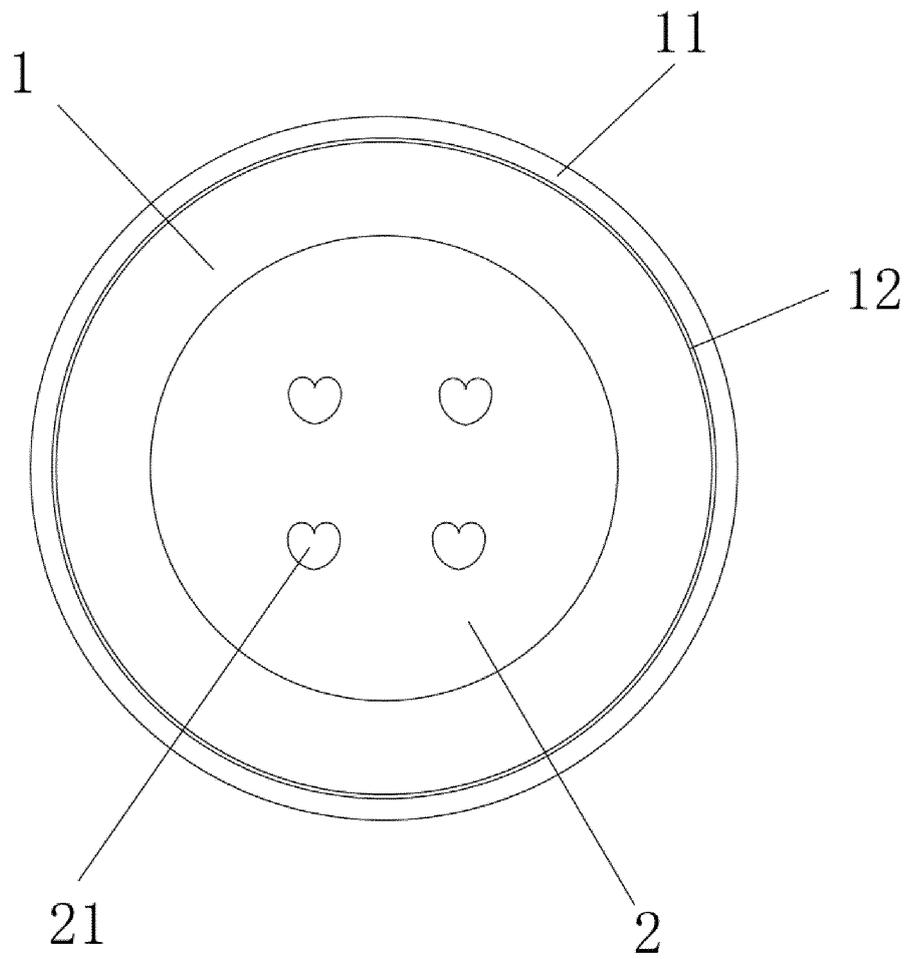


Fig. 2

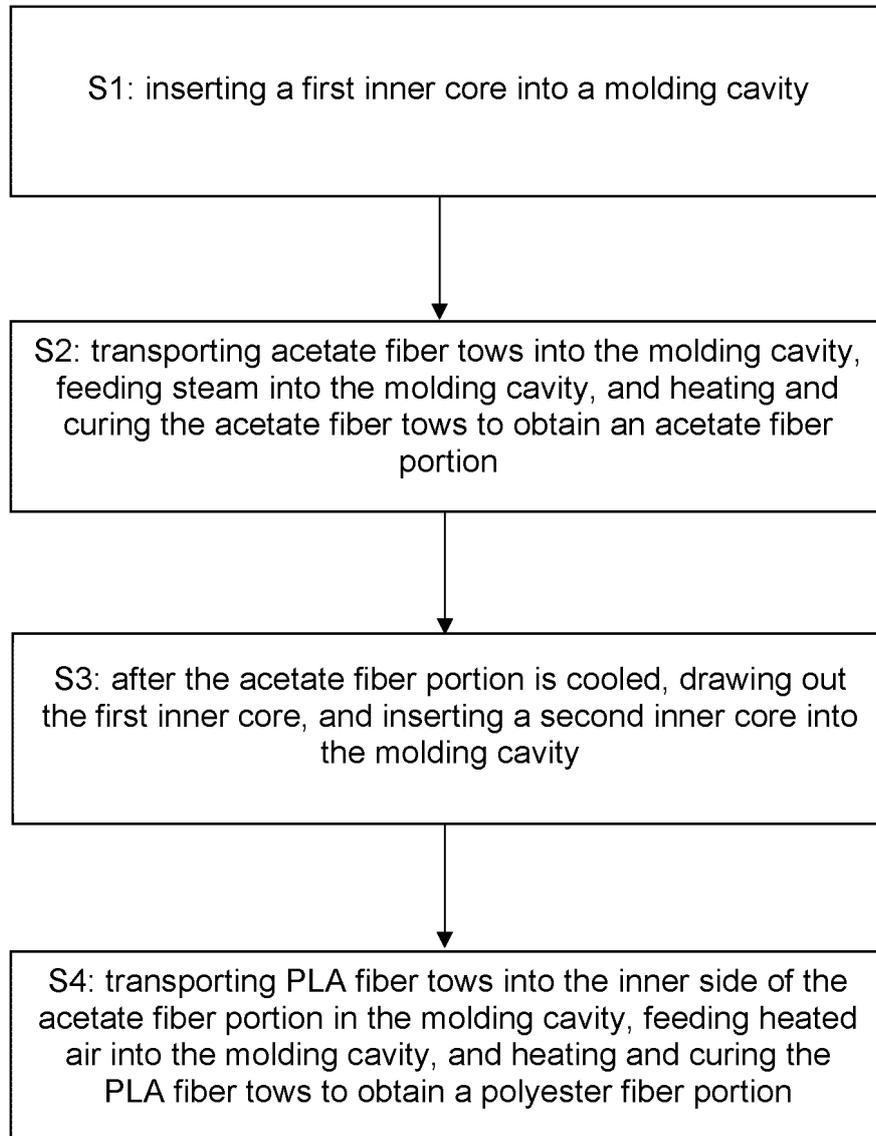


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/078099

5	<p>A. CLASSIFICATION OF SUBJECT MATTER A24D3/04(2006.01)i; A24D3/04(2006.01)i</p> <p>According to International Patent Classification (IPC) or to both national classification and IPC</p>																			
10	<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) IPC:A24D3</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNTXT, ENTXT, WPABS, VEN, CNKI, ISI WEB OF SCIENCE: 醋纤, 醋酸纤维, 乳酸纤维, 乳纤, 滤棒, 滤嘴, 过滤, 环, 热, 空气, 蒸汽, 中空, 层, acetate fiber, polylactic acid fiber, filter, annular, heat, air, steam, vapour, hollow, layer</p>																			
15	<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Category*</th> <th style="width: 70%;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="width: 20%;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">PX</td> <td>CN 116172244 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 30 May 2023 (2023-05-30) claims 1-10</td> <td style="text-align: center;">1-10</td> </tr> <tr> <td style="text-align: center;">PX</td> <td>CN 116210962 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 06 June 2023 (2023-06-06) description, paragraphs 75-84, and figure 6</td> <td style="text-align: center;">1, 4, 5, 8-10</td> </tr> <tr> <td style="text-align: center;">Y</td> <td>CN 215583157 U (HUNAN JISHOU MINZU MATERIALS CO., LTD.) 21 January 2022 (2022-01-21) description, paragraph 58, claim 2, and figure 3</td> <td style="text-align: center;">1-7</td> </tr> <tr> <td style="text-align: center;">Y</td> <td>CN 210747211 U (SHANGHAI SHENSHUN INTELLIGENT TECHNOLOGY CO., LTD. et al.) 16 June 2020 (2020-06-16) description, paragraphs 2 and 3</td> <td style="text-align: center;">1-7</td> </tr> <tr> <td style="text-align: center;">Y</td> <td>CN 115568624 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 06 January 2023 (2023-01-06) claims 1-8</td> <td style="text-align: center;">2, 3, 6, 7</td> </tr> </tbody> </table>		Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	PX	CN 116172244 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 30 May 2023 (2023-05-30) claims 1-10	1-10	PX	CN 116210962 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 06 June 2023 (2023-06-06) description, paragraphs 75-84, and figure 6	1, 4, 5, 8-10	Y	CN 215583157 U (HUNAN JISHOU MINZU MATERIALS CO., LTD.) 21 January 2022 (2022-01-21) description, paragraph 58, claim 2, and figure 3	1-7	Y	CN 210747211 U (SHANGHAI SHENSHUN INTELLIGENT TECHNOLOGY CO., LTD. et al.) 16 June 2020 (2020-06-16) description, paragraphs 2 and 3	1-7	Y	CN 115568624 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 06 January 2023 (2023-01-06) claims 1-8	2, 3, 6, 7
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																		
PX	CN 116172244 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 30 May 2023 (2023-05-30) claims 1-10	1-10																		
PX	CN 116210962 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 06 June 2023 (2023-06-06) description, paragraphs 75-84, and figure 6	1, 4, 5, 8-10																		
Y	CN 215583157 U (HUNAN JISHOU MINZU MATERIALS CO., LTD.) 21 January 2022 (2022-01-21) description, paragraph 58, claim 2, and figure 3	1-7																		
Y	CN 210747211 U (SHANGHAI SHENSHUN INTELLIGENT TECHNOLOGY CO., LTD. et al.) 16 June 2020 (2020-06-16) description, paragraphs 2 and 3	1-7																		
Y	CN 115568624 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 06 January 2023 (2023-01-06) claims 1-8	2, 3, 6, 7																		
20	<p><input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.</p>																			
25	<table style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "D" document cited by the applicant in the international application "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width: 50%; vertical-align: top;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "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 "&" document member of the same patent family</p> </td> </tr> </table>		<p>* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "D" document cited by the applicant in the international application "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "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 "&" document member of the same patent family</p>																
<p>* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "D" document cited by the applicant in the international application "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "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 "&" document member of the same patent family</p>																			
30	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Date of the actual completion of the international search 18 April 2024</td> <td style="width: 50%;">Date of mailing of the international search report 24 April 2024</td> </tr> </table>		Date of the actual completion of the international search 18 April 2024	Date of mailing of the international search report 24 April 2024																
Date of the actual completion of the international search 18 April 2024	Date of mailing of the international search report 24 April 2024																			
35	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/ CN) China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088</td> <td style="width: 50%;">Authorized officer Telephone No.</td> </tr> </table>		Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/ CN) China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088	Authorized officer Telephone No.																
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/ CN) China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088	Authorized officer Telephone No.																			

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/078099

5

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 109730356 A (YUNNAN TOBACCO BIOLOGICAL TECHNOLOGY CO., LTD.) 10 May 2019 (2019-05-10) description, paragraphs 20-24, and figure 1	1-7
Y	WO 2022222959 A1 (HUNAN JISHOU MINZU MATERIALS CO., LTD.) 27 October 2022 (2022-10-27) description, paragraph 67, and figure 1	1-7
Y	CN 115568620 A (CHINA TOBACCO YUNNAN INDUSTRIAL CO., LTD.) 06 January 2023 (2023-01-06) description, paragraph 21, and figure 2	2, 3
A	CN 113662244 A (KUNMING JIKE TECHNOLOGY CO., LTD.) 19 November 2021 (2021-11-19) entire document	1-10
A	WO 2020113796 A1 (CHINA TOBACCO ANHUI INDUSTRIAL CO., LTD.) 11 June 2020 (2020-06-11) entire document	1-10

10

15

20

25

30

35

40

45

50

55

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No. PCT/CN2024/078099

5
10
15
20
25
30
35
40
45
50
55

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 116172244 A	30 May 2023	None	
CN 116210962 A	06 June 2023	None	
CN 215583157 U	21 January 2022	None	
CN 210747211 U	16 June 2020	None	
CN 115568624 A	06 January 2023	None	
CN 109730356 A	10 May 2019	None	
WO 2022222959 A1	27 October 2022	EP 4256992 A1	11 October 2023
CN 115568620 A	06 January 2023	None	
CN 113662244 A	19 November 2021	None	
WO 2020113796 A1	11 June 2020	RU 2767008 C1 MY 196188 A	16 March 2022 21 March 2023

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 111436650 A [0003]