(19) Europäisches Patentamt / European Patent Office / Office européen des brevets

(11) **EP 4 283 191 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
29.11.2023 Bulletin 2023/48

(21) Application number: **22175354.4**

(22) Date of filing: **25.05.2022**

(51) International Patent Classification (IPC):
F22B 1/28 *(2006.01)* ***F22B 37/60*** *(2006.01)*
D06F 75/12 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F22B 1/284; F22B 1/287; F22B 1/288; F22B 37/60;
D06F 75/12

(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

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(54) STEAM GENERATOR COMPRISING AN ADAPTED STEAMING SURFACE

(57) The invention relates to a steam generator (120) for a garment care device. The steam generator comprises a steam generator body (122) comprising a steaming surface (124). An arrangement of spatially separated protrusions (126) project away from the steaming surface. A water inlet (128) is arranged to supply water towards the steaming surface. The steaming surface (124) extends away from the water inlet (128) in a first direction (DI). The steaming surface (124) comprises a first portion (124A) proximal to the water inlet, and a second portion (124B) extending from the first portion in the first direction. The arrangement of spatially separated protrusions comprises a first sub-arrangement of protrusions (126A) projecting from the first portion, with each of the protrusions of the first sub-arrangement having a truncated pyramidal shape. The arrangement of spatially separated protrusions further comprises a second sub-arrangement of protrusions (126B) projecting from the second portion, with each of the protrusions of the second sub-arrangement having a pyramidal shape.

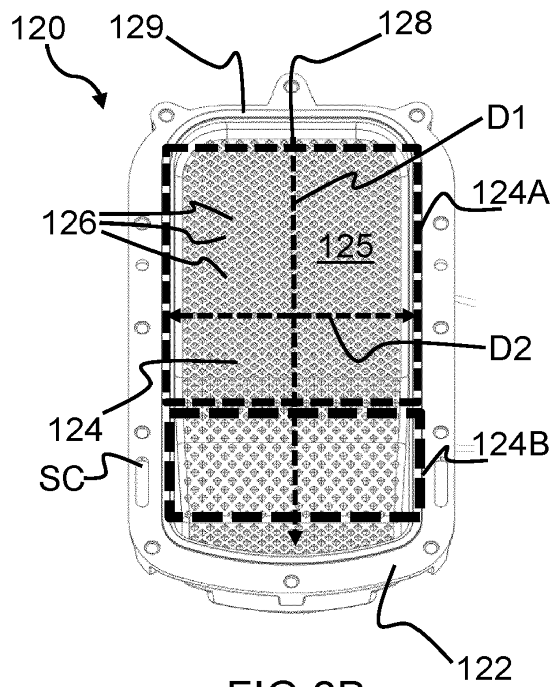

FIG.2B

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a steam generator for a garment care device, and a garment care device comprising the steam generator.

[0002] The invention may be used in the field of garment care.

BACKGROUND OF THE INVENTION

[0003] Steam generators vaporise water to generate steam. To this end, a water inlet is provided for dosing water into the steam generator, and a steam outlet permits steam to exit the steam generator.

[0004] Various types of garment care device are known which include a steam generator, such as so-called stand steamers. Such stand steamers typically include a base unit, a hand unit having at least one steam vent, and a steam hose cord connecting the steam generator in the base unit to the hand unit.

[0005] Conventional steam generators have a heated steaming surface to which water is supplied in order to generate steam. It can be desirable to shorten the length of the steaming surface in order to make the steam generator, and thus the base unit in the case of the above-mentioned stand steamer, more compact. However, this can risk undesirable pooling of water at the bottom of the steaming surface.

[0006] Steam generator temperatures also tend to be relatively high, such as above 150°C. Such high temperatures can result in film boiling of water on the steaming surface, also known as the Leidenfrost effect. This can compromise the capability of the steam generator to generate steam instantaneously.

[0007] Whilst the Leidenfrost effect can be mitigated via a steam promoter coating being applied to the steaming surface. Such a coating tends to be susceptible to delamination during use of the steam generator.

[0008] Scale build-up on the steaming surface can also cause steaming performance to decline over the operating lifetime of the steam generator. In particular, the more scale remains adhered to the steaming surface, the worse the instantaneous steam generation capability of the steam generator becomes, due to the adhered scale making heat transfer from the steaming surface to the water thereon less efficient.

OBJECT AND SUMMARY OF THE INVENTION

[0009] It is an object of the invention to propose a garment care device that addresses one or more of the above-mentioned challenges.

[0010] The invention is defined by the independent claims. The dependent claims define advantageous embodiments.

[0011] To this end, the steam generator according to the invention comprises

- a steam generator body comprising a steaming surface and an arrangement of spatially separated protrusions projecting away from the steaming surface,
- a water inlet arranged to supply water towards the steaming surface, the steaming surface extending away from the water inlet in a first direction, wherein the steaming surface comprises a first portion proximal to the water inlet, and a second portion extending from the first portion in said first direction, and wherein the arrangement comprises:

  i- a first sub-arrangement of protrusions projecting from the first portion, each of the protrusions of the first sub-arrangement having a truncated pyramidal shape, and
  ii- a second sub-arrangement of protrusions projecting from the second portion, each of the protrusions of the second sub-arrangement having a pyramidal shape.

[0012] The term "truncated" in the context of the truncated pyramidal shape of the protrusions of the first sub-arrangement may refer to a pyramidal shape having its apex (distal to the base of the pyramidal shape at the steaming surface) removed as a result of the truncation.

[0013] This truncated pyramidal shape can assist to promote regular flaking-off of scale deposited on the first portion of the steaming surface. The truncated pyramidal shape can also, in certain embodiments, assist to minimise flaking off of a coating, in particular a steam promoter coating, from the first portion of the steaming surface.

[0014] The term "pyramidal" in the context of the pyramidal shape of the protrusions of the second sub-arrangement may mean that the pyramidal shape comprises its apex distal to the base of the pyramidal shape at the steaming surface.

[0015] In other words, each of the protrusions of the second sub-arrangement has a non-truncated pyramidal shape.

[0016] This (non-truncated) pyramidal shape can assist with retaining/obstructing relatively large amounts of water and scale on the second portion of the steaming surface, thereby assisting to minimise or avoid water reaching and pooling at a base of the steam generator.

[0017] In some embodiments, each of the protrusions has a base having opposite corners parallel to the first direction. In other words, the opposite corners are spaced apart from each other along an axis parallel to the first direction of extension of the steaming surface from the water inlet.

[0018] Orientation of the protrusions in this manner may assist lateral/transverse water spreading on the steaming surface, and thereby assist to enhance steaming efficiency.

[0019] In some embodiments, the protrusions of the first sub-arrangement are more densely arranged than the protrusions of the second sub-arrangement. This may mean greater water spreading, and slower passage of the water in the first direction, on the first portion of the steaming surface. The lower density of the protrusions in the second sub-arrangement enables more efficient flaking-off of scale from the second portion of the steaming surface which may assist to minimise scale build-up on the second portion of the steaming surface.

[0020] In some embodiments, a coating is provided on and between the protrusions.

[0021] The protrusions can provide a greater surface area to which the coating can adhere. Thus, by applying the coating on and between the protrusions the risk of delamination, e.g. bulk delamination, of the coating can be reduced, for example in comparison with such a coating being applied to a flat steaming surface without any protrusions.

[0022] The coating is preferably adapted or selected to suppress film boiling of the water supplied to the steaming surface.

[0023] To this end, the coating, which can be termed a "steam promoter coating" in view of its film boiling suppression purpose, can be hydrophilic and/or porous.

[0024] In some embodiments, the second portion has an angular orientation compared to horizontal being larger than an angular orientation compared to horizontal of the first portion.

[0025] This arrangement has been found to permit more efficient flaking and dropping of scale from the steaming surface to enable scale to accumulate in a scale deposition area at the base of the steam generator. This, in turn, may assist to prolong the instantaneous steam generation capability of the steam generator, since less scale adhered to the steaming surface may mean that heat is more efficiently transferred to the water thereon.

[0026] The protrusions of the second sub-arrangement preferably project further away from the steaming surface than the protrusions of the first sub-arrangement. In other words, the height of each of the protrusions of the second sub-arrangement is greater than the height of each of the protrusions of the first sub-arrangement.

[0027] This may assist in retention and/or obstruction of water and scale on the second portion, and may assist to minimise the amount of water reaching and pooling in the base of the steam generator.

[0028] In some embodiments, the arrangement of protrusions comprises rows of protrusions, with each row extending transverse to the first direction.

[0029] The protrusions of a given row are preferably aligned with the spaces between protrusions of a neighbouring row such that the rows are staggered along the first direction. Such staggered rows can assist to enhance lateral/transverse water spreading on the steaming surface, and thereby assist to enhance steaming efficiency.

[0030] In some embodiments, portions of the protrusions of one row of a pair of neighbouring rows align with portions of the protrusions of the other row of the pair of neighbouring rows such that the neighbouring rows partially overlap with each other along the first direction. In this manner, the protrusions can be more densely arranged, with the concomitant increase in surface area assisting to enhance steaming efficiency.

[0031] In some embodiments, the steaming surface comprises a rounded transition between the first portion and the second portion. Such a rounded transition coupled with larger angular orientation of the second portion may assist to ensure smooth transfer of the water on the first portion to the second portion.

[0032] A radius of curvature of the rounded transition is preferably in the range of [20;40] mm. Such a radius of curvature may be large enough to assist water reaching the end of the first portion to continue to flow down the second portion due to surface tension instead of "falling-off', and descending directly into the base of the steam generator by gravity. This radius of curvature is also not so large so as to overly reduce the available steaming area of the first portion.

[0033] In some embodiments, a height of each of the protrusions is in the range of [0.3;1.3] mm.

[0034] A height of the protrusions of the first sub-arrangement is preferably in the range of [0.3;0.8] mm. This has been found to balance sufficient slowing/spreading of water on the first portion with scale flaking efficacy and/or coating adhesion.

[0035] A height H of the protrusions of the second sub-arrangement is preferably in the range of [0.8;1.3] mm. This has been found to balance sufficient slowing/spreading of water on the second portion with scale flaking efficacy and/or coating adhesion.

[0036] Alternatively or additionally, the protrusions may each have a base area on the steaming surface in the range of [2;6] mm^2.

[0037] The width of each of the protrusions at its base is preferably in the range of [1.4;2.5] mm.

[0038] A first distance between corresponding points, for example respective centres, of nearest neighbouring protrusions of the first sub-arrangement when measured in a second direction perpendicular to the first direction is preferably in the range [2.2;3.0] mm.

[0039] Alternatively or additionally, a second distance between corresponding points, for example respective centres, of nearest neighbouring protrusions of the first sub-arrangement when measured in the first direction may be in the range [1.7;2.5] mm.

[0040] Such distances have been found to assist in balancing sufficient slowing/spreading of water on the first portion with scale flaking efficacy and/or coating adhesion.

[0041] A further first distance between corresponding points, for example respective centres, of nearest neighbouring protrusions of the second sub-arrangement when measured in the second direction perpendicular to the first direction is preferably in the range of [2.2;3.0] mm.

[0042] Alternatively or additionally, a further second distance between corresponding points, for example respective centres, of nearest neighbouring protrusions of the second sub-arrangement when measured in the first direction may be in the range of [1.7;4.0] mm.

[0043] Such distances have been found to assist in balancing sufficient slowing/spreading of water on the second portion with scale flaking efficacy and/or coating adhesion.

[0044] According to another aspect there is provided a garment care device comprising

- a base unit comprising the steam generator according to embodiments described herein,
- a hand unit having at least one steam vent, and
- a steam hose cord connecting the steam generator to the hand unit, the steam generated by the steam generator exiting the device via the at least one steam vent.

[0045] In some embodiments, the hand unit further comprises a steam heater arranged to re-heat the steam received from the steam generator, prior to the steam exiting the hand unit via the at least one steam vent. The steam heater may assist to minimise the risk of spitting of water onto garments.

[0046] Detailed explanations and other aspects of the invention will be given below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0047] Particular aspects of the invention will now be explained with reference to the embodiments described hereinafter and considered in connection with the accompanying drawings, in which identical parts or sub-steps are designated in the same manner:

Figs.1A and 1B depict a garment care device according to an example,
Fig.2A depicts a steam generator according to an example,
Fig.2B provides a view of the interior of the steam generator,
Fig.3 provides a cross-sectional view of a coating applied on and between protrusions of a steaming surface of a steam generator,
Fig.4A provides a plan view of protrusions of a first sub-arrangement of protrusions,
Fig.4B provides a cross-sectional view of one of the protrusions of the first sub-arrangement,
Fig.5A provides a plan view of protrusions of a second sub-arrangement of protrusions,
Fig.5B provides a cross-sectional view of one of the protrusions of the second sub-arrangement,
Fig.6 provides another plan view of protrusions of a first sub-arrangement,
Fig.7 provides another plan view of protrusions of a second sub-arrangement,
Fig.8 provides a plan view of protrusions of a second sub-arrangement according to another example, and
Fig.9 provides a cross-sectional view of the steam generator shown in Figs.2A and 2B showing the orientations of portions of the steaming surface.

DETAILED DESCRIPTION OF THE INVENTION

[0048] Figs. 1A and 1B depict a garment care device 100 according to an example. The garment care device 100 comprises a base unit 102 comprising a steam generator (not visible in Figs.1A and 1B). The design of the steam generator will be described in more detail herein below.

[0049] The garment care device 100 also comprises a hand unit 104. At least one steam vent (not visible in the Figures) is provided in the hand unit 104 for releasing steam to a garment to be treated.

[0050] A steam hose cord 106 connects the steam generator to the hand unit 104. The steam generated by the steam generator exits the device via the at least one steam vent.

[0051] The garment care device 100 shown in Figs.1A and 1B can be regarded as a stand steamer. In this non-limiting example, the garment care device 100 comprises an ironing board 108 which is tiltable between a vertical orientation, as shown in Fig.1A and represented by the dotted lines 110 in Fig.1B, and a horizontal orientation, as shown in Fig.1B.

[0052] In some embodiments, the hand unit 104 further comprises a steam heater (not visible in the Figures) arranged to re-heat the steam received from the steam generator, prior to the steam exiting the hand unit 104 via the at least one steam vent. The steam heater may assist to minimise the risk of spitting of water onto the garment being treated.

[0053] In the non-limiting example shown in Figs.1A and 1B, the garment care device 100 includes a holder 112 for supporting the hand unit 104 while the hand unit 104 is not being held by the user. Such a holder 112 can be mounted on the ironing board 108, as shown.

[0054] Figs.2A and 2B depict a steam generator 120 according to an example. The steam generator 120 can, for example, be included in the above-described base unit 102 of the garment care device 100 shown in Figs.1A and 1B.

[0055] The steam generator 120 comprises a steam generator body 122 comprising a steaming surface 124. The steam generator body 122 can be formed from any suitable material capable of withstanding steam generation on the steaming surface 124. Preferably, the steam generator body 122 is formed from a metal material, such as aluminium.

[0056] In at least some embodiments, the steam generator body 122 is formed, at least in part, via a casting, for example die-casting, process. In a specific non-limiting example, the steam generator body 122 is formed from die-cast aluminium.

[0057] In some embodiments, such as that shown in Figs.2A and 2B, the steam generator 120 comprises a steam generator cover 123 which joins to the steam generator body 122 to enclose a steam chamber 125. In this case, the steaming surface 124 is provided in the steam chamber 125.

[0058] The steam generator cover 123 can be formed from any suitable material capable of withstanding steam generation in the steam chamber 125. Preferably, the steam generator cover 123 is formed from a metal material, such as aluminium.

[0059] In at least some embodiments, the steam generator cover 123 is formed, at least in part, via a casting, for example die-casting, process. In a specific non-limiting example, the steam generator cover 123 is formed from die-cast aluminium.

[0060] Joining of the steam generator cover 123 and the steam generator body 122 can be achieved in any suitable manner, such as using one or more screws SC.

[0061] Water is supplied towards the steaming surface 124 via a water inlet 128. The water is then vaporised on the steaming surface 124 to generate steam. To this end, a heating element arrangement (not visible in the Figures) is preferably arranged in the steam generator body 122 to heat the steaming surface 124 so that the water can be vaporised thereon.

[0062] In the non-limiting example shown in Figs.2A and 2B, the water inlet 128 is provided in the steam generator cover 123. In other examples (not shown), the water inlet 128 is provided in the steam generator body 122.

[0063] In the non-limiting example shown in Figs.2A and 2B, a steam outlet 129 is provided in the steam generator cover 123. The steam outlet 129 is arranged to deliver outside the steam chamber 125 steam generated in the steam chamber 125. In other examples (not shown), the steam outlet 129 is provided in the steam generator body 122.

[0064] The steam generator 120 comprises an arrangement of spatially separated protrusions 126 projecting away from the steaming surface 124. This arrangement of protrusions 126 can provide various benefits, as explained in more detail herein below.

[0065] In at least some embodiments, the protrusions 126 form part of the steam generator body 122. In such embodiments, the protrusions 126 are necessarily made of the same material, for example the same metal material, e.g. aluminium, as the rest of the steam generator body 122.

[0066] The protrusions 126 can be formed in any suitable manner, for example by being formed together with the rest of the steam generator body 122 in a casting process, such as a die-casting process. In a specific non-limiting example, the steam generator body 122, including the protrusions 126, is formed from die-cast aluminium.

[0067] In at least some embodiments, and as shown in Fig.3, a coating 130 is provided on and between the protrusions 126.

[0068] The protrusions 126 can provide a greater surface area to which the coating 130 can adhere. Thus, by applying the coating 130 on and between the protrusions 126, the risk of delamination, e.g. bulk delamination, of the coating 130 from the surface of the steam generator body 122 can be reduced, for example in comparison with such a coating being applied to a flat steaming surface without protrusions.

[0069] In some embodiments, such as that shown in Fig.3, the coating 130 conforms to the arrangement of spatially separated protrusions 126.

[0070] To this end, the coating 130 may be thinner than the height H of projection of the protrusions 126 away from the surface of the steam generator body 122, such that the surface of the coating 130 follows the contours provided by the arrangement of protrusions 126.

[0071] In this manner, surface area of the coating 130 may be increased, for example relative to a flat coating surface. This, in turn, can assist to improve efficiency of water vaporisation on the surface of the coating 130.

[0072] The thickness T of the coating 130 is preferably in the range of [10;60] μm.

[0073] In some embodiments, the height H of each of the protrusions 126 is in the range of [0.3;1.3] mm.

[0074] Alternatively or additionally, the protrusions 126 may each have a base area on the steaming surface 124 in the range of [2;6] mm^2.

[0075] Referring to Figs.4A and 5A, the width W of each of the protrusions 126 at its base is preferably in the range of [1.4;2.5] mm.

[0076] The coating 130 is preferably adapted or selected to suppress film boiling of the water supplied to the steaming surface 124. To this end, the coating 130, which can be termed a "steam promoter coating" in view of its film boiling suppression purpose, is preferably hydrophilic and/or porous.

[0077] In some embodiments, the coating 130 comprises an alkali metal silicate.

[0078] In a non-limiting example, the coating 130 comprises an alkali metal silicate and a polysaccharide. Xylan is an example of a polysaccharide suitable for inclusion in the coating 130.

[0079] In a particular non-limiting example, the coating 130 comprises an alkali metal silicate compound, and boron, preferably a salt of boron with a metallic element.

[0080] A coating 130 comprising an alkali metal silicate compound and boron is described in, for instance, WO 2009/044320 A2.

[0081] In a more specific non-limiting example, the coating 130 comprises a polysaccharide, an alkali metal silicate compound, and a salt of boron with a metallic element.

[0082] The coating 130 may be applied in any suitable manner, for instance by spraying a precursor layer, e.g. in the form of a sol, onto and between the protrusions 126, and curing the thus applied precursor layer, e.g. to form a sol-gel-type coating 130. The curing may be implemented thermally, for instance using a particular heating profile to cure the precursor layer.

[0083] Prior to the coating 130 being applied, e.g. prior to application of the precursor layer, the arrangement of protrusions 126 is preferably cleaned to remove contaminants, and then subjected to abrasive blasting, e.g. sand blasting, to prepare the protrusions 126 and the surface therebetween for the coating 130.

[0084] Referring again to Fig.2B, the steaming surface 124 extends away from the water inlet 128 in a first direction D1. In at least some embodiments, the steaming surface 124 is elongated so as to have a lengthways dimension, with this lengthways dimension extending parallel to the first direction D1. An example of this is shown in Fig.2B.

[0085] The steaming surface 124 comprises a first portion 124A proximal to the water inlet 128, and a second portion 124B extending from the first portion 124A in the first direction D1. This arrangement means that the water supplied via the water inlet 128 flows on the steaming surface 124 from the first portion 124A to the second portion 124B. The first portion 124A may thus be regarded as an upstream portion of the steaming surface 124, with the second portion 124B being a downstream portion of the steaming surface 124.

[0086] In some embodiments, and referring to Figs.2B, 4A and 5A, the arrangement of protrusions 126 comprises rows 132 of protrusions 126, with each row 132 extending transverse to the first direction D1.

[0087] Each row 132 preferably extends in second directions D2 perpendicular to the first direction D1.

[0088] The protrusions 126 of a given row 132 are preferably aligned with the spaces between protrusions 126 of a neighbouring row 132 such that the rows are staggered along the first direction D1. Such staggered rows 132 can assist to enhance lateral/transverse water spreading on the steaming surface 124, and thereby assist to enhance steaming efficiency.

[0089] Referring to Fig.4A, portions of the protrusions 126 of one row 132A of a pair of neighbouring rows 132A, 132B preferably align with portions of the protrusions 126 of the other row 132B of the pair of neighbouring rows 132A, 132B such that the neighbouring rows 132A, 132B partially overlap with each other along the first direction D1. In this manner, the protrusions 126 can be more densely arranged, with the concomitant increase in surface area assisting to enhance steaming efficiency. Other benefits which may be provided by more densely arranged protrusions 126 will be described herein below.

[0090] Referring to Figs.2B, 4A and 5A, the arrangement of spatially separated protrusions 126 comprises a first sub-arrangement of protrusions 126A projecting from the first portion 124A, and a second sub-arrangement of protrusions 126B projecting from the second portion 124B.

[0091] In some embodiments, the protrusions 126A of the first sub-arrangement are more densely arranged than the protrusions 126B of the second sub-arrangement. This may mean greater water spreading, and slower passage of the water in the first direction D1, on the first portion 124A of the steaming surface 124. The lower density of the protrusions 126B in the second sub-arrangement may assist to minimise scale build-up on the second portion 124B of the steaming surface 124.

[0092] In other words, there may be a larger number of protrusions 126A of the first sub-arrangement per unit area of the first portion 124A than the number of protrusions 126B of the second sub-arrangement per unit area of the second portion 124B.

[0093] The heating element arrangement is preferably arranged relative to the first portion 124A and the second portion 124B such that the first portion 124A is at a higher temperature than the second portion 124B.

[0094] This can assist to enhance steaming efficiency on the first portion 124A, particularly when the protrusions 126A of the first sub-arrangement are more densely arranged than the protrusions 126B of the second sub-arrangement.

[0095] Referring to Figs.4A and 4B, each of the protrusions 126A of the first sub-arrangement has a truncated pyramidal shape.

[0096] The term "truncated" in the context of the truncated pyramidal shape may refer to a pyramidal shape having its apex (distal to the base of the pyramidal shape at the steaming surface 124) removed as a result of the truncation.

[0097] This truncated pyramidal shape can assist to promote regular flaking off of scale deposited on the first portion 124A of the steaming surface 124. The truncated pyramidal shape can also, in certain embodiments, assist to minimise flaking off of the coating 130 from the first portion 124A of the steaming surface 124.

[0098] Whilst in the example shown in Fig.4A the truncated pyramidal shape of the protrusions 126A of the first sub-arrangement is a truncated square pyramidal shape, this is not intended to be limiting and other truncated pyramidal shapes can be contemplated, for instance a truncated pyramidal shape whose base is a quadrilateral being a rectangle, a trapezium, a rhombus or a kite.

[0099] In some embodiments, and as best shown in Fig.4B, a height H of the protrusions 126A of the first sub-arrangement is in the range of [0.3;0.8] mm. This has been found to balance sufficient slowing/spreading of water on the first portion 124A with scale flaking efficacy and/or coating 130 adhesion.

[0100] Referring to Figs.5A and 5B, each of the protrusions 126B of the second sub-arrangement has a pyramidal shape.

[0101] The term "pyramidal" in the context of the pyramidal shape of the protrusions 126B of the second sub-arrangement is intended to mean that the pyramidal shape comprises its apex AP distal to the base of the pyramidal shape at the steaming surface 124.

[0102] In other words, each of the protrusions 126B of the second sub-arrangement has a non-truncated pyramidal shape.

[0103] This (non-truncated) pyramidal shape can assist with retaining/obstructing relatively large amounts of water and scale on the second portion 124B, thereby assisting to minimise or avoid water reaching and pooling at a base of the steam chamber 125.

[0104] Whilst in the example shown in Fig.5A the pyramidal shape of the protrusions 126B of the second sub-arrangement is a pyramidal shape whose base is kite-shaped, this is not intended to be limiting and other pyramidal shapes can be contemplated, for instance a pyramidal shape whose base is a quadrilateral being a square (see the example shown in Fig.8), a rectangle, a trapezium, or a rhombus.

[0105] In some embodiments, and as best shown in Fig.5B, a height H of the protrusions 126B of the second sub-arrangement is in the range of [0.8;1.3] mm. This has been found to balance sufficient slowing/spreading of water on the second portion 124B with scale flaking efficacy and/or coating 130 adhesion.

[0106] The protrusions 126B of the second sub-arrangement preferably project further away from the steaming surface 124 than the protrusions 126A of the first sub-arrangement. In other words, the height H of each of the protrusions 126B of the second sub-arrangement is greater than the height H of each of the protrusions 126A of the first sub-arrangement. This may assist in retention and/or obstruction of water and scale on the second portion 124B, and may assist to minimise the amount of water reaching and pooling in the base of the steam chamber 125.

[0107] In some embodiments, and referring to both of Figs.4A and 5A, each of the protrusions 126 has a base having opposite corners C1, C2 parallel to the first direction D1. In other words, the opposite corners C1, C2 are spaced apart from each other along an axis parallel to the first direction D1. Orientation of the protrusions 126 in this manner may assist lateral/transverse water spreading on the steaming surface 124, and thereby assist to enhance steaming efficiency.

[0108] Fig.6 provides another plan view of the protrusions 126A of the first sub-arrangement. A first distance SP1A between corresponding points, for example respective centres, of nearest neighbouring protrusions 126A of the first sub-arrangement when measured in the second direction D2 perpendicular to the first direction D1 is preferably in the range [2.2;3.0] mm.

[0109] Alternatively or additionally, a second distance SP2A between corresponding points, for example respective centres, of nearest neighbouring protrusions 126A of the first sub-arrangement when measured in the first direction D1 may be in the range [1.7;2.5] mm.

[0110] Such distances SP1A, SP2A have been found to assist in balancing sufficient slowing/spreading of water on the first portion 124A with scale flaking efficacy and/or coating 130 adhesion.

[0111] Fig.7 provides another plan view of the protrusions 126B of the second sub-arrangement. A further first distance SP1B between corresponding points of nearest neighbouring protrusions 126B of the second sub-arrangement when measured in the second direction D2 perpendicular to the first direction D1 is preferably in the range of [2.2;3.0] mm.

[0112] Alternatively or additionally, a further second distance SP2B between corresponding points of nearest neighbouring protrusions 126B of the second sub-arrangement when measured in the first direction D1 may be in the range of [1.7;4.0] mm, and preferably in the range of [2.8;4] mm for the kite-shaped based pyramidal protrusions 126B shown in Fig.7.

[0113] The further second distance SP2B in the case of the square based pyramidal protrusions 126B shown in Fig.8 is preferably in the range of [1.7;2.5] mm.

[0114] Such distances SP1B, SP2B have been found to assist in balancing sufficient slowing/spreading of water on the second portion 124B with scale flaking efficacy and/or coating 130 adhesion.

[0115] In some embodiments, and referring to Fig.9, the second portion 124B has an angular orientation A2 compared to the horizontal HP being larger than an angular orientation A1 compared to the horizontal HP of the first portion 124A.

[0116] Fig.9 shows the steam generator 120 when orientated for use. This in-use orientation of the steam generator 120 may, for example, be adopted when the steam generator 120 is mounted in the base unit 102 of the garment care device 100, and the base unit 102 itself is orientated for use.

[0117] This arrangement has been found to permit more efficient flaking and dropping of scale from the steaming surface 124 to enable scale to accumulate in a scale deposition area at the base of the steam chamber 125. This, in turn, may assist to prolong the instantaneous steam generation capability of the steam generator 120, since less scale adhered to the steaming surface 124 may mean that heat is more efficiently transferred to the water thereon.

[0118] When orientated for use, the steam generator 120 is preferably oriented such that the first portion 124A is inclined at an incline angle A1, for example at an incline angle in the range of [45;75] degrees, such as about 60 degrees, with respect to the horizontal plane HP in an anti-clockwise direction. The second portion 124B is inclined at an incline angle A2 in the range of [50;80] degrees, such as about 65 degrees, with respect to the horizontal plane HP in a clockwise direction. The incline angle A2 of the second portion 124B is preferably equal to or greater than the incline angle A1 of the first portion 124A.

[0119] It is noted that the horizontal plane HP may be defined perpendicular to the local gravity direction-defined vertical.

[0120] In some embodiments, such as that shown in Fig.9, a rounded transition R is provided between the first portion 124A and the second portion 124B. Such a rounded transition may assist to ensure smooth transfer of the water on the first portion 124A to the second portion 124B.

[0121] A radius of curvature of the rounded transition R is preferably in the range of [20;40] mm. Such a radius of curvature may be large enough to assist water reaching the end of the first portion 124A to continue to flow down the second portion 124B due to surface tension instead of "falling-off', and descending directly into the base of the steam chamber 125 by gravity. This radius of curvature is also not so large so as to overly reduce the available steaming area of the first portion 124A.

[0122] In some embodiments, such as that shown in Fig.9, the steaming surface 124 further comprises a third portion 124C extending from the second portion 124B in the first direction D1.

[0123] The third portion 124C is preferably parallel to, or at least substantially parallel to, the first portion 124A.

[0124] The third portion 124C may form part of a scale collection area at the base of the steam chamber 125. Part of the heating element arrangement is preferably aligned with the third portion 124C to assist in vaporising, in other words steaming-off, of any water reaching the base of the steam chamber 125 to prevent pooling.

[0125] The performance of various steam generators 120 was evaluated. Each had the same basic architecture, namely that shown in Figs.2A, 2B and 9. The steaming surface 124 of each of the steam generators 120 included the first portion 124A, the second portion 124B, and the third portion 124C. The steam generators 120 were each orientated as shown in Fig.9, with the incline angle A1 of the first portion 124A being 60 degrees, the incline angle A2 of the second portion 124B being 65 degrees, and the third portion 124C being parallel to the first portion 124A.

[0126] For each of the steam generators 120, each of the protrusions 126B of the second sub-arrangement had the (non-truncated) pyramidal shape, since this was found to be particularly effective at retaining/obstructing relatively large amounts of water and scale on the second portion 124B, thereby assisting to minimise or avoid water reaching the third portion 124C and pooling at the base of the steam chamber 125. These pyramidal protrusions 126B each has a base area of 2 mm^2, and a height H of 1 mm. The SP1B is 2.6 mm, and the SP2B is 2.1 mm.

[0127] Table 1 provides details of the protrusions 126A of the first sub-arrangements used, together with observations from testing the steam generators 120 using hard water (B160), and using soft water (SG). The hard water was to test scale flaking performance. The soft water was to test steam promoter coating 130 flaking behaviour and water spreading.

Table 1

Ex. No.	Pyramidal or truncated pyramidal	Height H/ mm	Base areal mm^2	SP1A/ mm	SP2A/ mm	Observations from tests using hard water (B160)	Observations from tests using soft water (SG)
1	Pyramidal	1.0	2	2.4	1.9	Poor scale flaking: scale grew into a bigger piece then flaked off	-

(continued)

Ex. No.	Pyramidal or truncated pyramidal	Height H/ mm	Base areal mm^2	SP1A/ mm	SP2A/ mm	Observations from tests using hard water (B160)	Observations from tests using soft water (SG)
2	Truncated pyramidal	0.5	2	2.4	1.9	Regular scale flaking, although relatively thick layer of scale was left on the steaming surface 124	Steam promoter coating 130 flaking was not observed; wider lateral/ transverse water spreading than observed for Ex. 4
3	Pyramidal	1.0	2	4.8	3.8	Poor scale flaking: scale grew into a bigger piece then flaked off	-
4	Truncated pyramidal	0.5	2	4.8	3.8	Regular scale flaking, although very thick layer of scale was left on the steaming surface 124; sometimes the scale flaked off with steam promoter coating 130	Steam promoter coating 130 flaking was observed; narrower lateral/ transverse water spreading than observed for Ex. 2

[0128] These experiments showed that the truncated pyramidal shape of the protrusions 126A of the first sub-arrangement, in this case with the truncation causing the protrusions 126A to have a height of 0.5 mm, resulted in superior scale flaking efficacy.

[0129] The more densely arranged protrusions 126A of Ex. 2 resulted in no flaking of the steam promoter coating 130. This is thought to be due to the greater surface area of the first portion 124A due to the more densely arranged protrusions 126A of the first sub-arrangement. Moreover, the more densely arranged protrusions 126A of Ex. 2 were observed to result in wider lateral/transverse water spreading than the less densely arranged protrusions 126A of Ex. 4.

[0130] The above embodiments as described are only illustrative, and not intended to limit the technique approaches of the present invention. Although the present invention is described in details referring to the preferable embodiments, those skilled in the art will understand that the technique approaches of the present invention can be modified or equally displaced without departing from the protective scope of the claims of the present invention. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A steam generator (120) for a garment care device (100), the steam generator comprising:

- a steam generator body (122) comprising a steaming surface (124) and an arrangement of spatially separated protrusions (126) projecting away from the steaming surface,
- a water inlet (128) arranged to supply water towards said steaming surface, the steaming surface (124) extending away from the water inlet (128) in a first direction (D1), wherein the steaming surface (124) comprises a first portion (124A) proximal to the water inlet, and a second portion (124B) extending from the first portion in said first direction, and wherein the arrangement comprises:

  i- a first sub-arrangement of protrusions (126A) projecting from the first portion, each of the protrusions of the first sub-arrangement having a truncated pyramidal shape, and
  ii- a second sub-arrangement of protrusions (126B) projecting from the second portion, each of the protrusions of the second sub-arrangement having a pyramidal shape.

2. The steam generator (120) according to claim 1, wherein each of the protrusions (126) has a base having opposite corners (C1, C2) parallel to the first direction (D1).

3. The steam generator (120) according to claim 1 or claim 2, wherein the protrusions (126A) of the first sub-arrangement are more densely arranged than the protrusions (126B) of the second sub-arrangement.

4. The steam generator (120) according to any one of claims 1 to 3, comprising a coating (130) adapted to suppress film boiling of the water, the coating being provided on and between the protrusions (126).

5. The steam generator (120) according to any one of claims 1 to 4, wherein the second portion (124B) has an angular orientation (A2) compared to horizontal being larger than an angular orientation (A1) compared to horizontal of the first portion (124A).

6. The steam generator (120) according to any one of claims 1 to 5, wherein the protrusions (126B) of the second sub-arrangement project further away from the steaming surface (124) than the protrusions (126A) of the first sub-arrangement.

7. The steam generator (120) according to any one of claims 1 to 6, wherein the arrangement comprises rows (132) of protrusions (126), with each row extending transverse to said first direction (D1), and wherein the protrusions of a given row are aligned with the spaces between protrusions of a neighbouring row such that the rows are staggered along said first direction.

8. The steam generator (120) according to claim 7, wherein portions of the protrusions (126) of one row (132A) of a pair of neighbouring rows (132A, 132B) align with portions of the protrusions of the other row (132B) of the pair of neighbouring rows such that the neighbouring rows partially overlap with each other along the first direction (D1).

9. The steam generator (120) according to any one of claims 1 to 8, wherein the steaming surface (124) comprises a rounded transition (R) between the first portion (124A) and the second portion (124B).

10. The steam generator (120) according to claim 9, wherein a radius of curvature of the rounded transition (R) is in the range of [20;40] mm.

11. The steam generator (120) according to any one of claims 1 to 10, wherein at least some of the protrusions (126) each have a base area on the steaming surface (124) in the range of [2;6] mm^2.

12. The steam generator (120) according to any one of claims 1 to 11, wherein a height (H) of the protrusions (126A) of the first sub-arrangement is in the range of [0.3;0.8] mm; and/or a height (H) of the protrusions (126B) of the second sub-arrangement is in the range of [0.8;1.3] mm.

13. The steam generator (120) according to any one of claims 1 to 12, wherein a first distance (SP1A) between corresponding points of nearest neighbouring protrusions (126A) of the first sub-arrangement when measured in a second direction (D2) perpendicular to the first direction (D1) is in the range of [2.2;3.0] mm; and/or wherein a second distance (SP2A) between corresponding points of nearest neighbouring protrusions of the first sub-arrangement when measured in the first direction is in the range of [1.7;2.5] mm.

14. The steam generator (120) according to any one of claims 1 to 13, wherein a further first distance (SP1B) between corresponding points of nearest neighbouring protrusions (126B) of the second sub-arrangement when measured in a second direction (D2) perpendicular to the first direction (D1) is in the range of [2.2;3.0] mm; and/or wherein a further second distance (SP2B) between corresponding points of nearest neighbouring protrusions of the second sub-arrangement when measured in the first direction is in the range of [1.7;4.0] mm.

15. A garment care device (100) comprising:

- a base unit (102) comprising the steam generator (120) according to any one of claims 1 to 14,
- a hand unit (104) having at least one steam vent, and
- a steam hose cord (106) connecting the steam generator to the hand unit, the steam generated by the steam generator exiting the device via the at least one vent; optionally wherein the hand unit comprises a steam heater arranged to heat the steam prior to the steam exiting the device via the at least one steam vent.

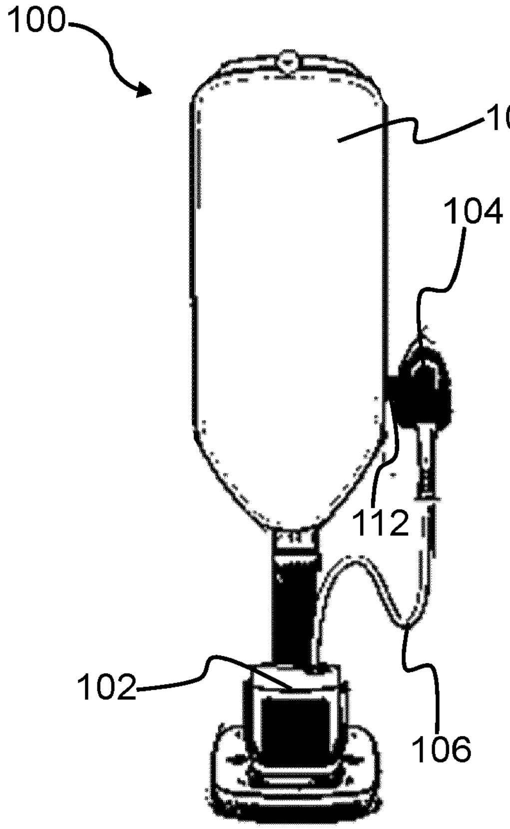

FIG.1A

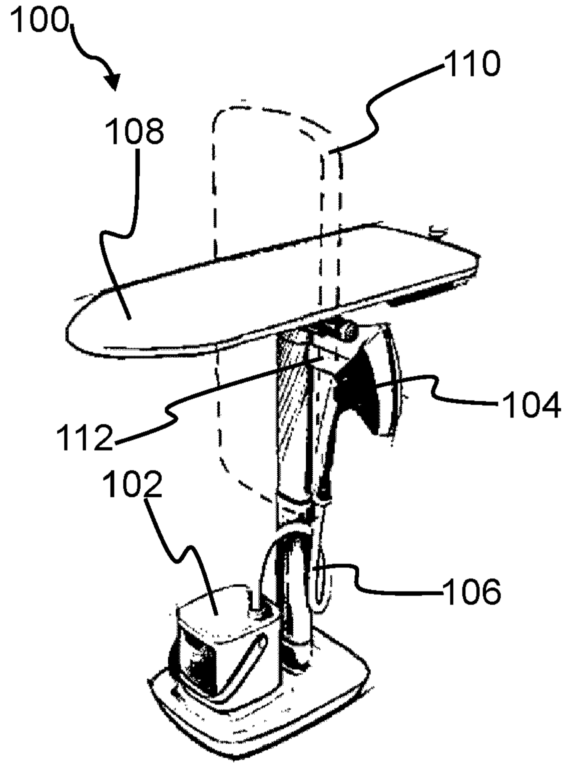

FIG.1B

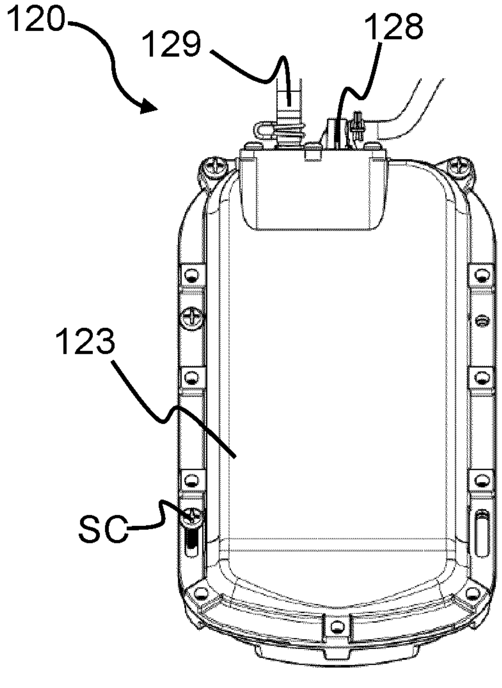

FIG.2A

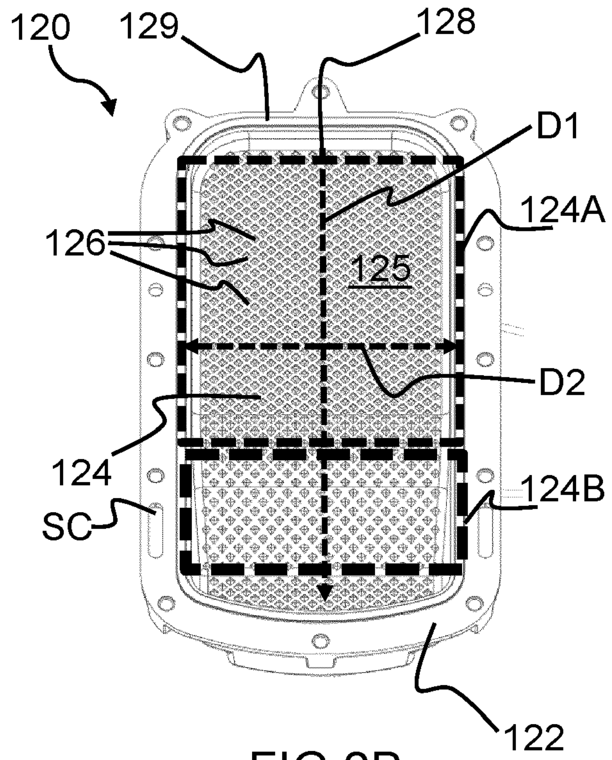

FIG.2B

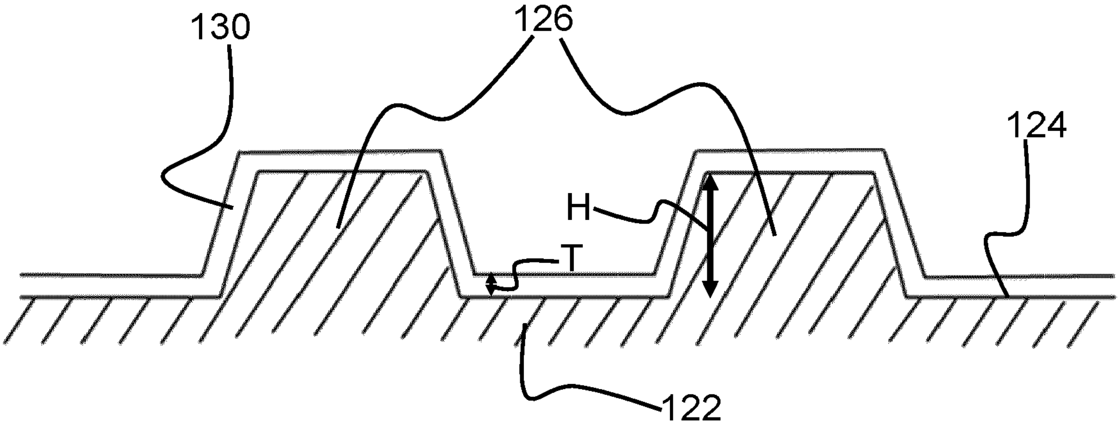

FIG.3

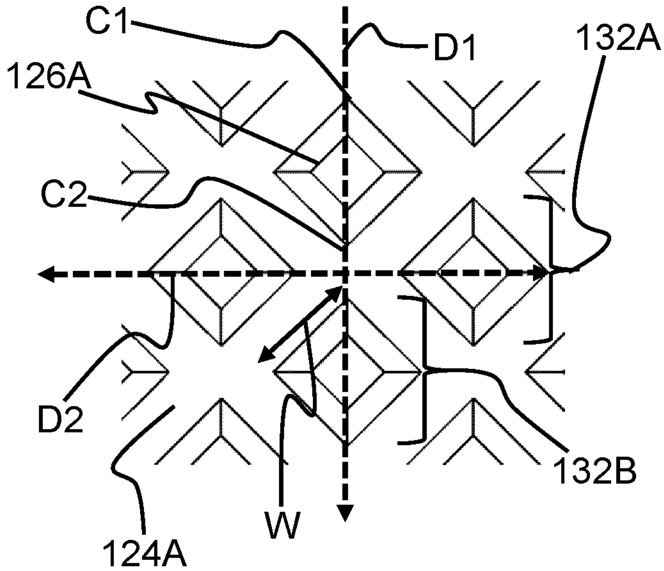

FIG.4A

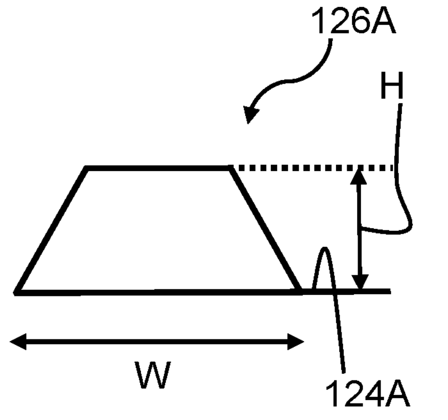

FIG.4B

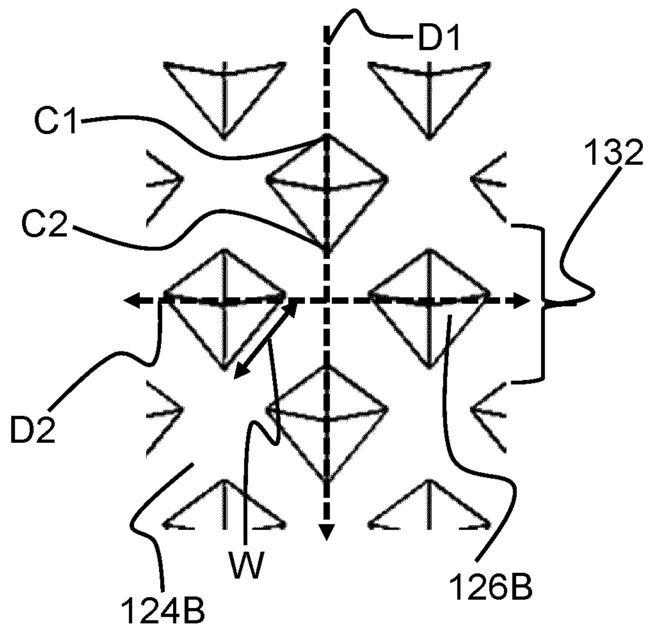

FIG.5A

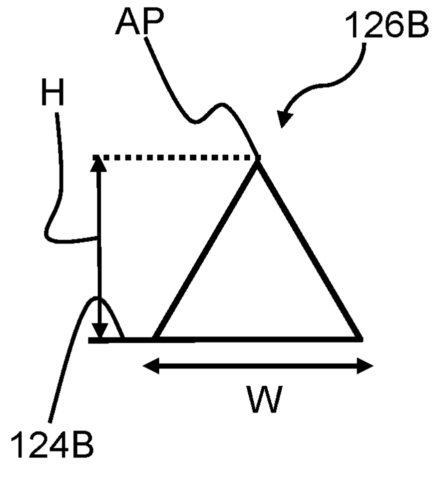

FIG.5B

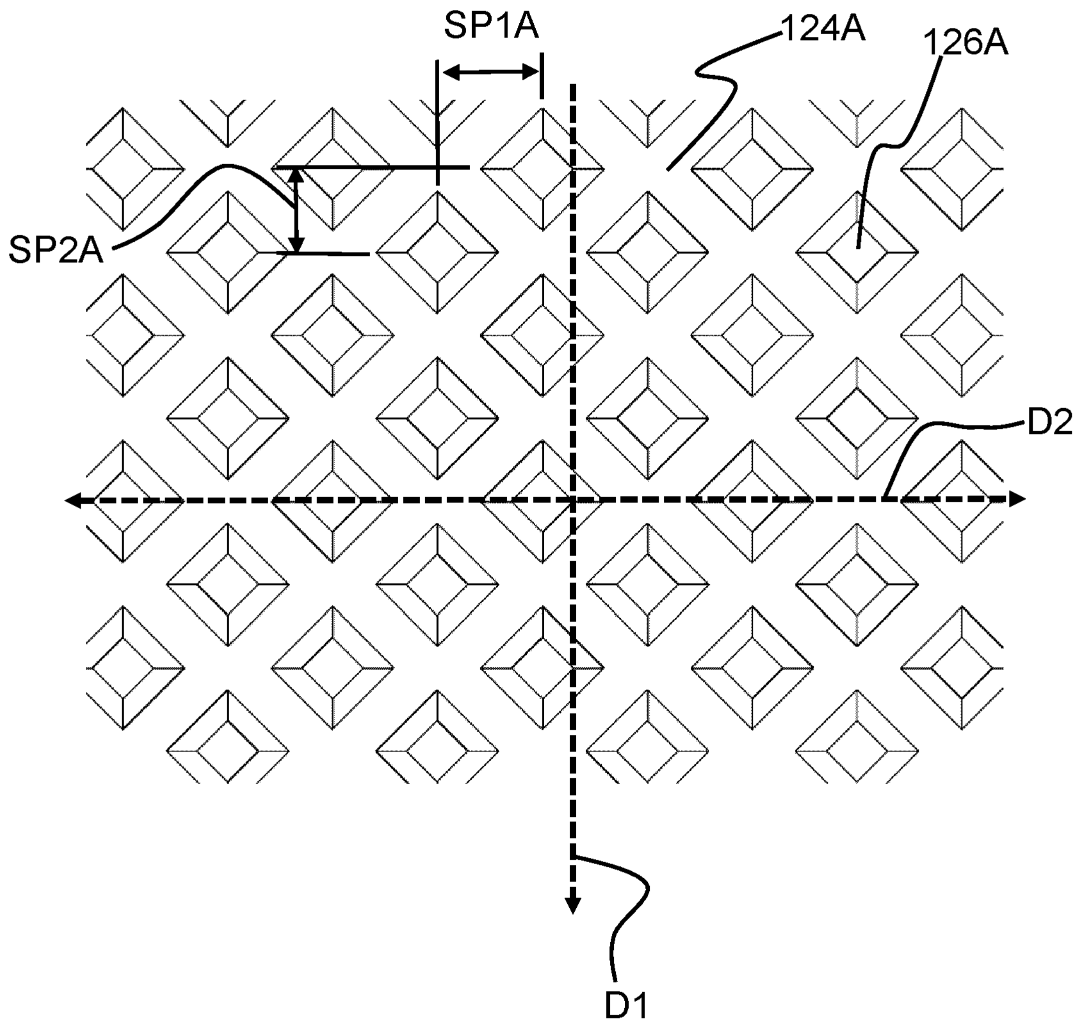

FIG.6

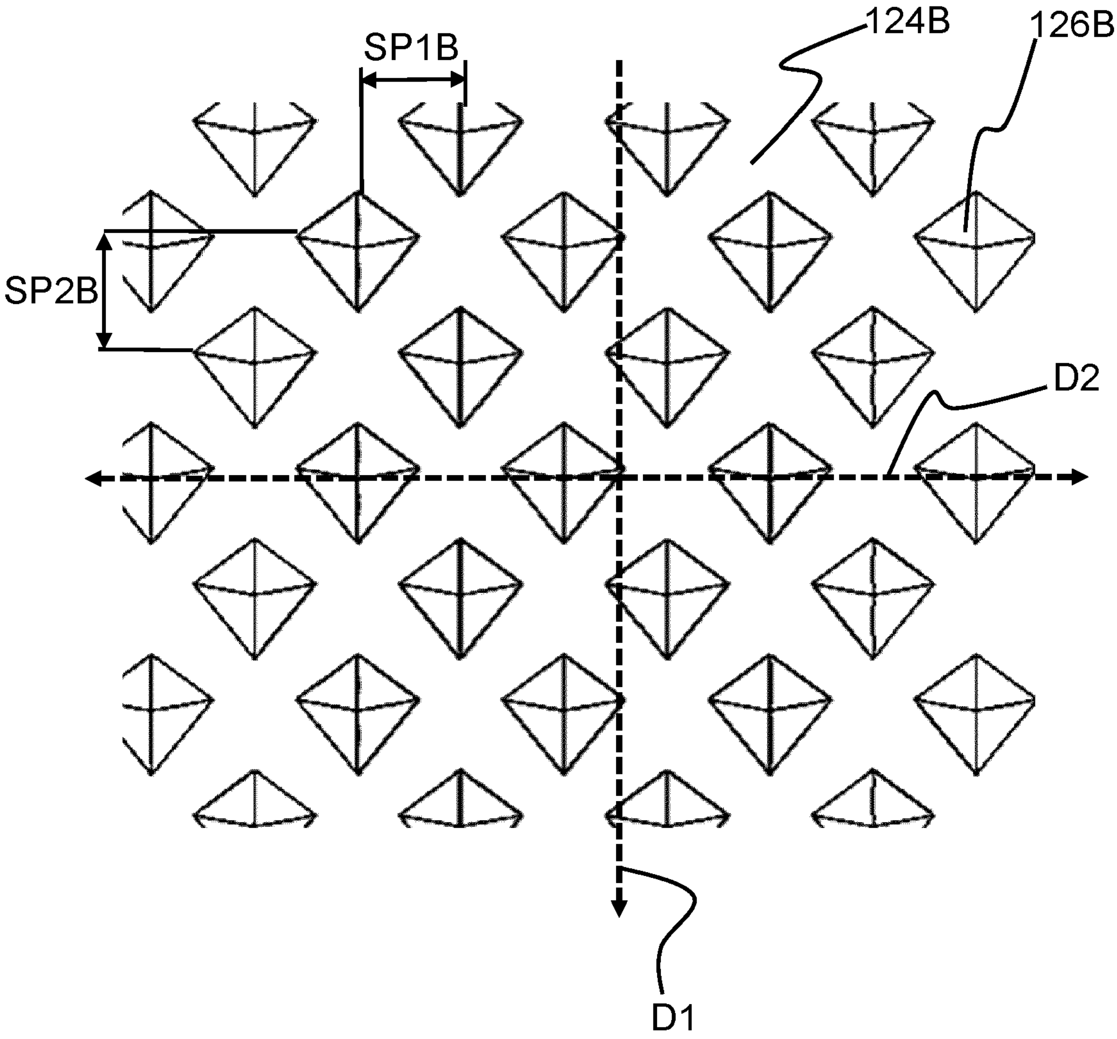

FIG.7

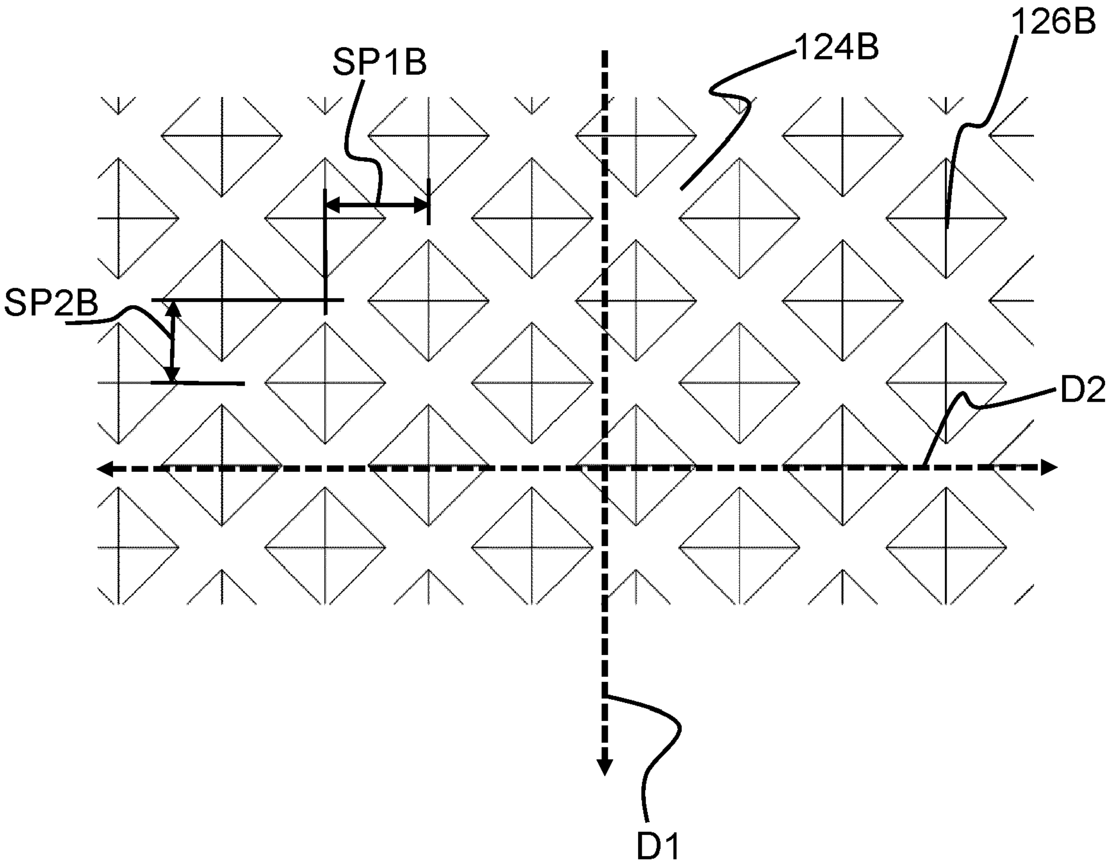

FIG.8

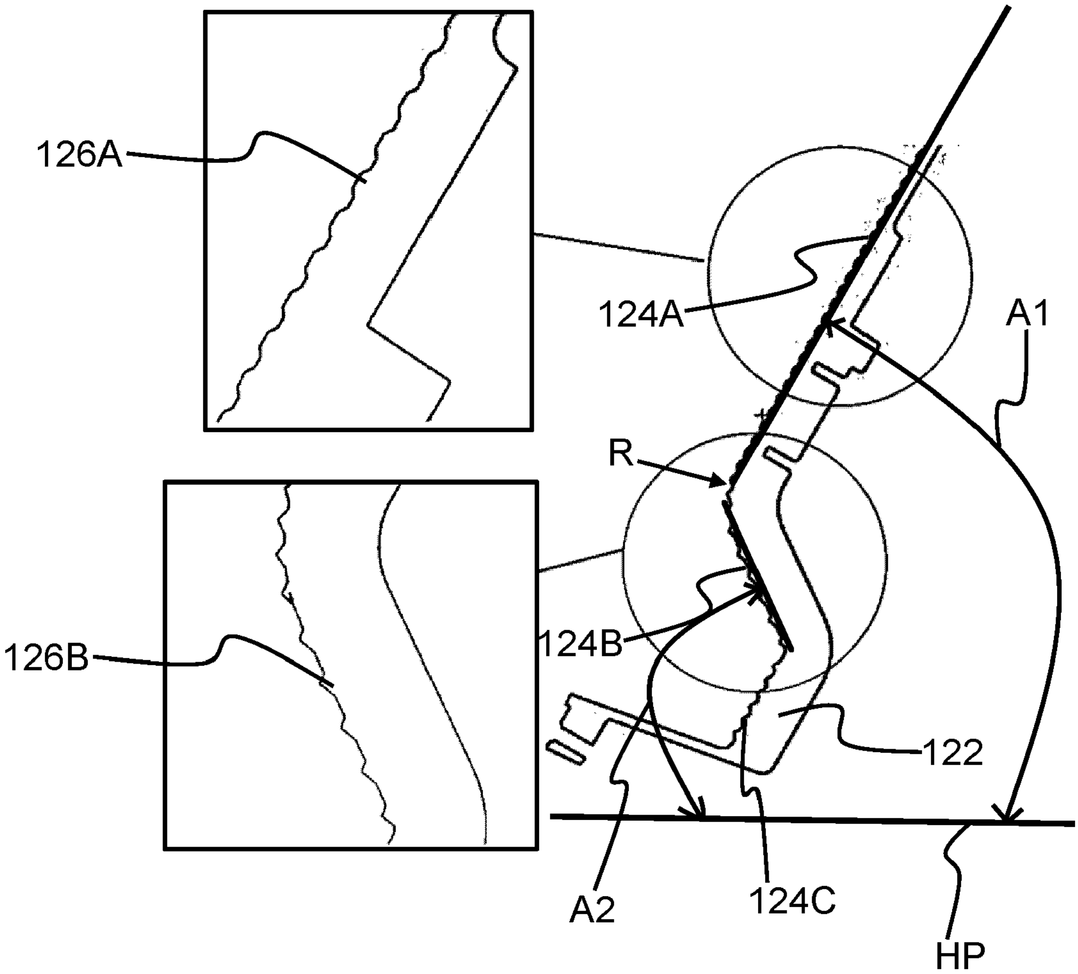

FIG.9

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EUROPEAN SEARCH REPORT

Application Number
EP 22 17 5354

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	21 November 2022	Röberg, Andreas

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