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(54) **METHOD OF PRODUCING ACRYLIC OR MODACRYLIC FIBER HAVING ANTI-ODOR EFFECT**

VERFAHREN ZUR HERSTELLUNG VON ACRYL- ODER MODACRYLFASERN MIT DESODORIERENDER WIRKUNG

PROCÉDÉ DE PRODUCTION DE FIBRE ACRYLIQUE OU MODACRYLIQUE AYANT UN EFFET ANTI-ODEUR

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Description

TECHNICAL FIELD

[0001] The invention relates to a method intended for the production of acrylic and modacrylic fiber having anti-odor feature.

PRIOR ART

[0002] Some features that are provided to textile products that are being produced in recent years have created positive effect in terms of human health as well as facilitating the human life. The textile products -that are ironed easily and that are light, having high air permeability and having low water permeability- are decreasing the loss of energy and time, and providing positive gains in terms of hygiene. One of the studies performed on textile products is to obtain textile product raw materials that are suppressing and/or preventing the odor and having anti-odor feature.

[0003] Acrylic fiber is the synthetic fiber type that is the most similar to wool, and it is a textile raw material used either by itself and/or as mixed with synthetic fiber types. Acrylic fiber, that has features such as easy washing and preserving its shape, resistant against moth, oil and chemicals and being able to be dyed in bright colors of perfect fastness, is a textile raw material which is extensively used.

[0004] There are numerous sweat glands in human body. Sweat, that is a very suitable environment for the bacterial growth, is structurally odorless. The source of bad sweat smells spreading from the human body is various bacteria and microorganisms growing at different parts of the body.

[0005] In the previous approaches, the use of heavy metal compounds had been referred as anti-odor material. But most of the referred materials are included in biocide lists that are being qualified as inconvenient. The biocides are chemical materials that are generated by the mixture of one or more active materials, and have controlling or destroying effect on microorganisms covering bacteria, fungus, tang, mold or yeast.

[0006] In the previous approaches, it had been worked with raw materials including silver ion as anti-odor in the production of fiber and thread. Silver is very efficient in terms of its anti-odor effect, and despite not constituting any problem in terms of human health, its use in the production of fiber is being disadvantageous due to its high cost.

[0007] Moreover, in the prevalent technique, it is known that the anti-odor feature is provided through coating on the surface of fiber / fabric. In the anti-odor studies realized, chemical materials are added at the chemical finishing step of the fiber production process and anti-odor feature is provided. But in the fiber / fabric being obtained by this method, the coating is abraded following specific number of washes, and the anti-odor feature of the fiber / fabric is lost.

[0008] In the material science approaches, zinc oxide (ZnO) is a chemical material that is preferred in terms of its features of high refractive index, high heat conductivity, joining, anti-bacterial and UV protection.

[0009] The studies performed on the anti-bacterial feature of ZnO have started by the beginning 1950s. The proof by Sawai et al. in 1995 that the ZnO powder exhibit anti-bacterial behavior against some bacteria was a significant step in the use of ZnO as anti-microbial material. It is known that ZnO is a reliable material that doesn't cause any problems in terms of human and animal health as well as being stable under compelling conditions such as high temperature and/or pressure. In the previous studies, it was determined that ZnO particles were effective in the prevention of gram-positive and gram-negative bacteria, and even of spores resistant to high temperature and pressure. As ZnO is a semiconductor material having wide band range (3.37 eV), it is able to absorb the ultraviolet (UV) light by the electronic stimulation in between the valance and conduction band. UV absorbers transform the UV energy to harmless thermal energy.

[0010] In the patent application 2006/03916 (TURKPATENT), a layer of which 99% is consisting of pure silver adheres on the surface of synthetic raw materials such as polyester or on the surface of natural thread raw materials. The silver layer adheres on the polymer, and it becomes a physical part of the textile's texture.

[0011] In the patent application 2012/15683, (TURKPATENT), the invention is the preparation and production method of nanofiber food packaging films by the electrospinning method of referred hybrid polymer solution by ensuring aloe vera -which is a natural polymer- and zinc oxide addition to the copolymer -which is formed by using polyvinyl alcohol biodegradable polymer material whose short name is PVA, and which is formed by mixing each and some of the polymers such as polyethylene glycol whose short name is PEG, polyvinyl pyrrolidone whose short name is PVP and polylactic acid whose short name is PLA with a slight amount of PVA biodegradable polymer when required- for it to ensure anti-microbial effect when required.

[0012] In the patent application JPH1025663 (Japan Patent Office), the absorption of odors such as smoke odor by a metal oxide selected from among, zinc oxide, silicon oxide, aluminum and silicon and aluminum compound oxide in the mixture of vinylamine and acrylic fiber is being referred.

[0013] Further the acrylic/modacrylic fibers comprising zinc oxide or zinc pyrithione are known also from US2010/029156A1, JP3349028B2, US3061398A, and US2014/272152A1.

[0014] As a result, all the aforementioned problems have made it obligatory to make innovation in the relevant field.

OBJECT OF THE INVENTION

[0015] The present invention makes it necessary to remove the above-mentioned problems and to make technical innovation in the relevant field.

[0016] The main object of the invention is to reveal the structure of a method that will enable the production of acrylic / modacrylic fiber having anti-odor effect.

[0017] Another object of the invention is to reveal the production method of acrylic / modacrylic fiber having anti-odor effect by using zinc oxide (ZnO) that has antibacterial feature.

[0018] Another object of the invention is to ensure the obtainment of acrylic / modacrylic fiber having anti-odor effect by the addition of zinc oxide (ZnO) at the preparation step of polymer solution (dope) in the fiber production process.

[0019] Another object of the invention is to enable the confinement of zinc oxide powders in acrylic / modacrylic fiber.

[0020] Another object of the invention is to ensure an acrylic / modacrylic fiber structure whose anti-odor feature isn't easily lost after washing.

[0021] Another object of the invention is to reveal an acrylic / modacrylic fiber structure allowing the absorption of ultraviolet lights due to the anti-UV feature of zinc oxide.

BRIEF DESCRIPTION OF THE FIGURES

[0022]

Figure 1 is the representative view of the acrylic / modacrylic fiber (1) structure relevant to "acrylic / modacrylic fiber having anti-odor effect" which is the subject of the invention.

Figure 2 is the representative view of the elements being used in the production of acrylic / modacrylic fiber (1) relevant to "acrylic / modacrylic fiber having anti-odor effect" which is the subject of the invention.

Figure 3 is diagram of the process steps of acrylic / modacrylic fiber (1) production method relevant to "acrylic / modacrylic fiber having anti-odor effect" which is the subject of the invention.

Figure 4 is the representative view of the use of zinc pyrithione in the production of acrylic / modacrylic fiber (1) relevant to "acrylic / modacrylic fiber having anti-odor effect" which is the subject of the invention.

Figure 5 is the diagram of the process steps of production method of acrylic / modacrylic fiber (1) including zinc pyrithione relevant to "acrylic / modacrylic fiber having anti-odor effect" which is the subject of the invention.

DESCRIPTION OF REFERENCE NUMBERS IN THE FIGURES

[0023]

1. Acrylic / modacrylic fiber
2. Polyacrylonitrile (PAN)
3. Solvent
4. Polymer solution (Dope)
5. Dilute polymer solution
6. Zinc oxide (ZnO)
6.a. Zinc pyrithione ($C_{10}H_8N_2O_2S_2Zn$)
7. Tank 1
8. Tank 2
9. Heat exchanger
10. Dynamic mixer
11. Fiber spinning machine

DESCRIPTION OF PROCESS STEPS

[0024] The invention entitled as **"ACRYLIC / MODACRYLIC FIBER HAVING ANTI-ODOR EFFECT"** which is the subject to this application, is numbered as shown in the attached figures, and the corresponding process steps for these numbers are given below.

Process steps for using zinc oxide (6)

[0025]

101. Adding solvent (3) into tank 1 (7)
102. Adding polyacrylonitrile (PAN) (2) into tank 1 (7)
103. Passing the solution which is prepared in tank 1 (7) from the heat exchanger (9) for polyacrylonitrile (PAN) (2) to completely dissolve
104. Preparing a more dilute polymer solution (5) in tank 2 (8) than the polymer solution (4) called dope which is prepared in tank 1 (7)
105. Adding zinc oxide (6) into tank 2 (8)
106. Mixing the solutions prepared in tank 1 (7) and tank 2 (8) by the assistance of dynamic mixer (10), and adding the same into the fiber spinning machine (11)
107. Obtaining acrylic / modacrylic fiber (1) from the final mixture through the wet spinning method

Process steps for using zinc prithione (6.a)

[0026]

111. Adding solvent (3) into tank 1 (7)
112. Adding polyacrylonitrile (PAN) (2) into tank 1 (7)
113. Passing it from the heat exchanger (9) for polyacrylonitrile (PAN) (2) to completely dissolve
114. Preparing a more dilute polymer solution (5) in tank 2 (8) than the polymer solution (4) called dope which is prepared in tank 1 (7)
115. Adding zinc pyrithione (6.a) into tank 2 (8)
116. Mixing the solutions prepared in tank 1 (7) and tank 2 (8) by the assistance of dynamic mixer (10), and adding the same into the fiber spinning machine (11)
117. Obtaining acrylic / modacrylic fiber (1) from the final mixture through the wet spinning method

DETAILED DESCRIPTION OF THE INVENTION

[0027] In this detailed description, **ACRYLIC / MODACRYLIC FIBER HAVING ANTI-ODOR EFFECT** which is the subject of the invention is only explained by examples which will not cause any limiting effect in order to understand the subject better.

[0028] The invention relates to a method that will enable the production of acrylic / modacrylic fiber (1) having anti-odor effect.

[0029] The acrylic / modacrylic fiber (1) which is the subject of invention and produced as having anti-odor feature is comprising the elements of polyacrylonitrile (PAN) (2), solvent (3), polymer solution (Dope) (4), dilute polymer solution (5), zinc oxide (ZnO) (6) or zinc pyrithione (6.a), tank 1 (7), tank 2 (8), heat exchanger (9), dynamic mixer (10) and fiber spinning machine (11).

[0030] Polyacrylonitrile (PAN) (2) is an acrylic material, and it is a material having polymer structure which is frequently used in clothing, textile fields. The crystal elongation and crystallization ratio of acrylic fiber -which was previously produced as homopolymer through 100% polymerization of acrylonitrile- is very high. For this reason, its features such as being dyed and absorption of humidity are negative, and dying it is very hard. In order to improve these features and to provide the capacity of being dyed, it has been transformed to copolymer by the addition of a second monomer, and its features have been made suitable for use in textile. Polyacrylonitrile (PAN) (2) is a type of thermoset polymer. Co-polyacrylonitrile (co-PAN) (2) includes comonomer at a rate of 4-12%. This comonomer is generally vinyl acetate or methyl acrylate. The molecular weight of co-polyacrylonitrile (co-PAN) (2) is in between 90,000 - 200,000.

[0031] The solvent (3), which is used as dissolver, is DMAc, DMF, DMSO and similar solutions which are polar aprotic solvents.

[0032] The polymer solution (4) is a viscous solution called "Dope" where polyacrylonitrile (PAN) (2) dissolves in the solvent (3).

[0033] The dilute polymer solution (5) is a polymer solution which is prepared as more dilute than the polymer solution (Dope) (4).

[0034] Tank 1 (7) is the location where the solvent (3) and polyacrylonitrile (PAN) (2) are mixed, and polymer solution (Dope) (4) is obtained.

[0035] Tank 2 (8) is the location where the dilute polymer solution (5) is prepared, and the zinc oxide (ZnO) (6) or zinc pyrithione (6.a) is added into this dilute polymer solution (5).

[0036] The heat exchanger (9) is enabling the complete dissolution of solutions at a temperature of 70-100°C.

[0037] Dynamic mixer (10) is used for mixing and homogenizing the dilute polymer solution (5) in which the prepared polymer solution (Dope) (4) and zinc oxide (ZnO) (6) or zinc pyrithione (6.a) are added.

[0038] Acrylic / modacrylic fiber (1) which is the subject of the invention is a new fiber produced by adding zinc oxide (ZnO) (6) and used in the fields of clothing, home textile and technical textile having anti-odor feature.

[0039] Moreover, the acrylic / modacrylic fiber (1) which is the subject of the invention is a new fiber produced by adding zinc pyrithione ($C_{10}H_8N_2O_2S_2Zn$) (6.a), and used in the fields of clothing, home textile and technical textile having anti-odor feature.

[0040] Initially, the solvent (3) doesn't have sufficient temperature for dissolution. For this reason, the polyacrylonitrile (PAN) (2) in the solvent (3) is passed through the heat exchanger (9) which is heated up with vapor for the its dissolution, and after completion of dissolution, the polymer solution (4) called dope is obtained. The obtained dope (4) is sensitive to heat so it is slightly cooled as being passed from water cooled exchanger (9) without being kept at high temperature.

[0041] In tank 2 (8), more dilute polymer solution (5) than the polymer solution (4) which is prepared in tank 1 (7) is prepared. Zinc oxide (ZnO) (6) in powder form at a size of 0.1-5.0 micrometers is added into the obtained dilute polymer solution (5). A suspension is obtained by the added zinc oxide (ZnO) (6) particles that is insoluble in the solution, and dispersing as solid particles

[0042] The polymer solution (dope) (4) in tank 1 (7), and the dilute polymer solution (5) in tank 2 (8) in which zinc oxide (ZnO) (6) is added are transferred to fiber spinning machine (11). The dilute polymer solution (5) in which zinc oxide (ZnO) (6) is added is delivered to fiber spinning machine (11) through the high power system called dynamic mixer (10). Thus, precipitation of zinc oxide (ZnO) (6) -in solid form- is prevented.

[0043] An acrylic / modacrylic fiber (1) having anti-odor effect is obtained by the wet spinning method from the final mixture obtained.

[0044] In another preferred embodiment of the invention, powder zinc pyrithione (6.a) with a grain size of 0,1-5,0 micrometers is added in the dilute polymer solution (5) prepared in tank 2 (8). The polymer solution

(dope) (4) in tank 1 (7), and the dilute polymer solution (5) in tank 2 (8) in which zinc pyrithione (6.a) is added are transferred to fiber spinning machine (11). An acrylic / modacrylic fiber (1) having anti-odor effect is obtained by the wet spinning method from the final mixture obtained. The referred acrylic / modacrylic fiber (1) includes zinc pyrithione (6.a) at a rate of 0.3-5% in weight. Zinc pyrithione (6.a) is confined in fiber (1). The representative form of the referred preparation method is shown in Figure 4, and its diagram is shown in Figure 5.

[0045] In the wet spinning method, the prepared polymer solution (4) is fed to a bath consisting of water - solvent mixture after having the required injections, filtering and pressurizing are made. The feeding is made over a perforated plate called spinneret bearing holes in between 10,000-100,000 microns. As the polymer dissolved in the solvent doesn't dissolve in water, it transforms to fiber as being instantaneously coagulated at the entrance to bath. The zinc oxide (ZnO) (6) -that is initially in the solution in solid form without dissolving-, or the zinc pyrithione (6.a) in the other embodiment becomes contained in the fibers at this phase. This operation is called coagulation, and the bath in which fibers form is called coagulation bath. For the fiber to be well dyed in the following phase, the solvent amount on it is required to be below 0.5%. For this reason, washing operation is realized. Generally basic dyes are used in dying of fibers. The acidic groups at the ends of polymer chain make a chemical bond with the basic dyes, and the dyeing of the fiber is ensured. The dyeing operation is realized as the absorption of dye by the fiber that passes through the dye bath and of which solvent is removed. For the orientation of dyed (or non-dyed) fibers, and for enabling the required physical properties (dtex, elongation, strength) of the fiber, a fiber drawing operation which is applied by heating it in two separate baths is realized. This operation is called as wet stretching. By the end of wet stretching, the length of the fiber increases by six times. Before the drying operation, chemical finish is applied on the washed, dyed fiber which is extended through wet stretching . Chemical finish is a lubricant material covering the surface of fiber, and it is a mixture of organic substances used in order to provide the operation and required softness of fiber in textile operations, and adjusting the friction of fiber with each other and on the metal surfaces. The fiber coming out of the chemical finish bath is dried by getting passed through a serial drying roll heated up by vapor. The water vapor leaving the surface of fiber is removed by being carried by the air in an aspiration system. The fibers are required to be curly, not straight, to hold each other. The curling operation providing wool feature and appearance to the fiber is performed while passing in between two rolls inside a crimping box of the tow band. Another importance of the crimping operation is enabling the penetration of vapor to each point of the fiber bands during the annealing phase.

[0046] After all the required phases, acrylic / modacrylic fiber (1) having anti-odor effect is obtained. The anti-odor and anti-bacterial effect of zinc on textile products activates when the skin spreads moisture, and an active variability is formed in between the fibers and the skin. Zinc oxide (ZnO) (6) having positive zeta potential easily holds on the cell membrane of negative bacteria, and Zn^{+2} ions are released. The released zinc ions interact with the bacteria. Vital ions such as sodium etc. inside the bacteria change place with the zinc ions. Due to this displacement, the metabolism of bacteria starts to collapse, and bacterial cell deaths becomes realized. By the death of bacteria which is the cause of bad odors, the sweat smell becomes prevented.

Claims

1. The invention is related to method of production of a type of acrylic / modacrylic fiber (1) having anti-odor effect, ***characterized in that;***

    a) Adding solvent (3) into tank 1 (7),
    b) Adding polyacrylonitrile (PAN) (2) into tank 1 (7),
    c) Passing it from the heat exchanger (9) for polyacrylonitrile (PAN) (2) to dissolve completely,
    d) Forming a more diluted polymer solution (5) in tank 2 (8) than the polymer solution (4) called dope which is prepared in tank 1 (7),
    e) Adding zinc oxide (6) or zinc pyrithione (6.a) into tank 2 (8),
    f) Mixing the solutions prepared in tank 1 (7) and tank 2 (8) by the assistance of dynamic mixer (10), and adding the same into the fiber spinning machine (11),
    g) Obtaining acrylic / modacrylic fiber (1) from the final mixture through the wet spinning method.

2. The invention is the method of production of an acrylic / modacrylic fiber (1) according to Claim 1, ***wherein*** the zinc pyrithione (6.a) is powder form at the size of 0.1-5.0 micrometers.

3. The invention is the method of production of an acrylic / modacrylic fiber (1) according to Claim 1, ***wherein*** the zinc oxide (6) is powder form at the size of 0.1-5.0 micrometers.

4. The invention is an acrylic / modacrylic fiber (1) obtained by the method of production of an acrylic / modacrylic fiber (1) according to any preceding claims.

5. The acrylic / modacrylic fiber (1) according to Claim 4, ***wherein*** comprises zinc pyrithione (6.a) at a rate of 0.3-5% by weight.

6. The acrylic / modacrylic fiber (1) according to Claim 4, ***wherein*** comprises zinc oxide (6) at a rate of 0.1-10% by weight.

7. The acrylic / modacrylic fiber (1) according to Claims 4-6, ***wherein*** comprises zinc oxide (6) or zinc pyrithione (6.a) confined to the fiber (1).

Patentansprüche

1. Die Erfindung betrifft die Herstellungsmethode für eine Art acrylic / modacrylic Faser (1), **dadurch gekennzeichnet;**

   a) Zusatz von Lösungsmittel (3) in einem tank 1 (7)
   b) Zusatz von polyacrylonitrile (PAN) (2) in einem tank 1 (7)
   c) Durchführen von polyacrylonitrile (PAN) (2) von einem Wärmetauscher (9) damit es vollständig gelöst wird,
   d) Bildung in dem Tank 1 (7) eines noch dünneren polymer Lösungsmittel (5) von einem polymer Lösungsmittel (4) sog. Dope, in dem Tank 2 (8),
   e) Zusatz von Zink Oxyd (6) oder Zink Pyrithione (6a.) in dem Tank 2 (8),
   f) Mischung von Lösungsmitteln die in dem Tank 1 (7) und Tank 2 (8) vorbereitet worden sind mit Hilfe eines dynamischen Mixer (10) und Zusatz in einer Faserspinnmaschine (11),
   g) Gewinnung von der endgültigen Mischung acrylic / modacrylic Faser (1) entsprechend der Nassspinnmethode.

2. Die Erfindung ist die acrylic / modacrylic Faser (1) Herstellungsmethode entsprechend Anspruch 1, **dadurch gekennzeichnet; dass** Zink pyritione (6a.) in Pulver form ist mit Größe von 0,1 - 0,5 Mikrometer.

3. Die Erfindung ist die acrylic / modacrylic Faser (1) Herstellungsmethode entsprechend Anspruch 1, **dadurch gekennzeichnet; dass** Zink Oxyd (6a.) in Pulver form ist, mit Größe von 0,1 - 0,5 Mikrometer.

4. Die Erfindung ist acrylic / modacrylic Faser (1) dass es mit der Herstellungsmethode entsprechend eines der vorherigen Ansprüche von acrylic / modacrylic Faser (1) hergestellt wurde.

5. Acrylic / modacrylic Faser (1) entsprechend Anspruch 4, **dadurch gekennzeichnet** das es in rate % 0,3 - 5 Gew., Zink pyrithione (6.a) umfasst.

6. Acrylic / modacrylic Faser (1) entsprechend Anspruch 4, **dadurch gekennzeichnet** das es in rate % 0,1 - 10 Gew., Zink Oxyd (6) umfasst.

7. Acrylic / modacrylic Faser (1) entsprechend Anspruch 4 - 6, **dadurch gekennzeichnet**, das es Zink Oxyd (6) oder Zink pyrithione (6.a) umfasst, die mit Faser (1) begrenzt sind.

Revendications

1. L'invention concerne un procédé de production d'un type de fibre acrylique/ modacrylique (1) à effet antiodeur, **caractérisé en ce que;**

   a) l'ajout de solvant (3) dans le réservoir 1 (7),
   b) l'ajout de polyacrylonitrile (PAN) (2) dans le réservoir 1 (7),
   c) le faire passer de l'échangeur de chaleur (9) pour que le polyacrylonitrile (PAN) (2) se dissolve complètement,
   d) formation d'une solution de polymère (5) plus diluée dans le réservoir 2 (8) que la solution de polymère (4) appelée dope qui est préparée dans le réservoir 1 (7),
   e) l'ajout d'oxyde de zinc (6) ou de pyrithione de zinc (6.a) dans le réservoir 2(8),
   f) mélange des solutions préparées dans le réservoir 1 (7) et le réservoir 2 (8) à l'aide du mélangeur dynamique (10), et l'ajout de celles-ci dans la machine à filer les fibres (11),
   g) l'obtention de la fibre acrylique/ modacrylique (1) à partir du mélange final par la méthode de filage humide.

2. L'invention est le procédé de production d'une fibre acrylique/ modacrylique (1) selon la revendication 1, **dans laquelle** la pyrithione de zinc (6.a) est sous forme de poudre d'une taille de 0.1 à 5.0 micromètres.

3. L'invention est le procédé de production d'une fibre acrylique/ modacrylique (1) selon la revendication 1, **dans laquelle** l'oxyde de zinc (6) est sous forme de poudre d'une taille de 0.1 à 5.0 micromètres.

4. L'invention est une fibre acrylique/ modacrylique (1) obtenue par le procédé de production d'une fibre acrylique/ modacrylique (1) selon l'une quelconque des revendications précédentes.

5. Fibre acrylique/ modacrylique (1) selon la revendication 4, **dans laquelle** comprend de la pyrithione de zinc (6.a) à un taux de 0.3 à 5% en poids.

6. Fibre acrylique/ modacrylique (1) selon la revendication 4, **dans laquelle** comprend de l'oxyde de zinc (6) à un taux de 0.1 à 10% en poids.

7. Fibre acrylique/ modacrylique (1) selon les revendications 4 à 6, **dans laquelle** comprend de l'oxyde

de zinc (6) ou de la pyrithione de zinc (6.a) confinée à la fibre (1).

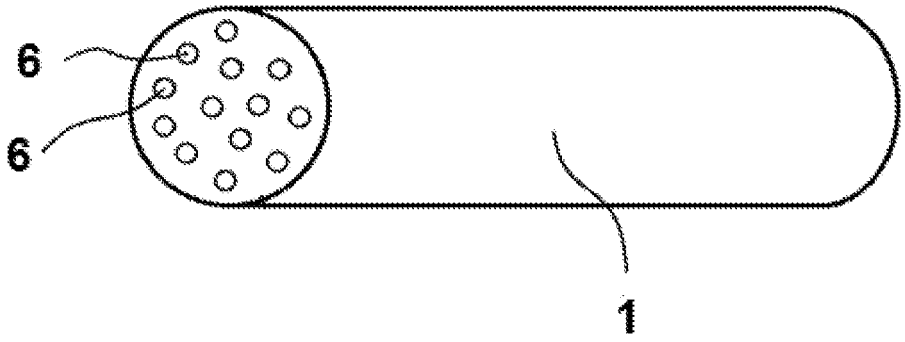

Figure 1

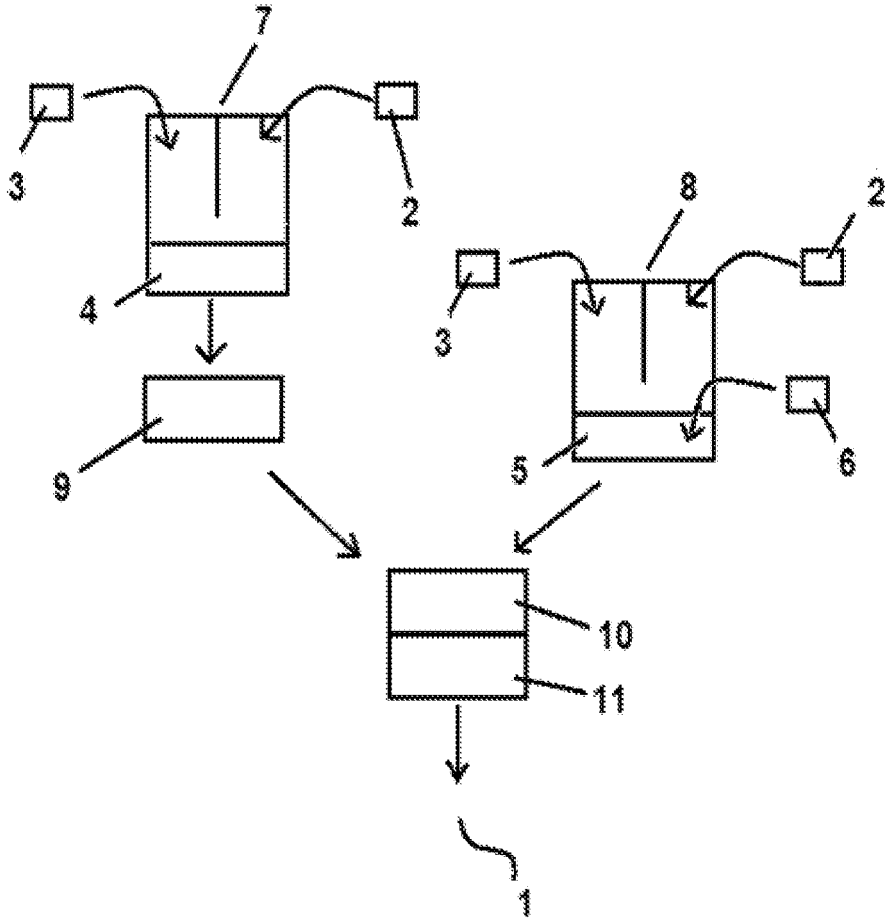

Figure 2

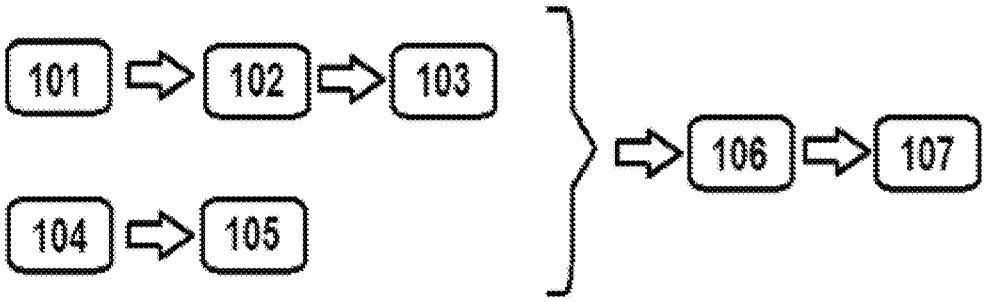

Figure 3

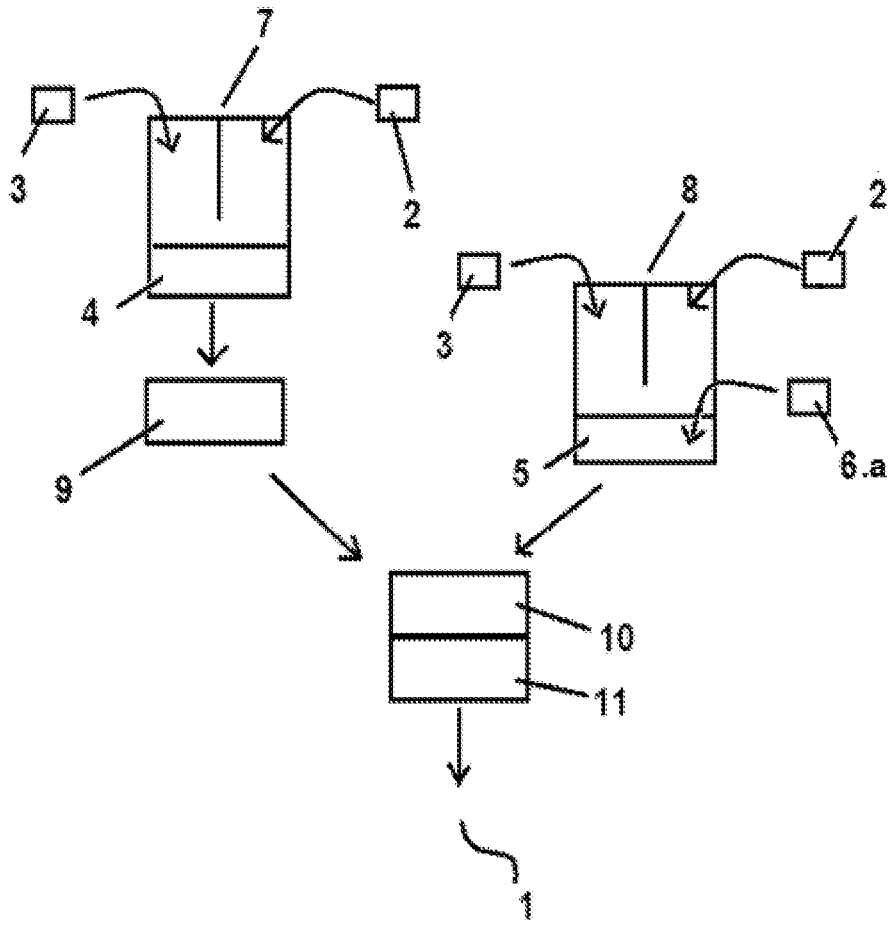

Figure 4

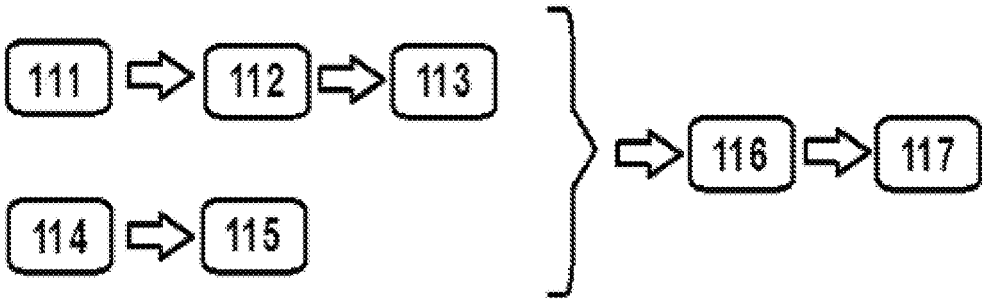

Figure 5

REFERENCES CITED IN THE DESCRIPTION

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