(19) Europäisches Patentamt
European Patent Office
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(11) **EP 3 995 625 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.05.2022 Bulletin 2022/19

(21) Application number: **21201022.7**

(22) Date of filing: **05.10.2021**

(51) International Patent Classification (IPC):
D06M 13/395 *(2006.01)* ***D06M 15/564*** *(2006.01)*
D06M 15/227 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
D06M 11/79; D06M 13/395; D06M 15/227; D06M 15/564; D06M 2200/12

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **04.11.2020 IT 202000026272**

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(54) METHOD FOR WATERPROOFING FABRIC GARMENTS

(57) The present invention relates to a method for waterproofing fabric products, in particular garments, in particular for restoring the water-repellent functionality of used garments.

In particular, the present invention relates to a method for giving water-repellent properties to textile products according to the invention and comprises the following operating steps:

A) providing new or used textile products;
B) washing said textile products;
C) drying said washed textile products;
D) waterproofing said dried textile products;
E) drying said waterproofed textile products;
F) heat-treating the waterproofed and dried textile products.

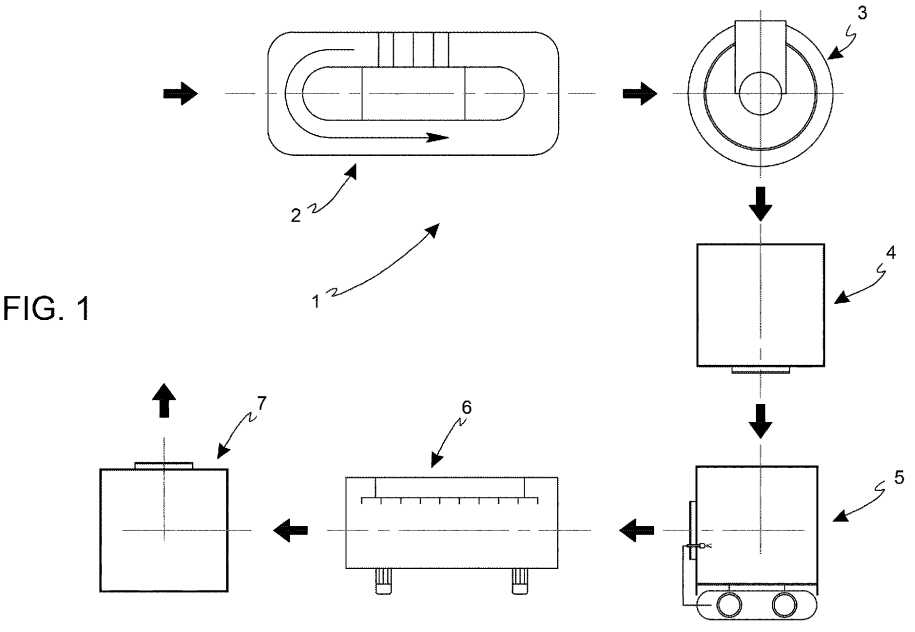

FIG. 1

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Description

[0001] The present invention relates to a method for waterproofing fabric products, in particular garments, in particular for restoring the water-repellent functionality of used garments.

[0002] Waterproofed garments are widely known and used. However, the water-repellent functionality degrades due to the number of washes to which the garment is subjected, exposure to atmospheric agents and use.

[0003] Products are available on the market which, applied to the used garment in a spraying mode or in a domestic washing machine, restore the water-repellent functionality.

[0004] However, the known household methods give a water-repellency of poor duration over time, expose the user in the domestic environment to potentially harmful effluents, and if carried out in a washing machine, include an excessive consumption of water.

[0005] In this context, it is the technical task underlying the present invention to provide a method which can be performed in an industrial environment and allows to overcome the drawbacks of the known art providing a restoration of the water-repellency of a garment for a sufficiently long period of time, at a low cost and environmental impact.

[0006] The specified technical task is substantially achieved by a method comprising the technical features set out in one or more of the appended claims, the definitions of which form an integral part of the present description.

[0007] Therefore, the present invention relates to a method for giving water-repellent properties to textile products according to the invention and comprises the following operating steps:

A) providing new or used textile products;
B) washing said textile products;
C) drying said washed textile products;
D) waterproofing said dried textile products;
E) drying said waterproofed textile products;
F) heat-treating the waterproofed and dried textile products.

[0008] Further features and advantages of the present invention will become more apparent from the indicative and thus non-limiting description of a preferred, but not exclusive embodiment of the invention, with reference to the drawings, in which:

figure 1 depicts a diagrammatic view of a plant for carrying out the method according to the invention

[0009] The method for giving water-repellent properties to textile products according to the invention comprises the following operating steps:

A) providing new or used textile products;
B) washing said textile products;
C) drying said washed textile products;
D) waterproofing said dried textile products;
E) drying said waterproofed textile products;
F) heat-treating the waterproofed and dried textile products.

[0010] The term "textile products" according to the present invention means in particular items of clothing, such as raincoats, coats, down jackets, anoraks, capes, hats, caps, shawls, duster coats, jackets, pants, padded or unpadded vests, etc. The term "textile products" further includes blankets, sleeping bags, tents, curtains, and any other used fabric products which require a waterproofing treatment.

[0011] The term "giving water-repellent properties" according to the present invention means both a first waterproofing on a new or used product which has not been previously waterproofed, and a restoration of the waterproofing properties which may have faded following prolonged use or washing.

[0012] Figure 1 diagrammatically shows a plant 1 for carrying out the method of the invention.

[0013] Step B) of washing is especially important in the case of used items as, in order to obtain a good water-repellent effect on a fabric, it is essential to eliminate the substances from the fabric which could interfere with the waterproofing treatment.

[0014] In particular, the interfering substances resulting from daily use can be:

- residues of surfactants, in particular highly wetting anionic surfactants, deriving from washing with poor rinsing;
- residues of deodorant;
- residues of insect-repellent substances;
- various kinds of dirt.

[0015] With reference to figure 1, the washing step B) can be carried out in an oval machine 2, for example an AOM-C WOOL machine from FLAINOX. Such an apparatus operates discontinuously and consists of an oval stainless steel container into which the textile products to be treated are manually loaded.

[0016] The movement of the bath is imparted by four stainless steel blades which rotate inside the oval container, on a horizontal shaft driven by an electric motor, with the aim of circulating the bath and the textile products to be treated in the same direction.

[0017] The bath temperature can be increased by indirect heating, obtained with heat exchange through the passage of steam inside a coil placed on the bottom of the oval container.

[0018] The bath temperature can also be decreased by passing cold water inside the heat exchanger.

[0019] The washing step B) preferably comprises the following steps:

b1) washing the textile products with low-surfactant detergent
b2) first rinsing
b3) washing with surfactant extraction agent b4) second rinsing
b5) optionally, third rinsing.

[0020] Step b1) is preferably carried out with an aqueous mixture of fatty acid starches and dispersants. An example is the commercial product Tanaterge EF from the company New Tanatex S.p.A. Such a detergent features excellent emulsifying power towards oils and paraffins, excellent suspending power for the removed impurities, a good soaping effect, good biodegradability, is low foaming and has low wetting power.

[0021] The concentration of detergent in water is preferably between 1 g and 3 g per liter of water.

[0022] Step b3) is preferably carried out with a condensation product of aromatic sulfonic acids and formaldehyde comprising sodium naphthalene sulfonate. An example of such a compound is the commercial product Erional RF from the company Huntsman, which comprises synthetic tannin and has a strong dispersing power so as to solubilize and extract the surfactants blocked inside the fibers.

[0023] The concentration of extracting agent in water is preferably between 1 g and 3 g of extracting agent per L of water.

[0024] In step b3), it is important that the pH of the bath is about 5. For example, 80% acetic acid can be used as an acidifying agent.

[0025] Steps b2), b4) and b5) of rinsing are carried out with water. The third rinsing step b5) is optional and will be carried out for example if the weight of the textile products being processed is high.

[0026] According to a particular embodiment of the invention, step B) includes:

i) weighing the dry textile products
ii) filling the machine with an amount of softened water at a ratio of 40:1 on the weight of the dry textile product
iii) adding a 2 g amount of detergent, preferably Tanaterge EF, for each L of bath
iv) actuating the bath movement blade, so as to circulate and homogenize the washing bath v) adding the textile products, preferably one at a time so that they are evenly distributed in the tank
vi) heating the bath up to a temperature of 30-40°C, for example based on the maintenance tag of the textile products
vii) once the treatment temperature has been reached, allowing the bath and textile products to circulate for about 20 minutes
viii) after this time, draining the bath, leaving the textile products therein
ix) rinsing the washed textile products by filling the machine with untreated water at a ratio of 40:1 on the weight of the dry textile products, at room temperature and for a residence time of about 10 minutes
x) removing the textile products from the tank xi) draining the bath
xii) filling the machine with an amount of softened water at a ratio of 40:1 on the weight of the dry textile products
xiii) adding a 2 g amount of surfactant extraction agent, preferably Erional RF, pre-diluted 1:1 with cold softened water, for each L of bath xiv) controlling the pH value of the bath, for example using a litmus paper
xv) if needed, adjusting the bath to the pH value ~ 5 by adding an appropriate amount of 80% acetic acid
xvi) inserting the wet textile products removed in step 10 into the tank
xvii) increasing the temperature to no more than 40°C
xviii) allowing the textile products to turn in the bath at this temperature for about 30 minutes
xix) draining the bath
xx) filling the machine with an amount of untreated water at a ratio of 40:1 on the weight of the dry textile products
xxi) cold-treating the textile products for about 10 minutes
xxii) based on the type of textile products being processed, considering whether to repeat another rinse
xxiii) removing the textile products from the tank and placing them on special carriages.

[0027] It should be noted that the washing step B) can also be carried out in a site other than that in which the remaining

steps of the method are carried out. For example, the washing step B) can be carried out in specialized laundries, for example industrial laundries.

[0028] Step C) of drying preferably comprises the following steps:

c1) spinning the textile products washed according to step B)

c2) drying the spun textile products.

[0029] With reference to figure 1, step c1) can be carried out in a centrifuge 3 for fabrics, for example an ESH.CC hydroextractor from the company Pozzi Leopoldo s.r.l. The hydroextractor is a machine for discontinuous processing, consisting of a stainless steel body provided with an openable upper lid, inside which a perforated basket is inserted which rotates on a vertical axis driven by an electric motor.

[0030] The spinning speed in step c1) is no higher than 500 rpm.

[0031] With reference to figure 1, step c2) can be carried out in a dryer 4 for fabrics, for example a dryer D 110 from the company Renzacci S.p.A. The dryer (or tumbler) is a machine for discontinuous processing, consisting of a closed and heated metal body, in which a perforated metal basket is inserted which rotates on a horizontal axis driven by an electric motor. The internal heating of the machine is obtained by a heat exchanger, inside which steam circulates.

[0032] The drying temperature in step c2) is preferably not more than 40°C.

[0033] Step D) of waterproofing is carried out using a waterproofing composition comprising or consisting of:

i) a suspension or nanosuspension of silicon dioxide;

ii) hydrocarbon dendrimers or aminated hydrocarbon dendrimers in a hydrocarbon matrix;

iii) polyfunctional isocyanate polymer containing hexamethylene diisocyanate.

[0034] The waterproofing composition preferably comprises or consists of:

- 75-85% by weight of silicon dioxide suspension or nanosuspension
- 14-23% by weight of hydrocarbon dendrimers or aminated hydrocarbon dendrimers in a hydrocarbon matrix
- 0.5-3% by weight of polyfunctional isocyanate polymer solution containing hexamethylene diisocyanate.

[0035] In a preferred embodiment, the waterproofing composition consists of:

- 79% by weight of the product Nanopool® Fibre Protect
- 20% by weight of the product Ruco-Dry® DHY
- 1% by weight of the product Arkophob® XLR.

[0036] The product Nanopool® Fibre Protect is marketed by APC Italia s.r.l. Silicon oxide simultaneously gives the fabric hydrophobicity and oleophobicity, is safe for both humans and the environment and can be used on practically all fabrics with natural fibers, but when used alone, it shows poor resistance to maintaining the performance thereof on synthetic fibers, especially polyamides.

[0037] The waterproofing composition of the present invention solves such a technical problem by virtue of the components ii) and iii) described above, which give rise to a low temperature cross-linking, compatible with the treatment of the used textile products according to the invention.

[0038] The product Ruco-Dry® DHY is marketed by the company Rudolf Group.

[0039] The product Arkophob® XLR is marketed by the company Archroma.

[0040] The amount of waterproofing composition used in step C) is preferably 70-90% by weight, more preferably about 80% by weight, with respect to the weight of the dry textile products.

[0041] The application of the waterproofing composition is preferably carried out by spraying and can be done with the following methods:

- manually by an operator with a spray gun in a vacuum cabin
- automated with anthropomorphic robot provided with a spray applicator in a vacuum cabin

- automated with closed machine provided with a spray applicator.

[0042] Preferably, with reference to figure 1, the application of the waterproofing composition on the washed and dried textile products is carried out by means of a spraying machine 5 for discontinuous processing, consisting of a closed chamber where the waterproofing product is sprayed. The chamber consists of a closed metal body inside which a perforated drum is placed, rotating on a horizontal axis driven by an electric motor, with a spray nebulization system installed on the closing door and powered by a dedicated external system.

[0043] The machine can be set, creating customized cycles, by means of a special PLC installed on the machine itself.

[0044] The basket can contain up to a maximum of 4 kg of dry fabric/garments, but a maximum load of 3 kg is used in the method according to the invention, so that the distribution of the waterproofing product is carried out uniformly on the textile products being processed.

[0045] A spray machine useable for the present invention is the model G1 35 HD/HW with Core system from the company Tonello s.r.l.

[0046] Preferably, step C) includes the following operating parameters:

- spraying air pressure 2 bar
- waterproofing composition pressure 2.6 bar
- basket rotation start

  20 right/left revolutions
  2 sec pause
  27 rpm drum rotation speed

- first maintenance of basket rotation 0.5 minutes
- waterproofing composition spraying time 15 minutes
- second drum rotation maintenance 5 minutes.

[0047] Step E) of drying the waterproofed textile products is carried out by hanging the waterproofed and wet textile product and allowing it to dry in a heated and ventilated place, for example in a forced air circulation oven or, with reference to figure 1, in a heated chamber 6.

[0048] The drying has the purpose of "wilting" the waterproofing resin before the cross-linking step, with the purpose of preserving it from the friction imparted by the machine used for the subsequent cross-linking, which otherwise could partially remove it.

[0049] Step F) of heat-treating the waterproofed and dried textile products comprises treating said textile products at a temperature between 40°C and 80°C and for a time between 15 and 40 minutes.

[0050] The selection of the temperature/time combination will be made based on the different features of the textile products and in particular of the resistance thereof to heat treatment, as reported on the textile product label or tag. For example, the most delicate textile products will undergo a treatment at no more than 45°C for a longer time, for example 35 minutes. Conversely, the most resistant textile products will undergo a treatment at 60°C or even up to 80°C, but for shorter times, for example about 15 minutes.

[0051] The heat treatment allows the cross-linking of the aminated dendrimers with the poly-isocyanates, so as to form a protective resin on the treated fabric.

[0052] In preferred embodiments, with reference to figure 1, step C) is carried out using a dryer 7 (or tumbler), for example the dryer model Essicat SW 50 from the company Renzacci S.p.A. Such a machine is configured for discontinuous processing, and consists of a closed and heated metal body, in which a perforated metal basket is inserted which rotates on a horizontal axis driven by an electric motor. The internal heating of the machine is obtained by a heat exchanger, inside which steam circulates.

[0053] However, such a dryer cannot be used for delicate textile products.

EXPERIMENTAL PART

[0054] Tests were carried out on the same garment (ski suit) with an initial spray test of 0, comparing the treatment according to the method of the invention with the main products (consumers) on the market for domestic use (TX direct spray Nikwax on, TX direct wash Nikwax, Organotex Wash In and Grangers Performance Repel Plus).

[0055] Application methods of products for domestic use:

a) Organotex Wash In: 100 ml in a washing cycle in the washing machine at 40°C;
b) Nikwax spray: 2 spraying passages on a wet garment;

c) Nikwax Wash On: 2 caps (about 100 ml) in a washing cycle in the washing machine at 30°C;
d) Grangers Repel plus: spray application from a distance of 15 cm on a wet garment.

[0056] Subsequent washing methods (with detergents recommended by the manufacturers for the various waterproofing treatments:

a) Organotex Bio Care detergent: 100 ml in a washing cycle in the washing machine at 30°C;
b) and c): Nikwax Tech Wash detergent: 2 caps (about 100 ml) in a washing cycle in the washing machine at 30°C;
d) Grangers Wash On: 1 cap (about 50 ml) in a washing cycle in the washing machine at 30°C.

[0057] A ski suit was instead subjected to the method of the invention for comparison.

[0058] For the garment treated according to the invention, successive washes in the washing machine at 30°C with detergent normally available on the market were carried out.

[0059] The samples thus obtained were evaluated by spray test, according to the standard ISO 4920:2013, i.e., by spraying 250 ml of distilled or completely deionized water on the sample to be tested which must be fixed on a circle and placed at an angle of 45° so that the center of the sample is 150 mm from the center of the spray nozzle surface. The spray test level is determined by visually comparing the sample with photographic or descriptive standards. The classification according to the spray test can be defined as follows:

0	Complete wetting of the entire sample surface
50	Complete wetting of the entire sample surface beyond the spray points
70	Partial wetting of the sample surface beyond the spray points
80	Wetting of the sample surface at the spray points
90	Light and random wetting of the sample surface
100	No wetting

[0060] The results obtained with the products for domestic use and those obtained according to the invention are reported below:

Spray test	Method of the inventio n	Organotex	Nikwax spray	Nikwax Wash On	Grangers
Time 0	90-100	90	70	50	90-100
After 1 wash	90-100	0	0	0	90-100
After 5 washes	90				70
After 10 washes	90	-	-	-	0

[0061] The tests carried out not only show a better waterproofing effect at time 0 (i.e., immediately after the application of the method of the invention), but above all a greater persistence of the effect (increased resistance to washing).

[0062] Further advantages of the method according to the invention can be found in the fact that the waterproofing step is carried out without the use of water, while for two of the domestic products tested (Organotex and Nikwax Wash On) the waterproofing application is carried out during a washing cycle in the washing machine with consequent water consumption (average water consumption: 40-50 liters per cycle).

[0063] The product for domestic use with spray application (Nikwax spray) instead does not require the use of water from the washing cycle in the washing machine, but includes the exposure of the user to the possible vapors deriving from the spray itself. Furthermore, the spray application does not allow to have a precise control of the amount of product used.

[0064] The waterproofing according to the method of the invention occurs in a closed environment, without exposure of the worker to possible vapors, and with a precise dosage of the waterproofing composition.

[0065] It is apparent that only a few particular embodiments of the present invention have been described, to which those skilled in the art will be able to make all of the necessary changes for the adaptation thereof to particular applications, without however departing from the scope of protection of the present invention.

Claims

1. A method for giving water-repellent properties to textile products, comprising the following operating steps:

   A) providing new or used textile products;
   B) washing said textile products;
   C) drying said washed textile products;
   D) waterproofing said dried textile products;
   E) drying said waterproofed textile products;
   F) heat-treating the waterproofed and dried textile products.

2. The method according to claim 1, wherein the washing step B) comprises the following steps:

   b1) washing the textile products with low-surfactant detergent
   b2) first rinsing
   b3) washing with surfactant extraction agent
   b4) second rinsing
   b5) optionally, third rinsing.

3. The method according to claim 2, wherein step b1) is carried out with a detergent based on an aqueous mixture of fatty acid starches and dispersants, preferably in an amount between 1 g and 3 g per liter of water.

4. The method according to claim 2 or 3, wherein step b3) is carried out with a surfactant extraction agent based on a condensation product of aromatic sulfonic acids and formaldehyde comprising sodium naphthalene sulfonate, preferably in an amount between 1 g and 3 g per liter of water, preferably at a pH of about 5.

5. The method according to claim 4, wherein step B) includes:

   i) weighing the dry textile products
   ii) filling the machine with an amount of softened water at a ratio of 40:1 on the weight of the dry textile product
   iii) adding a 2 g amount of detergent, preferably Tanaterge EF, for each L of bath
   iv) actuating the bath movement blade, so as to circulate and homogenize the washing bath
   v) adding the textile products, preferably one at a time so that they are evenly distributed in the tank
   vi) heating the bath up to a temperature of 30-40°C, for example based on the maintenance tag of the textile products
   vii) once the treatment temperature has been reached, allowing the bath and textile products to circulate for about 20 minutes
   viii) after this time, draining the bath, leaving the textile products therein
   ix) rinsing the washed textile products by filling the machine with untreated water at a ratio of 40:1 on the weight of the dry textile products, at room temperature and for a residence time of about 10 minutes
   x) removing the textile products from the tank
   xi) draining the bath
   xii) filling the machine with an amount of softened water at a ratio of 40:1 on the weight of the dry textile products
   xiii) adding a 2 g amount of surfactant extraction agent, preferably Erional RF, pre-diluted 1:1 with cold softened water, for each L of bath
   xiv) controlling the pH value of the bath, for example using a litmus paper
   xv) if needed, adjusting the bath to the pH value ~ 5 by adding an appropriate amount of 80% acetic acid
   xvi) inserting the wet textile products removed in step 10 into the tank
   xvii) increasing the temperature to no more than 40°C
   xviii) allowing the textile products turn in the bath at this temperature for about 30 minutes xix) draining the bath
   xx) filling the machine with an amount of untreated water at a ratio of 40:1 on the weight of the dry textile products
   xxi) cold-treating the textile products for about 10 minutes
   xxii) based on the type of textile products being processed, considering whether to repeat another rinse
   xxiii) removing the textile products from the tank and placing them on special carriages.

6. The method according to any one of claims 1 to 5, wherein the drying step C) comprises the following steps:

   c1) spinning the textile products washed according to step B)

c2) drying the spun textile products.

7. The method according to claim 6, wherein:

- in step c1), the spinning speed is no higher than 500 rpm, and/or
- in step c2), the drying temperature is no higher than 40°C.

8. The method according to any one of claims 1 to 7, wherein the waterproofing step D) is carried out, preferably by spraying, using a waterproofing composition comprising or consisting of:

i) a suspension or nanosuspension of silicon dioxide;
ii) hydrocarbon dendrimers or aminated hydrocarbon dendrimers in a hydrocarbon matrix;
iii) polyfunctional isocyanate polymer containing hexamethylene diisocyanate.

9. The method according to claim 8, wherein the waterproofing composition comprises or consists of:

- 75-85% by weight of silicon dioxide suspension or nanosuspension
- 14-23% by weight of hydrocarbon dendrimers or aminated hydrocarbon dendrimers in a hydrocarbon matrix
- 0.5-3% by weight of polyfunctional isocyanate polymer solution containing hexamethylene diisocyanate.

10. The method according to claim 8 or 9, wherein the amount of waterproofing composition used in step C) is 70-90% by weight, or about 80% by weight, with respect to the weight of the dry textile products.

11. The method according to any one of claims 1 to 10, wherein the step F) of heat-treating the waterproofed and dried textile products comprises treating said textile products at a temperature between 40°C and 80°C and for a time between 15 and 40 minutes.

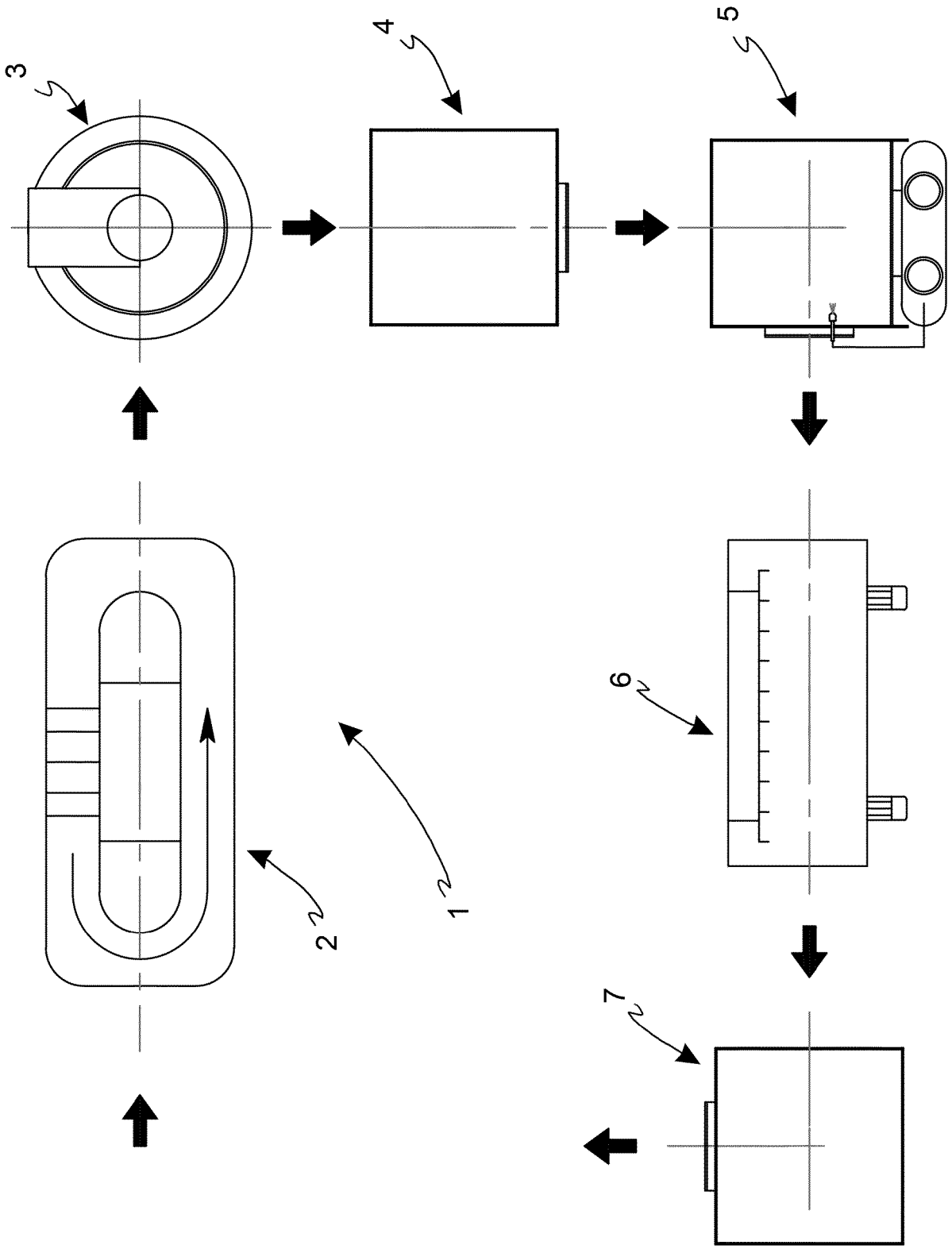

FIG. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 1022

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)
D06M

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 December 2021	Rella, Giulia

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