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(54) **SEALING ELEMENT, TUMBLE DRYER AND METHOD**

(57) The present invention is related to a sealing element (10) for sealing a rotating drum against a surface of a household appliance, in particular a tumble dryer, comprising: an elastic element (11) designed to provide a holding force, an abrasive element (12) designed to be in

permanent contact with the rotating drum, wherein the abrasive element (12) and the elastic element (11) are connected and wherein the abrasive element (12) comprises talc.

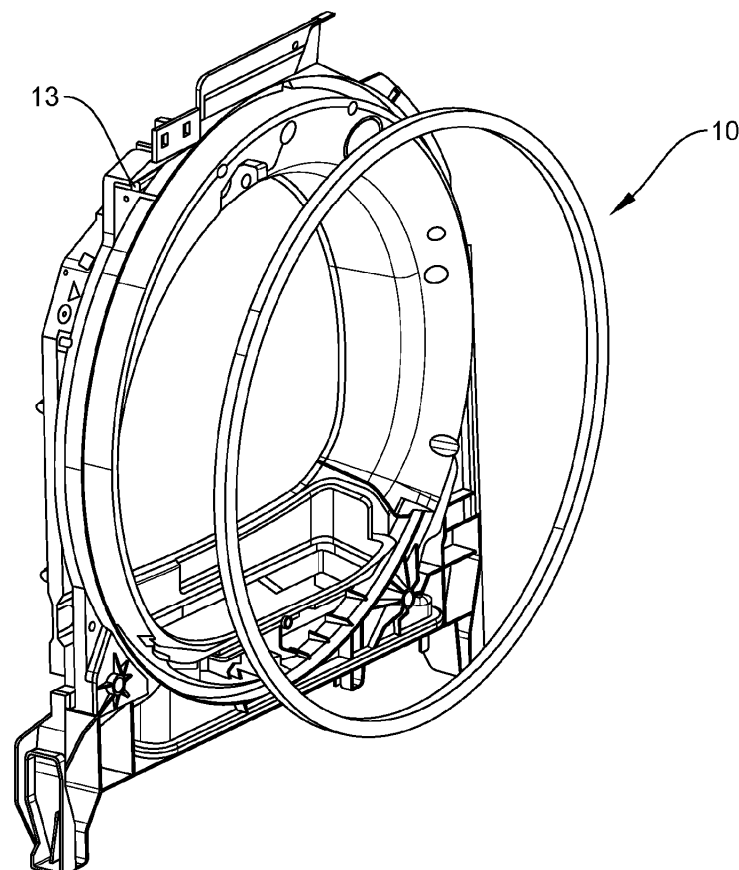


**FIG. 4**

## Description

**[0001]** The present invention relates to a sealing element, in particular for a tumble dryer. Furthermore, the invention relates to a tumble dryer and a method to produce such a sealing element.

**[0002]** Tumble dryers, for example, use a heated process air stream to heat textiles inside a tumble drum and to absorb moisture from the textiles. It is known to seal the drum of the dryer opposite the feed opening by providing a front sealing element. The front sealing element consists of an elastic part, which ensures sufficient tightness and pressure on the drum, and an abrasive part, which is in direct contact with the rotating drum. The abrasive part is subject to constant abrasion during operation, which is why the abrasive part can wear out quickly. The abrasive part may comprise or may be coated with Polytetrafluoroethylene (PTFE). The use of PTFE improves durability, sealing and sliding properties. However, PTFE particles, which may be released into the air, can be very harmful to human health. However, the lifespan of this front sealing element is limited and the front sealing element has to be replaced after a certain number of process cycles.

**[0003]** In view of this, it has been found that a further need exists to provide an improved sealing element, in particular for a tumble dryer.

**[0004]** Therefore, it is an object of the present invention to provide a sealing element for sealing a rotating drum against a surface of a household appliance, in particular a tumble dryer. Furthermore, it is an object of the present invention to provide a tumble dryer and a method to produce such a sealing element.

**[0005]** These and other objects, which become apparent upon reading the following description, are solved by the subject matter of the independent claims. The dependent claims refer to preferred embodiments of the invention.

**[0006]** According to an aspect of the present invention, a sealing element for sealing a rotating drum against a surface of a household appliance, in particular a tumble dryer, is provided, comprising: an elastic element designed to provide a holding force, an abrasive element designed to be in permanent contact with the rotating drum, wherein the abrasive element and the elastic element are connected and wherein the abrasive element comprises talc.

**[0007]** The sealing element is particularly intended for use in a tumble dryer. In particular, the sealing element may be intended to seal a drum of such a tumble dryer with respect to a surface, in particular an inner surface of a front panel. Alternatively, it is possible that the sealing element is used with other household appliances, in particular water-bearing household appliances, for example a washing machine or similar.

**[0008]** The elastic element is designed to provide a holding force so that the sealing element is held or arranged in a position provided for it. Preferably, the elastic element may comprise a foam material. A foam material

can provide flexible and elastic properties, which are needed for the elastic element. The foam may be a polyurethane foam. Also, it may be possible that the elastic element is made of rubber material, i.e. is made from a rubber material. For example, the foam of the elastic element may be an ethylene-propylene-diene-monomer foam (EPDM-foam). Also, the elastic element may comprise at least partially a hard synthetic material, for example polyethylene. Alternatively, or additionally, the elastic element may have a shape designed to provide a holding force. For example, the elastic element may have an undercut that, when mounted, interacts with a projection to form a closure.

**[0009]** The abrasive element is designed to be in permanent contact with the rotating drum. When mounted, the abrasive element is not firmly attached to the rotating drum, but merely rests against it. During operation, the abrasive element grinds or brushes over the rotating drum. This makes it possible to realize a seal against the rotating drum. In particular, this may prevent air and/or water from passing through the sealing element. In summary, the permanent contact of the abrasive element provides sealing properties for the sealing element. For example, the abrasive element may be designed to protrude from the sealing element such that a sufficient permanent contact with the rotating drum may be achieved.

**[0010]** The elastic element and the abrasive element are connected to each other. This means that the elastic element and the abrasive element are formed as a single piece. In particular, it is possible that the elastic element and the abrasive element are glued and/or sewn together. The elastic element and the abrasive element preferably comprise different materials.

**[0011]** The abrasive element includes or comprises talc. The talc is advantageous compared to the state of the art, because it improves the friction between the abrasive element and the rotating drum. Furthermore, the talc is advantageous because during operation, abrasion of the abrasive element may enter the air. When inhaled, this abrasion, i.e. these particles, are less harmful to a person's health. In contrast, PTFE used as in the prior art presents a significant health risk. Furthermore, the talc provides better friction properties as well as better sealing properties than PTFE.

**[0012]** In an embodiment the talc is applied as a coating to the abrasive element. The coating may be applied by different methods. For example, the coating may be applied by spraying. More precisely, the talc may be applied, for example, by using a nozzle and pressure. The coating may also be applied by dipping the abrasive element into the talc. The talc may be dissolved in a liquid. Then, the abrasive element may be dipped into the liquid. At last, the abrasive element is dried, leaving the talc behind after drying. Other methods may be the active application of the talc by brushing or rolling with a roller or a brush.

**[0013]** In an embodiment the abrasive element com-

prises a textile-material. For example, the abrasive element may comprise a fabric and/or a scrim. The textile material may comprise synthetic fibers. The synthetic fibers may comprise polyester and/or acrylic. Nylon is also a synthetic fiber that may be used, especially when high abrasion resistance is required, since nylon is very durable, resilient and water repellent. Another example for synthetic fibers may be aramid fibers. Aramid fibers have great strength and chemical resistance and heat resistance. Synthetic fibers may be versatile, cost-effective, resilient, and easy to maintain. Alternatively, the textile material may comprise natural fibers such as linen, hemp, jute and/or cotton. Natural fibers provide environmental sustainability, softness, and flexibility. When treated with appropriate coatings or compounds, they can offer good sealing properties.

**[0014]** Furthermore, it is possible for different kind of wools, for example Sheep's wool, to be used in the abrasive element.

**[0015]** In an embodiment the talc is arranged between fibers of the textile-material. In other words, the talc particles may be arranged not only on a surface of the abrasive element, but also at least partially inside the abrasive element. That way, the talc may stay in the textile material. As a result, the sealing properties of the abrasive material are improved.

**[0016]** In an embodiment the textile material comprises a felt-material. Felt is a flexible and compressible material that easily adapts to irregular or uneven surfaces. This characteristic makes felt ideal for seals used in applications where the sealing surfaces are not perfectly smooth or flat. Felt materials are particularly useful with machines that generate vibrations or components that expand or contract due to temperature changes. Felt has good damping properties and may absorb vibrations and shocks during operation of for example a tumble dryer. This helps to reduce noise and extend the life of machines and components. Felt-materials, especially when finished with specialized coatings or treatments, may be water and oil resistant. This characteristic makes felt-materials an excellent gasket material in environments that involve moisture and/or lubricants. Felt-materials are able to undergo high compression when pressure is applied without losing its structural properties. This ability makes it an ideal material for seals that are exposed to strong forces. Felt-materials may also be highly resistant to wear and ageing. In many cases, it offers long-lasting performance with no significant loss of sealing properties. Felt-materials may have the ability to attenuate sound, making it a good choice for gaskets in areas where noise reduction is needed.

**[0017]** In an embodiment the sealing element is arc-shaped, in particular circular shape. In particular, the abrasive element and the elastic element may both be at least partially arc-shaped. Preferably, the whole sealing element may have a circular shape or a ring shape. In other words, the sealing element may form a full circle. This is advantageous to form a seal, in particular around

the drum of a tumble dryer.

**[0018]** In an embodiment the talc comprises particles, which have an average diameter between 100 nm and 1000 nm, in particular between 200 nm and 300 nm, wherein the average diameter is the volume-based average (V50), determined as described below. The particles preferably may have an approximately spherical shape. The average size of the talc-particles may be determined by a volume-based average. The volume-based average (V50) is the particle diameter at which 50% of the volume of particle sizes are smaller and 50% larger. The diameter of the talc-particles may be determined by a screening process, for example based on highly precise measurement methods such as TEM (transmission electron microscopy) or AFM (atomic force microscopy). The "diameter" of a non-spherical particle is taken to be the largest diameter. Alternatively, the particle diameter may be determined by a sieving process, wherein particles are separated through a set of sieves with different mesh sizes. The average size can then be calculated as the particle size in the sieve with the highest number of particles. This is a commonly used measure to describe the average size of particles in a distribution.

**[0019]** In an embodiment the abrasive element has a friction coefficient between 0,14 and 0,17, in particular between 0,14 and 0,16, on a metal material, in particular a steel material and/or aluminum material. This may improve the friction properties of the sealing element. This increases the service life of the sealing element, as less abrasion occurs with talc.

**[0020]** Another aspect of the present invention is directed to a tumble dryer comprising a sealing element according to one of the preceding embodiments.

**[0021]** Another aspect of the present invention is directed to a method for producing a sealing element according to one of the preceding embodiments, comprising: providing or producing an elastic element, providing or producing an abrasive element, connecting the abrasive element with the elastic element, and applying a talc material at least on the abrasive element.

**[0022]** In an embodiment, the abrasive element may be coated with a liquid, wherein the liquid comprises talc with a density between 1 g/ml and 3g/ml, in particular 2,2 g/ml. The liquid may comprise a solid content between 40% and 80%, in particular 59%.

**[0023]** The talc particles may have a size between 100 nm and 1000 nm, in particular between 200 nm and 300 nm.

**[0024]** In the following, the present disclosure is described exemplarily with reference to the enclosed figures, in which

**Figure 1a** is a detailed view of a sealing element without coating;

**Figure 1b** is a detailed view of a sealing element with PTFE coating;

**Figure 1c** is a detailed view of a sealing element with talc coating;

**Figure 2** a diagram of different air tightness;

**Figure 3** a diagram of the friction coefficient;

**Figure 4** a perspective view of a sealing element according to an embodiment of the present invention with a front panel; and

**Figure 5** a detailed view of a cut of a sealing element.

**[0025]** **Figure 1a** shows a detailed view of an abrasive element 12 of a sealing element 10 without additives, in particular without talc and without Teflon (PTFE). **Figure 1b** shows a detailed view of an abrasive element 12 of a sealing element 10 with Teflon (PTFE). **Figure 1c** shows a detailed view of an abrasive element 12 of a sealing element 10 with talc.

**[0026]** **Figure 2** shows a diagram that illustrates the different coefficients of friction of the sealing element without any additive, with Teflon and with talc, each on a rotating drum.

**[0027]** The rotating drum is preferably made of a metal, in particular steel or iron. It can be seen that the sealing element with talc has the lowest coefficients of friction for a static state and in for a dynamic state. In particular, the coefficient of friction of the sealing element with talc, i.e. with a talc coating, is between 0.15 and 0.17. That means, the sealing element 10 with talc has the lowest friction in operation. As a result, the sealing element 10 with talc may have a longer life cycle than a sealing element 10 without talc.

**[0028]** **Figure 3** shows another diagram that illustrates the leakage of a sealing element without any additive, with Teflon and with talc. The leakage is given in cubic meters per hour. Furthermore, the leakage was measured at 20 Pa, 50 Pa, 75 Pa and 100 Pa. In all pressure ranges, the sealing element 10 with talc, i.e. in a talc coating, showed the lowest leakage. For Polytetrafluoroethylene (PTFE), the tightness depends on the number of particles between the fibers. The particles provide resistance to airflow through the fibers. For talc, the tightness also depends on the number of particles between the fibers. The particles provide resistance to airflow through the fibers. However, with no additional substance, air flows easier through fibers.

**[0029]** **Figure 4** shows a sealing element 10 before assembly in a front panel 13. The sealing ring 10 is ring-shaped. The elastic element 11 faces the side of the sealing element 10 facing the front panel 13. The abrasive element 12 faces away from the front panel 11.

**[0030]** **Figure 5** is a cross-section of a sealing element 10. The sealing element 10 includes an abrasive element 12 and an elastic element 11. The abrasive element 12 is connected to the elastic element 11. The elastic element

11 is made of a foam material. The abrasive element 12 is made of a felt material. The elastic element 11 and the abrasive element 12 may be connected by a material bonding connection and/or by a suture connection.

**[0031]** The present disclosure has been described in conjunction with a preferred embodiment as examples as well. However, other variations can be understood and effected by those persons skilled in the art and practicing the claimed invention, from the studies of the drawings, this disclosure and the claims. In the claims as well as in the description the word "comprising" does not exclude other elements or steps and the indefinite article "a" or "an" does not exclude a plurality. A single element or other unit may fulfill the functions of several entities or items recited in the claims. The mere fact that certain measures are recited in the mutual different dependent claims does not indicate that a combination of these measures cannot be used in an advantageous implementation.

#### Reference signs

#### **[0032]**

- 10 sealing element
- 11 elastic element
- 12 abrasive element
- 13 front panel

#### **Claims**

1. Sealing element (10) for sealing a rotating drum against a surface of a household appliance, in particular a tumble dryer, comprising:

- an elastic element (11) designed to provide a holding force,
- an abrasive element (12) designed to be in permanent contact with the rotating drum,
- wherein the abrasive element (12) and the elastic element (11) are connected and
- wherein the abrasive element (12) comprises talc.

2. Sealing element (10) according to claim 1, wherein the talc is applied as a coating to the abrasive element (12).

3. Sealing element (10) according to claim 1 or 2, wherein, the abrasive element (12) comprises a textile-material.

4. Sealing element (10) according to one of the preceding claims, wherein the textile material comprises a felt-material.

5. Sealing element (10) according to one of the preceding claims, wherein the sealing element (10) is

arch-shaped, in particular a circular form.

6. Sealing element (10) according to one of the preceding claims, wherein the talc comprises particles have an average size between 0,01 and 0,1 mm. 5
7. Sealing element (10) according to one of the preceding claims, wherein the abrasive element (12) has a friction coefficient between 0,14 and 0,17, in particular between 0,14 and 0,16, on a metal material, in particular a steel material and/or aluminum material. 10
8. Tumble dryer comprising a sealing element (10) according to one of the claims 1 to 7. 15
9. Method for producing a sealing element (10) according to one of the claims 1 to 7, comprising:
  - providing or producing an elastic element (11), 20
  - providing or producing an abrasive element (12),
  - connecting the abrasive element (12) with the elastic element (11), and
  - applying a talc material at least on the abrasive element (12). 25

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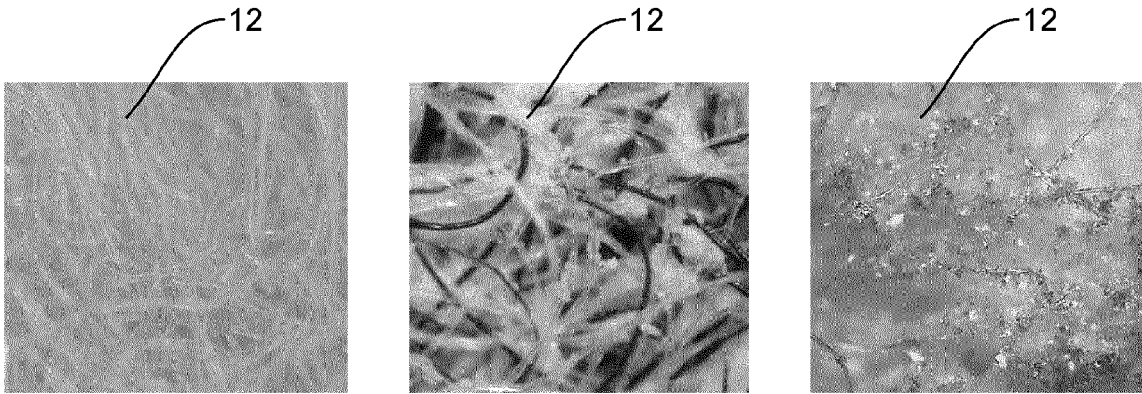


FIG. 1A

FIG. 1B

FIG. 1C

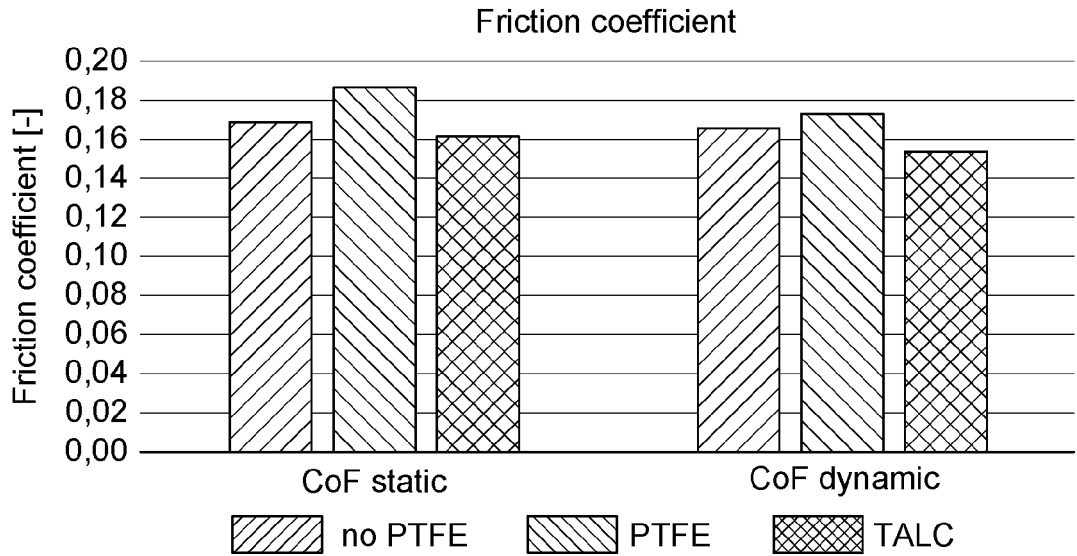


FIG. 2

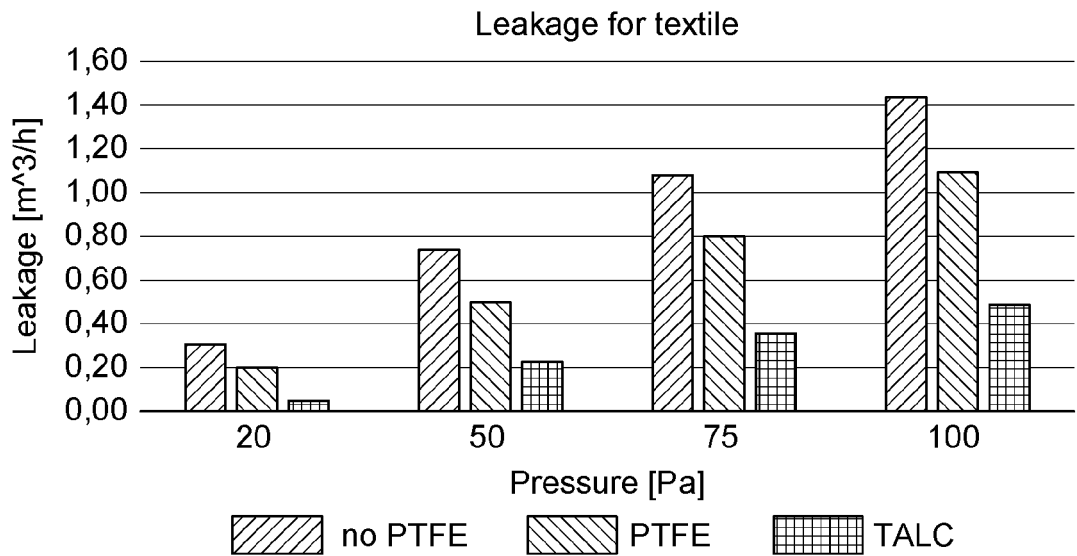


FIG. 3

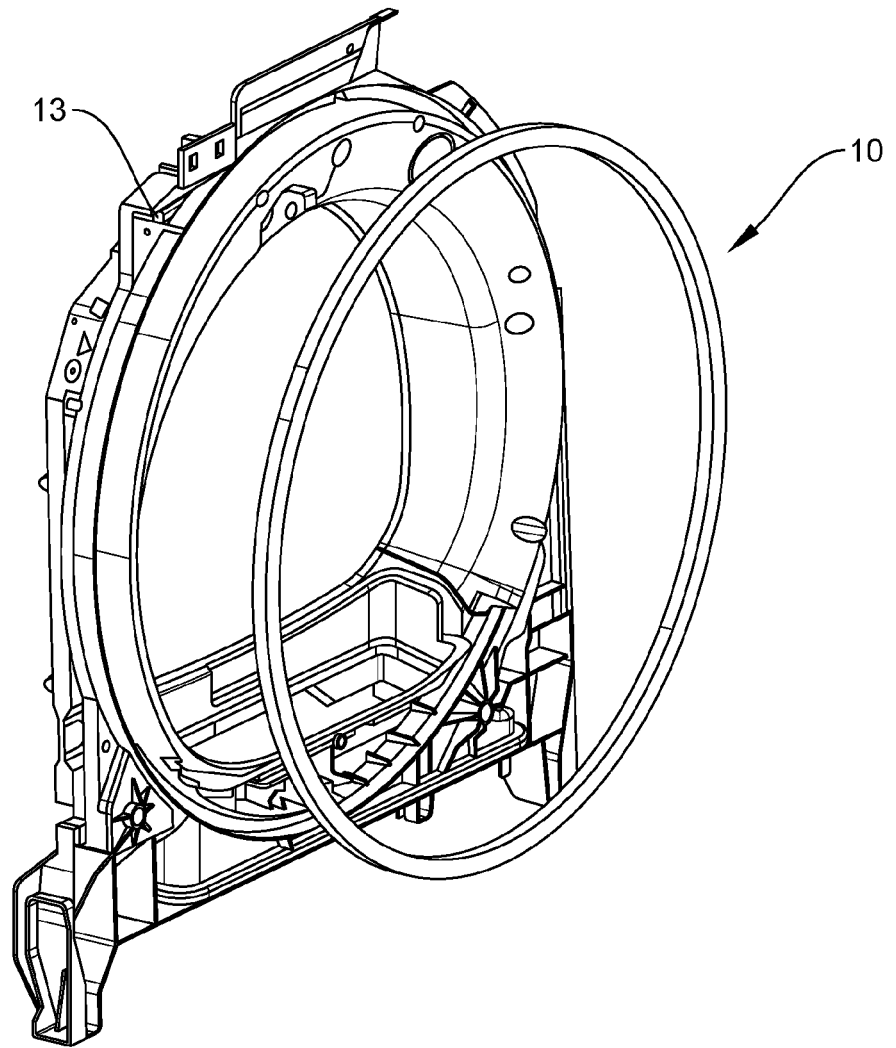


FIG. 4

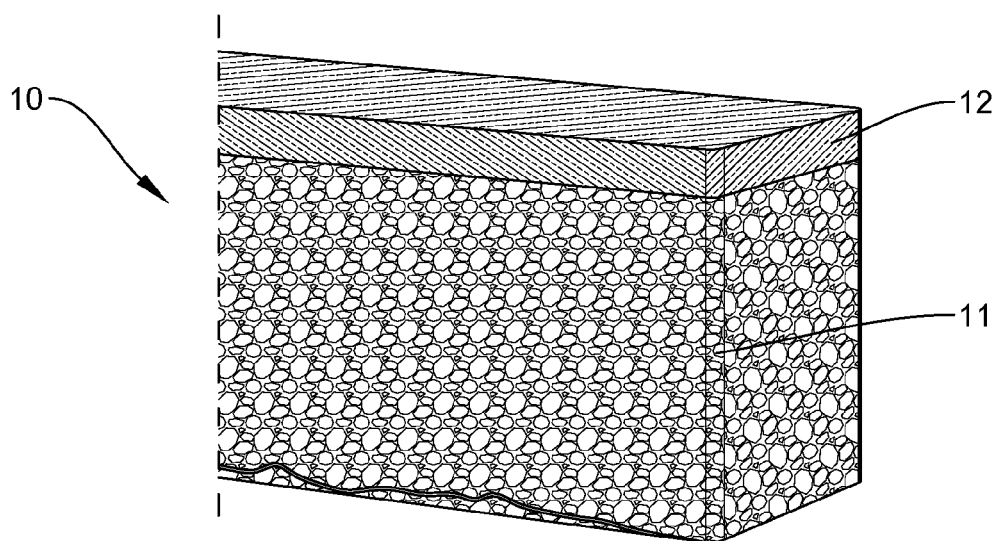


FIG. 5



## EUROPEAN SEARCH REPORT

Application Number

EP 25 16 7287

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category                                                                         | Citation of document with indication, where appropriate, of relevant passages                                       | Relevant to claim                | CLASSIFICATION OF THE APPLICATION (IPC) |
|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------|
| X                                                                                | KR 102 617 916 B1 (SEO SEUNG BEOM [KR])<br>27 December 2023 (2023-12-27)<br>* paragraphs [0008] - [0124] *<br>----- | 1-9                              | INV.<br>D06F58/04                       |
|                                                                                  |                                                                                                                     |                                  | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                  |                                                                                                                     |                                  | D06F                                    |
| The present search report has been drawn up for all claims                       |                                                                                                                     |                                  |                                         |
| Place of search                                                                  |                                                                                                                     | Date of completion of the search | Examiner                                |
| Munich                                                                           |                                                                                                                     | 5 September 2025                 | Weidner, Maximilian                     |
| CATEGORY OF CITED DOCUMENTS                                                      |                                                                                                                     |                                  |                                         |
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ANNEX TO THE EUROPEAN SEARCH REPORT  
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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| 10 | Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
| 15 | KR 102617916                              | B1                  | 27-12-2023                 | NONE                |
| 20 | -----                                     |                     |                            |                     |
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