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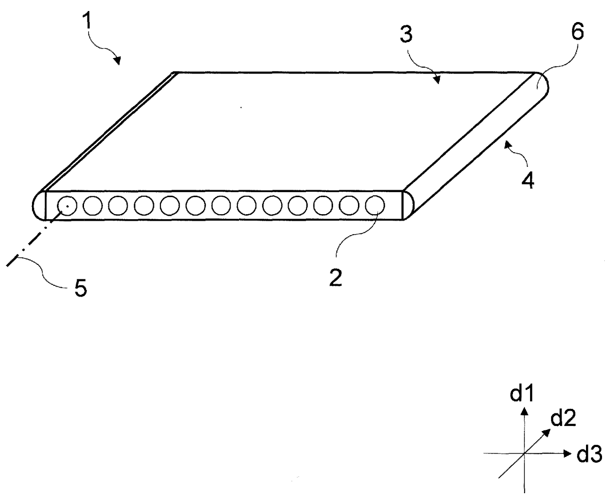
(54) LAYER PAD, USE OF A LAYER PAD, PACKAGE SYSTEM AND METHOD OF PRODUCING A LAYER PAD

(57) There is provided a layer pad (1) for covering a layer of articles forming a load, having a substantially plate-like shape. The layer pad (1) comprising: a first surface (3) and a second surface (4), wherein the first surface (3) is arranged opposite to the second surface (4), and at least one hollow channel (2) having a substantially circular cross section. The at least one hollow channel (2) is arranged between the first surface (3) and the second surface (4) and has a central axis (5) extending in an axial direction (d2).

Fig. 1



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Description

[0001] The present invention relates to a layer pad for covering a layer of articles forming a load, to a use of a layer pad, to a package system including such layer pad and to a method of producing the layer pad. More particularly, this invention relates to a layer pad for use on a layer forming a load.

[0002] Plastic-Layer-Pads (PLPs) in the following simply referred to as layer pads are used between layers of articles forming a load on pallets to hold the lower layer in place and to provide a base for the upper layer. The layer pads may be also referred to as slip sheets. Such pads are often made of corrugated panels having rectangular channels in the pad cross section. As a result, the pads may have appropriate physical properties while they have a low weight. During the life cycle of a pad, the pad goes through a number of different process steps. In more detail, the pads are shipped in palletized form. Subsequently, the pads are positioned between layers of articles and form a base for an upper layer of articles. For positioning and transporting of the pads, the pads may be grasped with suction lifting devices. During transport the layer pads alone or together with a load may be surrounded by a shrink-film which also applies loads onto the layer pads. After use, the layer pads may be washed and prepared to be ready for a further implementation.

[0003] Thus, a plurality of different loads may be applied to the pads. Hence, securing the rigidity of the pad during a use of the pad is an important issue.

[0004] Therefore, the present invention aims at providing a layer pad for covering a layer of articles forming a load having an increased rigidity and stiffness. In other words, the layer pad should have an increased resistance against deformation and a prolonged durability.

[0005] The present invention solves the problem with a layer pad having the features of claim 1, a use of said layer pad having the features of claim 13, a package system having the features of claim 14 and a method of producing the layer pad having the features of claim 15.

[0006] According to one aspect of the present invention, a layer pad for covering a layer of articles forming a load, having a substantially plate-like shape is provided, the layer pad comprising:

a first surface and a second surface, wherein the first surface is arranged opposite to the second surface, and
at least one hollow channel having a substantially circular cross section,
wherein the at least one hollow channel is arranged between the first surface and the second surface and has a central axis extending in an axial direction.

[0007] The layer of articles may be provided on a pallet. On top of said layer the layer pad may be provided so as to cover the layer of articles. Onto the layer pad another layer of articles may be provided. This may be repeated several times until a plurality of layers of articles are stacked on the pallet with one layer pad interposed between the layers. In other words, in a stacked condition, a layer of articles may be positioned on the first surface of the layer pad while the layer pad may be positioned with its second surface on another layer of articles. Therefore, the first surface may be referred to as a top surface of the layer pad and the second surface may be referred to as a bottom surface of the layer pad. Hereinafter, stacked layers of articles with layer pads in between will be referend to as a package system. Further, several package systems (e.g. four package systems) may be stacked on top of each other. Moreover, the layer pad may be also directly placed on top of a pallet such that articles are provided on top of the layer pad. Accordingly, the layer pad may be used as a separation means for separating the articles from the pallet for hygienic reasons, for example.

[0008] The layer pad may be a sheet like element for covering fragile articles like bottles or jars made of glass. Therefore, the layer pad may be configured such that even fragile articles may not be damaged by the layer pad if it is positioned onto the articles. Accordingly, the layer pad may have relatively low weight as compared to that of the layer of articles, for example. In order to achieve a low weight, the layer pad may be thin relative to its edge length. In other words, the layer pad may have a small thickness as compared to its edge length. In addition, the layer pad may have a plurality of substantially circular channels so as to reduce the weight of the layer pad. Accordingly, the weight of the layer pad may be approximately half the weight of a layer pad having the same dimension without the channels. In addition or alternatively, the layer pad may be made of resin or other lightweight materials.

[0009] Generally, the layer pad may have the effect of stabilizing the package system (i.e. the articles to be transported). While being transported and processed, the package system may be shaken and thus it is important to securely hold each of the articles in its position. In particular, the layer pad may have the effect of providing a base for the articles positioned on top of the layer pad (i.e. on the first surface). In addition, the layer pad may stabilize the articles on which it is positioned by being in contact with each article (i.e. the second surface). In particular, the layer pad may be configured so as to hold the articles by a frictional connection. Therefore, the layer pad may be flexible in order to provide contact with each article on which it is positioned even if the articles have slightly different dimensions (e.g. different heights). However, the flexibility of the layer pad may be dimensioned such that the layer pad provides a substantially flat base for the articles positioned on top of the layer pad.

[0010] The layer pad may be sized so as to have essentially the same outer contour as the pallet on which the articles are provided and which is used to transport the articles. The layer pad may have a rectangular shape such that the layer pad may have one edge longer than the other edge. Preferably, in a top view, the layer pad may have a size of 800 mm x 1000 mm (Euro-Size), 1000 mm x 1200 mm (industry size) or 1120 mm x 1420 mm (CAN size).

[0011] Hereinafter, the following definition of directions may be used:

thickness direction may be the direction from the first surface to the second surface,
axial direction may be the direction in which the central axis of the at least one substantially circular channel extends, preferably, the axial direction is perpendicular to the thickness direction, and
width direction may be a direction perpendicular to the axial direction and to the thickness direction.

[0012] The first surface may be positioned in a first plane and the second surface may be positioned in a second plane. The first plane and the second plane may intersect with each other. That is, the first surface and the second surface may be inclined with respect to each other. Accordingly, the layer pad may have a bigger thickness at one edge as compared to another edge of the layer pad. This provides the advantage that the layer pad may be in contact with the articles with its second surface even if the articles have different heights, while the first surface of the layer pad is oriented substantially flat with respect to the horizontal so as to provide a substantially flat base for a further layer of articles to be placed on top of the layer pad. The first plane and the second plane may form an angle between each other of between 0.1° to 30°. In this range, a further increase in resistance against deformation may be attained. In addition, the stackability of several layer pads onto each other may be still possible. Therefore, the field of application of the layer pad may be widened.

[0013] Alternatively, the first plane and the second plane may not intersect with each other. In this case the first surface and the second surface may be parallel to each other. It is to be noted that the first and the second surface may be considered as parallel to each other even if some fabrication tolerances exist (e.g. about 0.2 %). In this case a plurality of layer pads may be easily stackable onto each other independent of their orientation with respect to each other. Therefore, the transport of the layer pads may be facilitated.

[0014] The channel may extend throughout the whole layer pad such that the channel has openings at two opposite edges of the layer pad. In other words, the channel may extend through the whole layer pad. Accordingly, throughout the length of the layer pad, the same static properties may be attained. In addition, the production of the pad may be facilitated. Preferably, the openings of the channel or of the channels are closed so as to seal the interior of the at least one channel from the environment. In more detail, after manufacturing of the layer pad (e.g. after extrusion and cutting of the layer pad) the edges of the layer pad which have the openings may be heated so as to soften and/or partly melt the material of the layer pad in the edge region. However, all edges of the layer pad may be processed in this way. Then, the edge may be processed using a roller, for example, so as to close the openings. Accordingly, the openings of the at least one channel may be sealed. The material that may seal the openings of the channel or channels may form a rounded edge of the layer pad (also refer to the further details below). Accordingly, the rounded edge prevents dirt, water and other foreign substances from entering into the channel(s). Further, the rounded edge may protect the layer pad from being damaged by mechanical impacts at the relatively susceptible flanks (e.g. the edges having the openings of the channels(s)) of the layer pad. Moreover, the rounded edge may protect a shrink film or a hose which may surround the package system from being damaged by sharp portions (e.g. due to the cutting process of the layer pad). That is, the rounded edge may be formed as a smooth connection between the first surface and the second surface.

[0015] In addition, the channel or the central axis of the channel may extend parallel to the longest edge of the layer pad. As a result, an excessive deformation of the layer pad transverse to the longest edge of the layer pad may be prevented and the resistance against deformation perpendicular to the axial direction may be increased. This is particularly advantageous in cases where the articles have the same dimensions and weights. Moreover, the channel or the central axis of the channel may extend parallel to the shortest edge of the layer pad. Alternatively, the at least one channel may extend inclined with respect to the longest edge of the layer pad. This may be realized by cutting the layer pad accordingly. Further, the channel within the pad may be appropriately adjusted to different weights and/or sizes of articles to be placed on the layer pad. Therefore, a stable package system may be provided even if one layer of articles is provided with different articles (e.g. having a different shape and/or weight). Alternatively, the channel or the central axis of the channel may extend parallel to the shortest edge of the layer pad. In this case, the resistance of the layer pad may be sufficiently ensured in case the layer pad has a smaller surface area.

[0016] The at least one channel may have the shape of a tube having a substantially circular cross section, extending through the pad. Due to the at least one substantially circular channel the push through resistance of the pad may be significantly increased. In particular, the rounded contour or cross section of the at least one channel provides an increased resistance against a damage of the layer pad (e.g. due to a deformation of the layer pad transverse to the axial direction). Typical loads applied to the layer pad may be due to the weight of articles placed on top the layer pad and/or if the layer pad is lifted using a suction device. In addition, load may be applied onto the layer pad by a shrinking film attached to the package system. Moreover, a load may be applied to the layer pad by articles of the layer of articles on which the layer pad is placed (e.g. tip ends of open bottles). In other words, the pad having at least one circular channel may exhibit an increased robustness against deformation as compared to a layer pad having rectangular channels, for example.

[0017] Especially, by providing the at least one circular channel, imprints or deformations in the layer pad caused by articles may be reduced. Moreover, it was found that dentations of the layer pad may be reduced while the weight of the layer pad is kept low. In more detail, it was found that the layer pad having at least one circular channel have an approximately 15% higher "push-through resistance" as compared to known layer pads. That is, the layer pad may be improved so as to exhibit an increased robustness while the grammage of the layer pad may be kept constant.

[0018] In the present case, the substantially circular channel also includes a sectional shape of the channel that is not strict circular, but has an oval shape, for example. In other words, the substantially circular channel may have a cross sectional shape that is other than polygonal (e.g. other than rectangular). The polygonal shaped cross section may be formed by straight lines. In other words, the cross-sectional shape of the substantially circular channel may be at least partly round (e.g. round may be defined by not having any corners). For example, at least 50 % of the circumference of cross section of the substantially circular channel may be formed circular (i.e. round). The rounded portion or portions of the substantially circular channel provides a high push through resistance.

[0019] The substantially circular channel may have at least one flattened portion (e.g. straight portion). Preferably, the circular channel may have two flattened portions. That is, the top section and/or the bottom section of a circular channel in the cross section orthogonal to the axial axis may be cut off so as to form the flattened portions. In other words, part of the cross-sectional shape of the channel may be parallel to the first surface and/or to the second surface. Accordingly, the layer pad may be provided with substantially circular channels while the grammage of the layer pad may be kept low.

[0020] In a cross section orthogonal to the axial axis, the substantially circular channel may have a plurality of radii (i.e. distances from the contour of the channel to its center, in particular to its barycenter). That is, the cross section of the substantially circular channel may have n radii, wherein n is a positive integer. In addition, the n radii may be evenly distributed over cross section of the substantially circular channel (i.e. may be spaced from each other by the same angular distance). Preferably, at least eight radii may be provided. Further, none of the n radii deviates from the mean value of all radii by more than 0.5 mm. This provides the effect that the production of the layer pad may be realized in a simplified manner so as to reduce costs. Nevertheless, the above-described robustness against deformation is still provided. Preferably, none of the n radii deviates from the mean value of all radii by more than 0.3 mm. Accordingly, an improved resistance against deformation transverse to the axial direction may be provided. Most preferably, none of the n radii deviates from the mean value of all radii by more than 0.2 mm. In this case, the highest push-through resistance may be attained, while the layer pad may be efficiently manufactured. Thus, the durability of the layer pad may be prolonged. The axial axis may be the central axis of each channel. In other words, the axial axis may extend through the barycenter of each cross section of the channel. According to an embodiment of the present invention, the at least one substantially circular channel may have a cross sectional shape that is circular. In this case a high resilience may be attained.

[0021] Further, the substantially circular channel may be symmetrically to the thickness direction and/or the width direction. Thus, the same mechanical properties of the pad may be obtained regardless of the orientation of the layer pad during use.

[0022] For example, the cross section of the substantially circular channel may have eight radii being separated from each other by an angle of 45° (i.e. evenly distributed over the cross section). Further, none of the different radii deviates from the mean value of all radii by more than 0.3 mm. In this case it was found that the ductility of the layer pad is in an optimal range such that the pad may withstand even high concentrated loads without dentation. As a result, the durability of the layer pad may be prolonged.

[0023] Moreover, the layer pad may have a plurality of substantially circular channels arranged so as to be substantially parallel to each other. Further, the channels may be evenly distributed over a cross section of the layer pad perpendicular to the central axis of the channels. Alternatively, the channels may be arranged in a plurality of sets of channels. That is, the channels constituting a set may have the same distance from each other. Each set of channels may be evenly distributed over the cross-section perpendicular to the axial direction of the channels. That is, between each set the distance may be larger than between the channels constituting a set of channels. This provides the effect that in marginal areas, for example, the density of channels may be increased so as to avoid a deformation in said areas. As a result, the layer pad may be adapted to specific requirements while the manufacturing of the pad may be simplified.

[0024] In addition, at least two channels may be arranged in the thickness direction of the layer pad so as to from a layer pad having at least two rows of channels one upon the other in the thickness direction. Hence, the rigidity of the layer pad may be further increased. Accordingly, a layer pad may be provided that is configured to be used for high weight articles.

[0025] Preferably the layer pad is made of a thermoplastic material, preferably of Polypropylene.

[0026] The thermoplastic material (also referred to as thermosoftening plastic) may be a plastic polymer material that becomes pliable or moldable at a certain elevated temperature and solidifies upon cooling. The thermoplastic material may have a high molecular weight. The polymer chains associate by intermolecular forces, which weaken rapidly with increased temperature, yielding a viscous liquid. In this state, the thermoplastic material may be reshaped and are typically used to produce parts by various polymer processing techniques such as injection molding, compression molding, calendering, and extrusion. The thermoplastic material may differ from thermosetting polymers (or "thermosets"), which form irreversible chemical bonds during the curing process. Thermosets do not melt when heated, but typically decompose and do not reform upon cooling. Further, there may be added additives to the material of the layer pad so as to reduce the weight of the pad while at the same time the material properties may be maintained.

[0027] The layer pad may be made of a material that is physiologically harmless and biologically inert. As a result, the layer pad may be also used in the food industry. Further, the material may have an E-module of between 1300 to 1800 N/mm^2. It was found that in the above range of the E-module, the shape of the substantially circular channel provides the highest resistance against deformation transverse to the axial axis. In addition or alternatively, the material may have a density of between 0.7 g/cm^3 to 1.1 g/cm^3, preferably 0.85 g/cm^3 to 0.95 g/cm^3. This range of density provides a good resistance against deformation of the layer pad along the axial direction while at the same time a low grammage of the layer pad is secured. As outlined above, the low grammage is preferred in order to avoid damages of fragile articles covered by the layer pad. For example, the layer pad may have a coating in order to provide physiologically harmless and biologically inert properties. The coating may comprise nanoparticles. Further, any coating may be used that provides physiologically harmless and biologically inert properties. Preferably, the friction between the layer pad and the articles is not significantly reduced.

[0028] In a preferred embodiment of the invention, the ratio of a thickness of the layer pad in a thickness direction from the first surface to the second surface and a length of the longest edge of the layer pad is less than 1/100, preferably less than 1/200, most preferably less than 3,6/1000.

[0029] The ratio of less than 1/100 provides the advantage that the layer pad may be light enough (i.e. may have a corresponding grammage) so as to not damage susceptible or fragile articles while at the same time all articles positioned on a standardized pallet may be covered by the layer pad so as to hold them in place. The ratio of less than 1/200 provides the advantage that the layer pad is thin relative to its extension in the axial direction and/or in the width direction such that only very less transporting space is occupied by the layer pad while at the same time the resistance against deformation of the layer pad is kept high. In other words, a rigidity of the layer pad is provided such that the layer pad is not excessively bended during processing thereof. Accordingly, the layer pad may be easily manageable by a suction device, for example. In the prior art there are no layer pads known that are relatively thin (i.e. as defined by the present ratio) and that have a substantially circular channel. This may be due to manufacturing limits in known manufacturing processes. In particular, there may be no moulds available for an extrusion process that may manufacture such thin layer pads having substantially circular channel(s). The ratio of less than 3,6/1000 provides the effect that stiffness of the layer pad is optimal for a transport of bottles and jars made of glass. That is, the layer pad having the above ratio, has both a sufficient rigidity so as to provide a good base for the layer of articles to be placed thereon and a low weight so as to not damage the articles on which the layer pad is provided. In addition, the deformation of the pad is reduced such that a handling of the layer pad with suction devices, for example, is readily possible.

[0030] Preferably, the layer pad has a substantially rectangular shape in a plan view, preferably with rounded corners.

[0031] As mentioned above, the layer pad may be sized so as to have essentially the same outer contour dimensions as the pallet (e.g. standardized EP pallets) on which the articles are provided. Accordingly, the layer pad may be used together with the common conveying devices, fork lifters and other commonly used processing machinery. Preferably, in a top view, the layer pad may have a size (i.e. the outer contour) of 800 mm x 1000 mm (Euro-Size), 1000 mm x 1200 mm (industry size) or 1120 mm x 1420 mm (CAN size). The rounded corners may provide a compatibility with automatic conveying systems so as to be smoothly transportable therewith. Further, the rounded corners may correspond to the outer contours of rounded articles that may be positioned on and below the layer pad. In addition, damages of the layer pad may be avoided by the rounded corners as sharp corners are prone to be damaged. Moreover, the bending of the layer pad especially in the corner regions may be reduced by the rounded corners. For example, the bending of the corners due to applying a shrink film to the layer pad may be significantly reduced the rounded corners. In some embodiments, the lay pad is thinner than 10 mm, preferably thinner than 5 mm and most preferably about 3,6 mm thick. The small thickness provides an advantageous packing size of the layer pad and of the stack of articles. In addition, the desired properties are attained by the at least one circular channel (refer to the above outlined).

[0032] Preferably, a plurality of substantially circular channels is provided, and wherein the substantially circular channels are evenly distributed within the layer pad or the substantially circular channels are irregularly distributed within the layer pad.

[0033] Evenly distributed, in this context, may mean that the axial axes of adjacent channels have the same distance to each other in the cross section orthogonal to the axial axes (e.g. in the width direction). As a result, a homogeneous rigidity of the layer pad may be attained. In particular, this is advantageously if articles are transported having a similar weight so as to apply a homogenous load onto the layer pad.

[0034] In an alternative embodiment, the substantially circular channels are irregularly distributed in the cross section orthogonal to the axial axes (e.g. in the width direction). For example, there may be provided some channels in the marginal regions of the layer pad, wherein in the center region of the layer pad none or only 1 or 2 channels is/are provided. This provides the advantage that the layer pad may have an increase rigidity in the marginal regions where the deformation is normally likely to occur. As a result, this deformation may be reduced or even prevented by selectively providing the circular channels in regions of the layer pad known to be prone to deformations.

[0035] Preferably, the layer pad comprises at least one substantially circular-channel section having the at least one substantially circular channel and at least one non-circular-channel section having at least one channel having a polygonal cross section other than circular.

[0036] In other words, the layer pad may have channels with different shapes in a cross-section perpendicular to the axial direction (e.g. in the width direction of the layer pad). For example, the substantially circular shaped channels are providing an increased rigidity of the layer pad, wherein the polygonal channels are providing a light-weight layer pad. By combining them, an optimal balance of a reduced weight and an increased rigidity of the layer pad may be attained. For example, a plurality of polygonal channels may be provided within the non-circular-channel section. Similarly, a plurality of substantially circular channels may be provided within the substantially circular-channel section. Within the respective section, the substantially circular or the polygonal channels may be evenly distributed. By providing several sections having different shaped channels, the layer pad may be further optimized with respect to rigidity and weight. That is, in sections of the layer pad that are prone to deformations, the circular channel region may be provided, while in sections of the layer pad where deformation is not such big issue, the non-circular-channel section may be provided to save weight.

[0037] Preferably, the at least one channel of the non-circular-channel section has a rectangular or a trapezoidal cross section.

[0038] The rectangular shaped channel may be easily manufactured. The rectangular or a trapezoidal cross section are examples for polygonal cross sections. Further, polygonal cross sections may further comprise triangular, hexagonal and octagonal cross sections. Thus, the cost of production of the layer pad may be reduced because the die for extruding such layer pads may be easily manufactured e.g. by cutting. On the other hand, the trapezoidal cross section may provide an increased stability of the layer pad as compared to the rectangular shaped channel. Further, a combination of rectangular shaped channels and trapezoidal shaped channels may be provided so as to optimally adapt the layer pad the requirements posed by the specific articles to be transported.

[0039] Preferably, the layer pad has the non-circular-channel section and two substantially circular-channel sections, and wherein the substantially circular-channel sections and the non-circular-channel section are arranged adjacent to each other so as to sandwich the non-circular-channel section between the substantially circular-channel sections.

[0040] That is, in a cross section orthogonal to the axial direction (e.g. the width direction of the layer pad), the non-circular-channel section may be arranged in the middle of the layer pad, whereas the substantially circular-channel sections may be arranged at the outer edges of the layer pad (i.e. marginal regions of the layer pad), respectively. As a result, the deformation of the layer pad may be specifically reduced in the marginal regions of the layer pad. Hence, an increased stability for the articles supported by the layer pad may be provided. Preferably, each of the circular channel section and the non-circular channel section have the same extension within the cross-section perpendicular to the axial axis. That is, each of the sections may extend 1/3 of the length of the shorter edge of the layer pad. It was found that this distribution of sections with substantially circular channels and sections with polygonal channels provides a layer pad having the optimal balance between rigidity and weight.

[0041] Preferably, a ratio of the mean diameter of the substantially circular channel and to the thickness of the layer pad in the thickness direction from the first surface to the second surface is between 0.2 to 0.9, preferably between 0.4 to 0.9, most preferably between 0.6 to 0.9.

[0042] The range between 0.2 to 0.9 provides the effect that the layer pad may be easily manufactured, while it has a sufficiently high resistant against deformation due to concentrated loads, for example. The range between 0.4 to 0.9 provides the effect that the layer pad may be used to transport relatively heavy loads on top of the layer pad (e.g. articles made of glass). In addition, the layer pad has a relatively low weight while being still resistant against deformation. As a result, the layer pad is readily manageable during the whole process and sufficiently protects the articles from being damaged. The range between 0.6 to 0.9 provides the above described higher "push-through resistance" as compared to known layer pads.

[0043] Preferably, the edges of the layer pad are at least partly rounded. That is, the connection at at least one edge of the layer pad between the first surface and the second surface may be formed in an arc shape. Preferably, two rounded edges are provided, one at each edge having the shorter length as compared to the other two edges of the layer pad. In another embodiment, rounded edges are provided at each edge of the layer pad. As a result, the layer pad may be advantageously transported on a roller conveyor belt (e.g. during the washing process) because the rounded edge of the layer pad runs smoothly from one roll to the other. In particular, the rounded edge may be directly and smoothly connected to the first surface and to the second surface. Preferably, the rounded edges may be defined by a radius r_{edge}, wherein a ratio between the radius r_{edge} and the length of the shortest edge length of the layer pad is less than

1/160. In this case an especially smooth transfer of the layer pad from one roll to the next of a roller conveyer may be realized. Preferably, the ratio is less than 2,5/800. In this case, the layer pad may be advantageously transported on a roller conveyer even if the conveyer is inclined upwards. Hence, the field of application of the layer pad is increased because it may be smoothly used in automated conveying systems which overcome a difference in height. Most preferably, the ratio is less than 1,8/800. It has been found that the latter ratio provides a further increase in rigidity of the layer pad in the marginal regions where the rounded edge is provided. Thus, the deformation of the layer pad may be further reduced. Moreover, the rounded edges may be provided at the two edges of the layer pad having the shorter length as compared to the other two edges of the layer pad. This may further facilitate the production of the layer pad. However, the rounded edges may be provided at all edges of the layer pad. Accordingly, the same properties may be attained at all edges. The layer pad may have a constant thickness throughout the layer pad.

[0044] Preferably, the layer pad is an integral member, wherein the layer pad is formed as an extruded element.

[0045] In other words, the layer pad is not composed of several parts, but may be created in one piece by an extrusion process. Accordingly, there is no further assembling or processing necessary to manufacture the layer pad. Further, the production may be accelerated. Hence, production costs may be reduced. Further, since it is not necessary to assemble the layer pad of several parts, there is no connection point between the single parts and thus no weak spot which may limit the durability of the layer pad. As a result, the layer pad may have an increased robustness and a prolonged live cycle. A further characteristic of an extruded element or product is that the surface is forms continuously and smoothly without any wrapping or unevenness. On the other hand, a product created by injection molding, for example, always has an injection duct which may affect the surface quality of the molded product.

[0046] Preferably, the layer pad has a grammage between 500 g/m^2 to 2500 g/m^2, preferably between 800 g/m^2 to 2200 g/m^2, most preferably between 1000 g/m^2 to 1500 g/m^2.

[0047] The range between 500 g/m^2 to 2500 g/m^2 provides the effect that the layer pad may be easily manageable and advantageously graspable by a suction device. That is, in the above range the layer pad may have the appropriate rigidity so as to be manageable by an automated system (for example to be graspable, separable from other layer pads and/or transported in an automated conveying system). The range between 800 g/m^2 to 2200 g/m^2 provides the effect that even fragile articles may be covered by the layer pad without being damaged. In other words, the tension (i.e. force per area) applied onto the articles covered by the layer pad may be significantly reduced as compared to known layer pads. The range of 1000 g/m^2 to 1500 g/m^2 provides the effect that an optimal ductility of the layer pad is achieved. In addition, in this range an optimal balance between a robust layer pad and light weight is achieved that has a long durability. Independent of the above, a grammage of a layer pad smaller than 1500 g/m^2 is advantageous because in this case the transportation costs per volume layer pad can be kept low.

[0048] Preferably, the substantially circular channels are arranged such that, in a cross section of the layer pad perpendicular to the axial direction, the thinnest material thickness between two adjacent substantially circular channels is the same as the minimal material thickness between the substantially circular channel and the first surface and/or the second surface in the thickness direction of the layer pad.

[0049] The provision of similar minimal material thicknesses provides the effect that the layer pad may be homogeneously produced. This is particularly true in the case the layer pad is an extruded product. That is, the molten material may be smoothly and uniformly guided through the extrusion die to each part of the layer pad. Thus, the resulting layer pad has a homogeneous molecular structure. As a result, the layer pad has an improved resistance against deformation. Moreover, the cooling process after the extrusion process may be realized very uniformly in particular if the layer pad has a symmetrical cross section. This results in less internal tensions within the layer pad which results in turn in an improved resistance of the layer pad against deformations.

[0050] According to a further aspect of the present invention a package system is provided, comprising;

at least two layers of articles forming a load, and
at least one above-described layer pad,
wherein one layer pad is positioned between the layers of articles.

[0051] As described above the, package system may comprise a plurality of layers and thus a plurality of layer pads interposed between two layers of articles. Due to the above-described effects and advantages of the layer pad, the same holds true for the package system. The package system may be wrapped with shrinking foil which may additionally apply a load to the layer pad. However, since the inventive layer pad has an increased resistance against deformation, the layer pad is less prone to be deformed by wrapping the package system with shrinking foil. In addition, since the preferred low thickness of the layer pad, the package system may have a reduce height as compared to package system having known layer pads as an intermediate layer. Thus, less space is required to transport and/or store the inventive package system.

[0052] According to a still further aspect of the present invention a method of producing an above-described layer pad is provided, wherein the method comprises the following step:

extrusion of a thermoplastic material so as to attain the above-described layer pad.

[0053] The extrusion process may be carried out by using an extrusion mold (also referred to as extrusion die). The method may further include a supplying step of supplying molten material (e.g. PP) to the extrusion mould. The extrusion mold may include a cavity through which the molten material may be guided. Within the cavity, a vane may be provided which may at least partly be surrounded by the molten material. The vane may include at least one finger at a downstream side of the vane, responsible for creating the at least one substantially circular channel. Downstream may be determined with respect to the flow direction of the molten material. In addition, the at least one finger may include a port for introducing pressurized air into the created channel. Pressurized air may be air having a pressure above the ambient air pressure. Accordingly, it may be prevented that the channel collapses after being created by the finger. Subsequently, the formed material (i.e. provided with channels) leaves the extrusion mold through a die gap. The inner width of die gap and the feed of the extrusion machine may define the resulting thickness of the layer pad. Further, the inner width of the die gap may be adjustable. Therefore, the extrusion mold may be used to produce a plurality of different layer pads. The fingers of the vane may have a cross section corresponding to the desired shape of the at least one channel within the layer pad. By selecting different fingers (having different cross sections, for example) and positioning them at specific positions at the vane, the shape, position and the distribution of the channels in the resulting layer pad may be determined.

[0054] In addition, the method may comprise a step of cutting the layer pad such that the layer pad has the desired dimensions (e.g. the above defined dimensions). Further, the method may comprise a step of sealing the openings of the at least one channel. Accordingly, at least the edges of the layer pad having the openings of the at least one channel may be heated such that the material of the layer pad (e.g. a thermoplastic material) melts in the edge region such that the material is easily deformable. Further, rollers may be used to deform the molten material of the layer pad so as to seal the openings of the at least one channel.

[0055] Moreover, the present invention is also directed to a use of a above layer pad in transporting of articles, wherein the layer pad is disposed between two layers of articles, preferably empty bottles and/or jars. Accordingly, the layer pad may be used as an intermediate layer between two layers of articles such that one layer is covered by the layer pad and the other layer stands on the layer pad. It was found that the use of the above layer pad is particularly advantageously together with articles having a small area of support (e.g. like open bottles) on which the layer pad may be placed because the layer pad may withstand high loads applied to a relatively small surface without being excessively deformed or damaged in the contact area.

[0056] The features and advantages of the devices are also applicable to the method and vice versa. Single features and aspect of one of the above-described embodiments may be combined with other features and aspect of other embodiments. The resulting embodiment may have the same effects and advantages as provided in connection with the features thereof.

Fig. 1 is a schematic perspective view of a layer pad according to an embodiment of the present invention.

Fig.2 is a schematic perspective view of a layer pad according to an embodiment of the present invention.

Fig. 3 is a schematic perspective view of a layer pad according to an embodiment of the present invention.

Fig. 4 is a schematic perspective view of a layer pad according to an embodiment of the present invention.

Fig. 5 is a schematic perspective view of an embodiment according to the present invention.

Fig. 6 is a sectional view of a part of the layer pad according to an embodiment of the present invention.

Fig. 7 is a sectional view of a part of the layer pad according to the embodiment of the present invention.

Fig. 8 is a sectional view of a part of the layer pad according to the embodiment of the present invention.

Fig. 9 is a sectional view of a part of the layer pad according to an embodiment of the present invention.

[0057] **Fig. 1** shows a layer pad 1 according to an embodiment of the present invention. Fig. 1 is a schematical and perspective view seen from slightly above the layer pad 1. In addition, in figures 1 to 5 a part of the layer pad 1 is cut away so as to see the cross section of the layer pad 1. The layer pad 1 has a plurality of substantially circular channels 2 arranged within the layer pad 1 between a first surface 3 and a second surface 4 of the layer pad 1. Further, the layer pad 1 has a rectangular shape in a plane view. The edges of the layer pad 1 are formed as rounded edges 6. Accordingly, the layer pad may be easily transferred by an automatic conveying mechanism (i.e., by a roller conveying device). In addition, the stiffness or rigidity of the layer pad 1 is improved by providing the rounded edges 6. Further, the rounded edges seal the channels from the environment so as to prevent foreign substances and water from entering into the channels 2. In addition, the substantially circular channels 2 also provide an increase of resistance of the layer pad 1 against pushing through. In addition, the layer pad 1 has an increased resistance against deformation due to loads applied to the layer pad 1. Each channel 2 has a centreline 5 extending in an axial direction d2. In the figures, only one centreline 5 is depicted for simplification. Each channel 2 has its own centreline 5. In more detail, the centreline 5 may extend through the barycentre of each cross-section of each channel 2. Further, a width direction d3 is defined which is perpendicular to the thickness direction d1 and the axial direction d2. In the present embodiment, the first surface 3 and the second surface 4 are substantially parallel to each other and the central axes 5 of each channel 2 are also parallel to the first surface 3 and to the second surface 4.

[0058] The layer pad 1 of the present invention may be used as a layer sheet for being provided between layers of articles (e.g., empty bottles or jars). In more detail, articles may be provided on pallets in a stacked manner. In order to improve the stability of such stacked articles, between each layer of articles the layer pad 1 according to embodiments of the present invention may be provided. Accordingly, the layer of articles on which the layer pad 1 is provided may be stabilized by being covered by the layer pad 1. In addition, the layer of articles, which is provided on top of the layer pad 1, could be stabilized because this layer of articles has a substantially flat plane as a base.

[0059] In a further embodiment, not depicted in the figures, the layer pad 1 does not have the rounded corners 6. That is, the layer pad 1 has polygonal edges. Accordingly, the manufacturing of the layer pad 1 may be simplified.

[0060] **Fig. 2** shows a schematical and perspective view of a layer pad 1 according to a further embodiment of the present invention. The present embodiment differs from the embodiment depicted in Fig. 1 in that the substantially circular channels 2 are not evenly distributed over the cross-section defined by the thickness direction d1 and the width direction d3, but are irregularly distributed in said cross section. In more detail, sets of several circular channels 2 (in the present embodiment three) are provided, wherein the sets of channels are evenly distributed over the cross-section of the layer pad 1. In more detail, the distance between each set of circular channels 2 is larger than the distance between each circular channel 2 within one set. Therefore, the rigidity of the layer pad may be adapted to the requirements posed by specific articles to be transported.

[0061] **Fig. 3** is a schematical and perspective view of the layer pad 1 according to a further embodiment of the present invention. The layer pad 1 of the present embodiment differs from the before-described layer pad 1 in that a substantially circular-channel section 10 and a non-circular-channel section 11 are provided. In more detail, each section defines a part of the cross-section of the layer pad 1. Within the substantially circular-channel section 10, three substantially circular channels 2 are provided. On the other hand, within the non-circular-channel section 11, three rectangular channels 7 are provided. In the present embodiment, the non-circular-channel section 11 is sandwiched by two substantially circular-channel sections 10.

[0062] **Fig. 4** shows a schematical and perspective view of a layer pad 1 according to a further embodiment of the present invention. The layer pad 1 of the present embodiment differs from the before-described embodiments in that the non-circular-channel section 11 includes channels 8 having a polygonal cross-section (i.e. the channels 8 have a hexagonal cross-sectional shape, respectively). Further, in the present embodiment, there are two non-circular-channel sections 11 and one substantially circular-channel section 10 provided. The substantially circular-channel section 10 is sandwiched by the non-circular-channel sections 11. Moreover, the substantially circular-channel section 10 includes seven circular channels 2.

[0063] **Fig. 5** is a schematical and perspective view of a layer pad 1 according to a further embodiment of the present invention. In the present embodiment, there are three substantially circular-channel sections 10 and two non-circular-channel sections 11 provided. In addition, two of the three substantially circular-channel sections 10 include three substantially circular channels 2, and one substantially circular-channel section 10 includes one substantially circular channel 2. The sections are arranged from the outer edge of the layer pad 1 in the following order: substantially circular-channel section 10, non-circular-channel section 11, substantially circular-channel section 10 having one substantially circular channel, non-circular-channel section 11 and substantially circular-channel section 10 having three substantially circular channels 2.

[0064] **Fig. 6** is a sectional view showing a part of the cross-section in the thickness direction d1 and the width direction d3 direction. In Fig. 6, substantially circular channels 2 are depicted, however, the following definitions are also applicable to other shapes of the channel. In one embodiments of the present invention, the thickness t of the layer pad 1 in a thickness direction d1 is defined in relation to the longest edge of the layer pad 1. That is, this ratio is preferably less than 1/100 which provides an advantageously grammage of the layer pad 1 such that the articles covered by the layer pad 1 are not damaged. In a further embodiment of the present invention, that ratio is less than 1/200 which provides the advantage that the layer pad is thin relative to its extension and occupies thus only very few transporting space which makes the transport as a whole more efficient. In a still further embodiment of the present invention, that ratio is less than 3.6/1000 which provides a layer pad 1 which has an increase resistance against deformation and a high push through resistance. As can be seen in Fig. 5, the thickness of the layer pad 1 is measured from the first surface 3 to the second surface 4. In particular, the thickness is measured orthogonal to one of the first or second surfaces.

[0065] Moreover, in some embodiments a ratio of a mean diameter d of the substantially circular channel 2 with respect to the thickness t of the layer pad 1 in the thickness direction d1 is between 0.2 to 0.9. If the circular channel 2 is not strict circular, the mean diameter d means a mean value of a plurality of different diameters of the substantially circular channel 2. That is, the more diameters are used to determine the mean value of a diameter, the more accurate the determent value is, however, for efficiency reasons it is appropriate to use four different diameters to determine the mean diameter. Thereby, the used diameters should be evenly distributed over the substantially circular shape of the channel 2. In some further embodiments of the present invention, that ratio is between 0.4 to 0.9. In a preferred embodiment, the ratio is about 0.72 in this case the push through resistance of the layer pad 1 may be maximized.

[0066] In addition, in some embodiments of the present invention the substantially circular channels 2 are arranged such that, in a cross-section of the layer pad 1 defined by the width direction d3 and the thickness direction d2, the thinnest material thickness a2 between two adjacent substantially circular channels 2 or between other channels is the same as the minimal material thickness a1 between the channel and the first surface 3 and/or the second surface 4 in the thickness direction d1 of the layer pad 1. As can be seen in Fig. 5, the distances a1 and a2 are measured so as to determine the thinnest material thickness between both the circumferences of two adjacent channels and the circumferences of a channel and the first surface 3 or the second surface 4. In addition, in some embodiments, the distance between the channels and the first surface 3 may be the same distance as between the channels and the second surface 4.

[0067] **Fig. 7** shows a part of the layer pad 1 in a sectional view. In more detail, the rounded edge 6 will be further defined using the present figure. The rounded edge 6 may be shaped as a part of a circle. A ratio is defined dependent of the radius r_{edge} and the length of the shortest edge length of the layer pad 1. That is, a ratio between the radius r_{edge} and the length of the shortest edge length of the layer pad 1 is less than 1/160. It is to be noted that the rounded edge 6 smoothly connects the first surface 3 with the second surface 4. That is, there is no step or other contour between the first and second surfaces and the rounded edge 6. The above-defined ratio provides the advantage that the layer pad 1 can be smoothly transferred on a roller conveyer, because the radius of the rounded edge 6 in connection with the dimension of the layer pad (i.e., the shortest edge length of the layer pad 1) is in an optimal ratio for a smooth transportation of the layer pad. In some other embodiments, the above ratio is preferably less than 2.5/800. This makes it possible to transfer the layer pad 1 even on a roller conveyer that is ascending. That is, the risk that the layer pad 1 is stucked between two adjacent rollers of the roller conveyer is significantly reduced or prevented. In some still further embodiments, the above ratio is less than 1.8/800. In this case, the rounded edge 6, in addition to the substantially circular channel 2, provides an increased rigidity of the layer pad 1. Therefore, a deformation of the layer pad 1 can be prevented. In addition, the rounded edge 6 seals the channels from the environment. Further, by the above defined rounded shape of the rounded edge, the layer pad 1 may be mechanically protected from being damaged. Moreover, due to the rounded edge 6 sharp edges of the layer pad 1 may be avoided so as to not damage a shrink film used together with the layer pad 1, or a person handling the layer pad 1.

[0068] **Fig. 8** shows a part of the layer pad 1 in a sectional view. In more detail, the present figure is used to explain the shape of the substantially circular channels 2. That is, the substantially circular channel 2 is considered to be substantially circular if a radius of the channel 2 deviates less than 0.5 millimeters from a mean value of a plurality of radii of the channel, wherein at least eight radii are considered in the above definition. Accordingly, in the example depicted in Fig. 8, radii r1, r2, r3, r4, r5, r6, r7 and r8 are used. The arithmetic mean is calculated using the eight radii. However, there may be more radii used to determine the mean value of all radii. For example, there may be used 16, 32 different radii. As a result, even an oval shape of the substantially circular channel 2 is considered to be circular and provides the advantageously effects of the present invention.

[0069] **Fig. 9** shows a part of the layer pad 1 according to a further embodiment in a sectional view. In this embodiment the at least one circular channel 2 has two flattened portions. Each flattened portion is parallel to the first surface 3 and/or to the second surface 4. In a further embodiment not depicted in the figures the flattened portions are inclined to the first surface 3 and/or the second surface 4. In a still further embodiment not depicted in the figures the flattened portions are rectangular to the first surface 3 and/or the second surface 4. The two flattened portions are connected to each other with a segment of a circle forming the circular or round portion of the substantially circular channel 2. Similar to the embodiment depicted in Fig. 8, eight radii are depicted, wherein the radii have the same angular distance to each other. Each radius corresponds to a distance between the barycenter of the cross section of the channel to the outer contour of the channel. In a further embodiment not depicted in the figures, the flattened portions may be inclined with respect to the first surface 3 and/or second surface 4.

Reference Sign List

[0070]

1	layer pad
2	substantially circular channel

3	first surface
4	second surface
5	axial axis
6	rounded edge
7	polygonal channel
8	polygonal channel
d1	thickness direction
d2	axial direction
d3	width direction
t	thickness
a1	distance between substantially circular channel and first surface or second surface
a2	distance between two adjacent substantially circular channels
d	mean diameter of the substantially circular channel
r_{edge}	radius of the rounded edge
r1, r2, r3, r4, r5, r6, r7, r8	radii of the substantially circular channel

Claims

1. A layer pad (1) for covering a layer of articles forming a load, having a substantially plate-like shape, the layer pad (1) comprising:

    a first surface (3) and a second surface (4), wherein the first surface (3) is arranged opposite to the second surface (4), and
    at least one hollow channel (2) having a substantially circular cross section,
    wherein the at least one hollow channel (2) is arranged between the first surface (3) and the second surface (4) and has a central axis (5) extending in an axial direction (d2).

2. Layer pad (1) according to claim 1, wherein the pad (1) is made of a thermoplastic material, preferably of Polypropylene.

3. Layer pad (1) according to claim 1 or 2, wherein a ratio of a thickness (t) of the layer pad (1) in a thickness direction (d1) from the first surface (3) to the second surface (4) and a length of the longest edge of the layer pad (1) is less than 1/100, preferably less than 5/1000, most preferably less than 3,6/1000.

4. Layer pad (1) according to any one of the preceding claims, wherein the layer pad (1) has a substantially rectangular shape in a plan view, preferably with rounded corners.

5. Layer pad (1) according to any one of the preceding claims, wherein a plurality of substantially circular channels (2) is provided, and wherein the substantially circular channels (2) are evenly distributed within the layer pad (1) or the substantially circular channels (2) are irregularly distributed within the layer pad (1).

6. Layer pad (1) according to any one of claims 1 to 4, wherein the layer pad (1) comprises at least one substantially circular-channel section (10) having the at least one substantially circular channel (2) and at least one non-circular-channel section (11) having at least one channel (7;8) having a polygonal cross section other than circular.

7. Layer pad (1) according to claim 6, wherein the layer pad (1) has the non-circular-channel section (10) and two substantially circular-channel sections (11), and wherein the substantially circular-channel sections (10) and the non-circular-channel section (11) are arranged adjacent to each other so as to sandwich the non-circular-channel section (11) between the substantially circular-channel sections (10).

8. Layer pad (1) according to any one of the preceding claims, wherein a ratio of the mean diameter (d) of the substantially circular channel (2) and the thickness (t) of the layer pad in the thickness direction (d1) from the first surface (3) to the second surface (4) is between 0.2 to 0.9, preferably between 0.4 to 0.9, most preferably between 0.6 to 0.9.

9. Layer pad (1) according to any one of the preceding claims, wherein the edges (6) of the layer pad (1) are at least partly rounded.

10. Layer pad (1) according to any one of the preceding claims, wherein the layer pad (1) is an integral member, wherein the layer pad (1) is formed as an extruded element.

11. Layer pad (1) according to any one of the preceding claims, wherein the layer pad has a grammage of between 500 g/m^2 to 2500 g/m^2, preferably between 800 g/m^2 to 2200 g/m^2, most preferably between 1000 g/m^2 to 1500 g/m^2.

12. Layer pad (1) according to any one of the preceding claims, wherein the substantially circular channels (2) are arranged such that, in a cross section of the layer pad (1) perpendicular to the axial direction (d2), the thinnest material thickness (a2) between two adjacent substantially circular channels (2) is the same as the minimal material thickness (a1) between the substantially circular channel (2) and the first surface (3) and/or the second surface (4) in the thickness direction (d1) of the layer pad (1).

13. Use of the layer pad according to any one of the preceding claims in transporting of articles, wherein the layer pad is disposed between two layers of articles, preferably empty bottles and/or jars.

14. Package system, comprising;
at least two layers of articles forming a load, and
at least one layer pad (1) according to any one of claims 1 to 12,
wherein one layer pad (1) is positioned between the layers of articles.

15. Method of producing a layer pad (1) according to any one of claims 1 to 12, wherein the method comprises the following step:
extrusion of a thermoplastic material so as to attain the layer pad (1) according to any one of claims 1 to 12.

Fig. 1

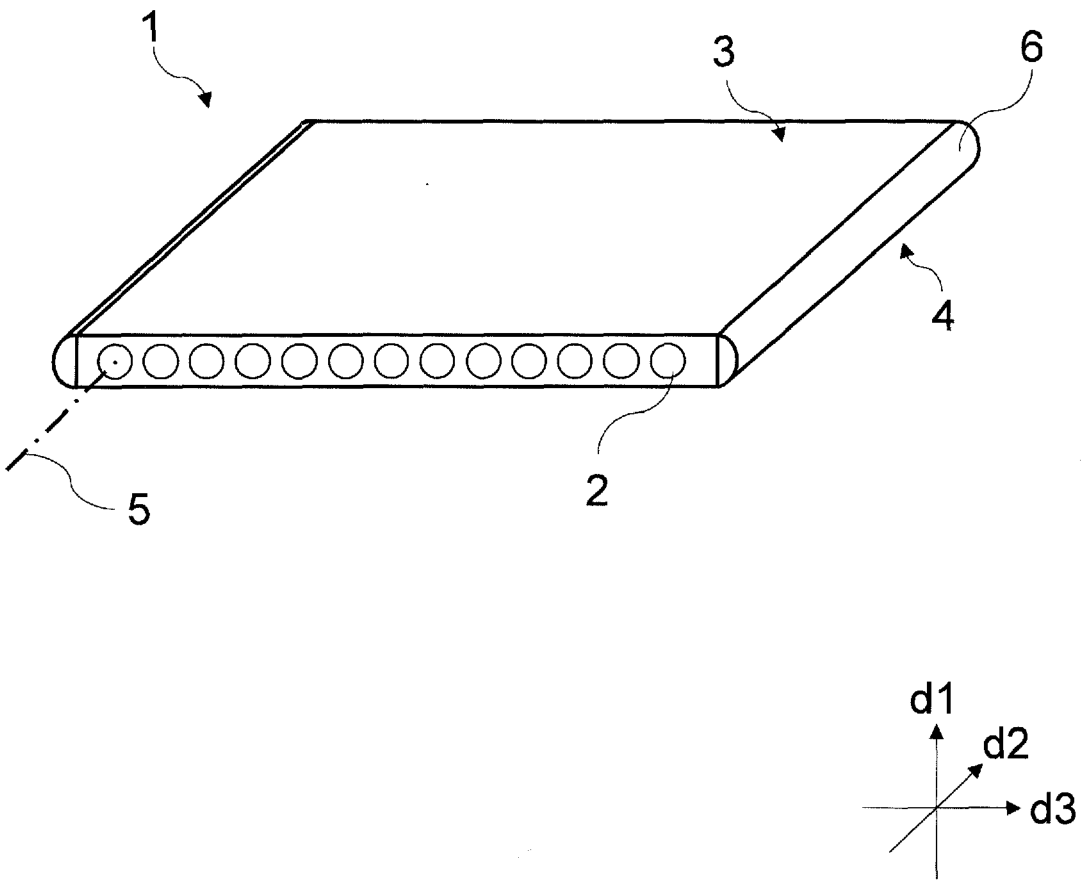


Fig. 2

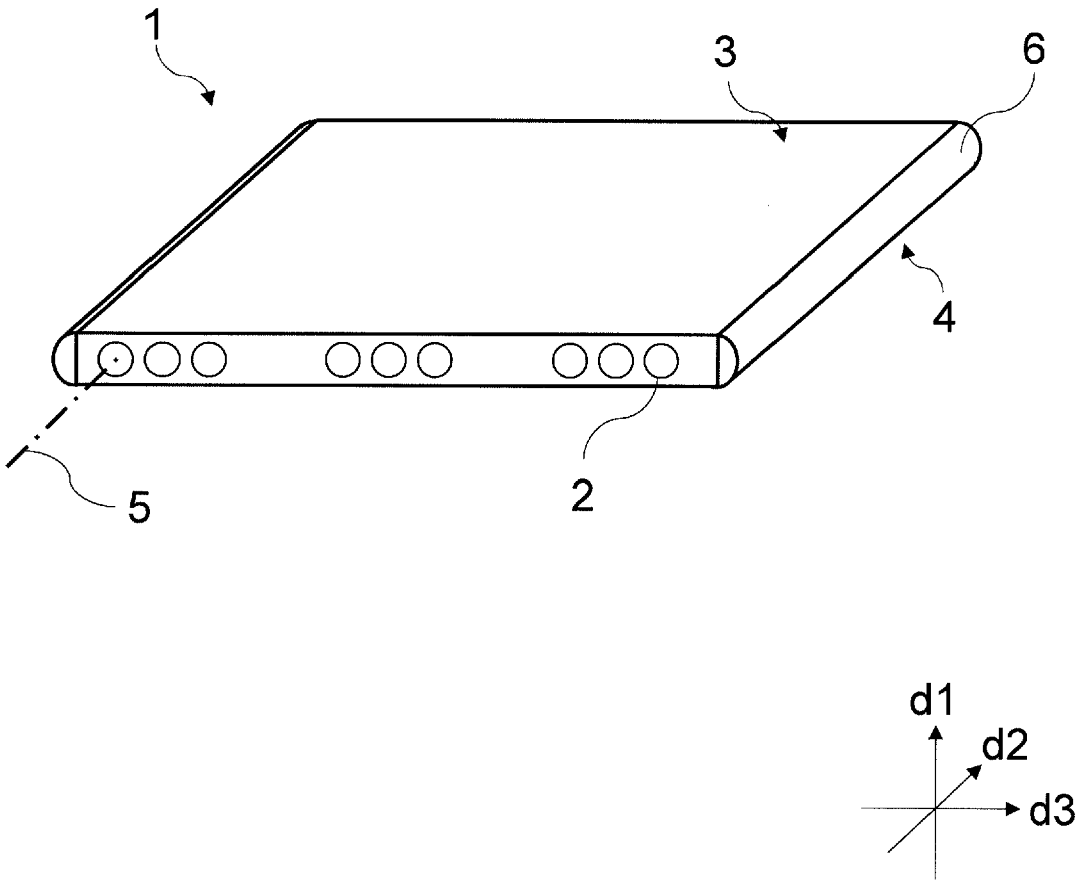


Fig. 3

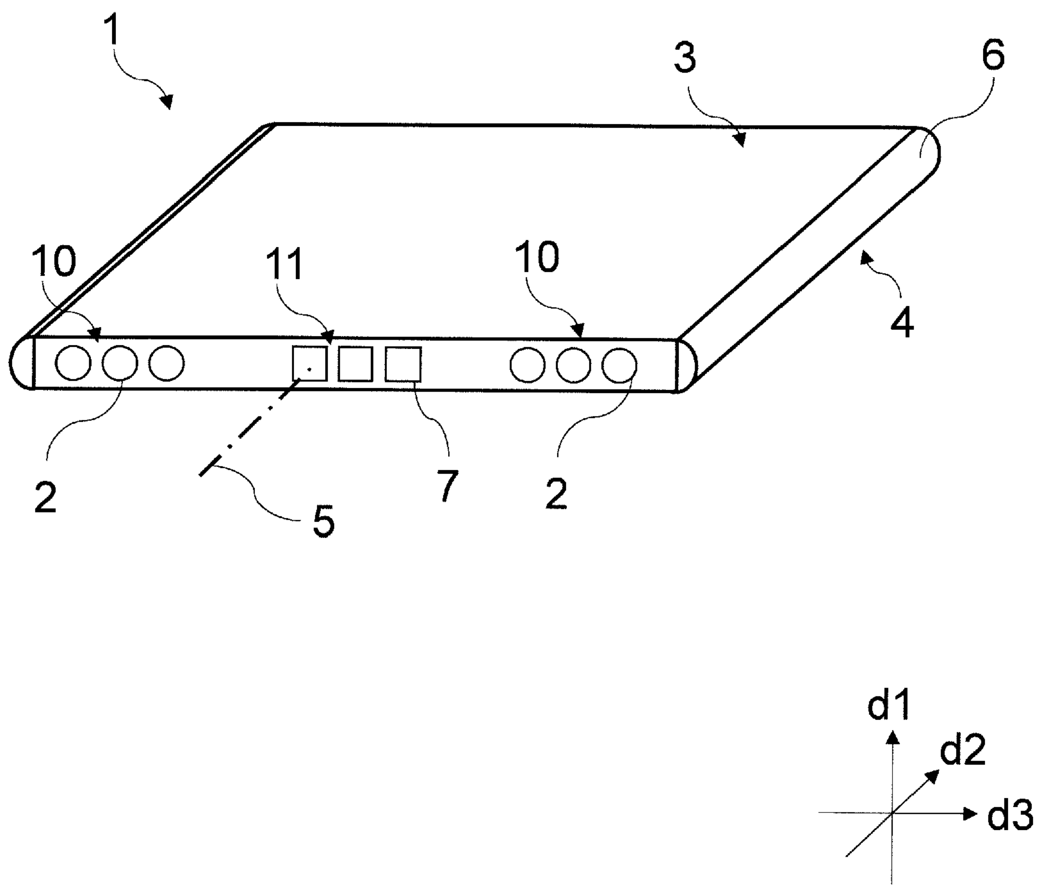


Fig. 4

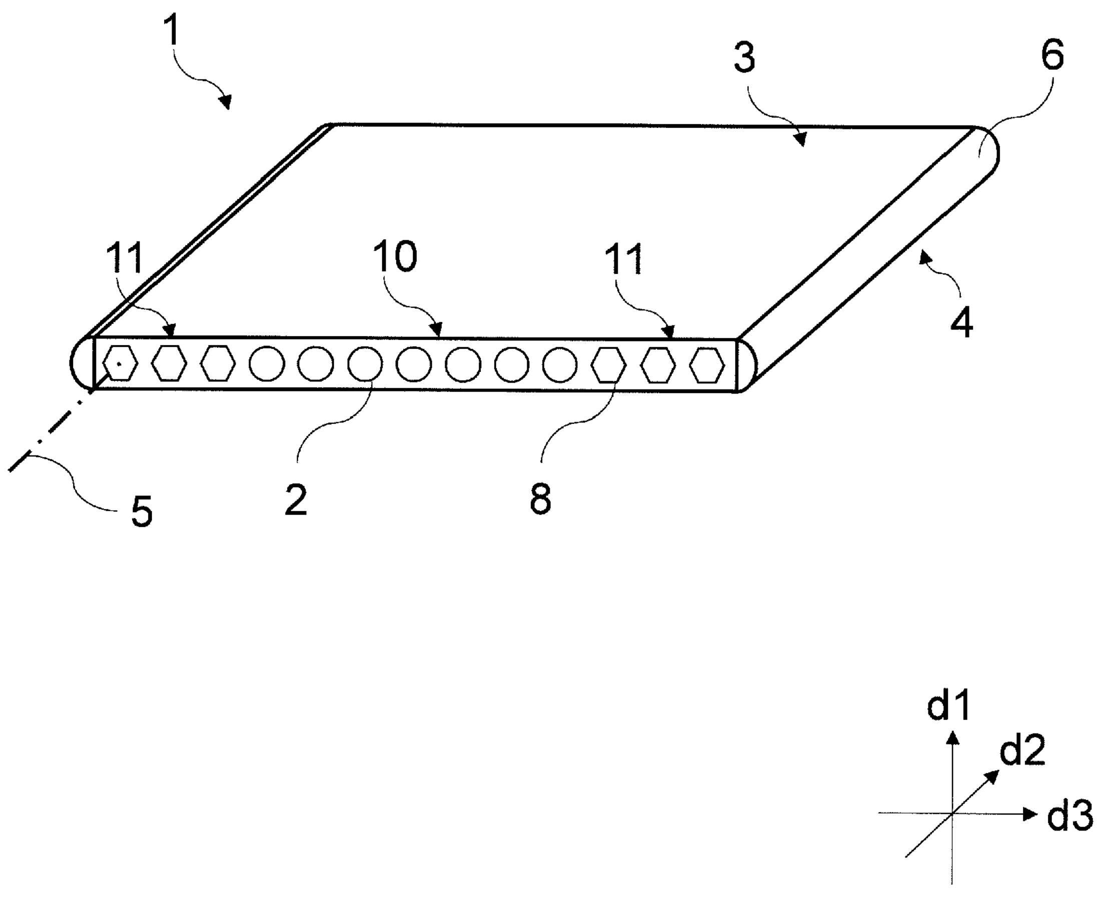


Fig. 5

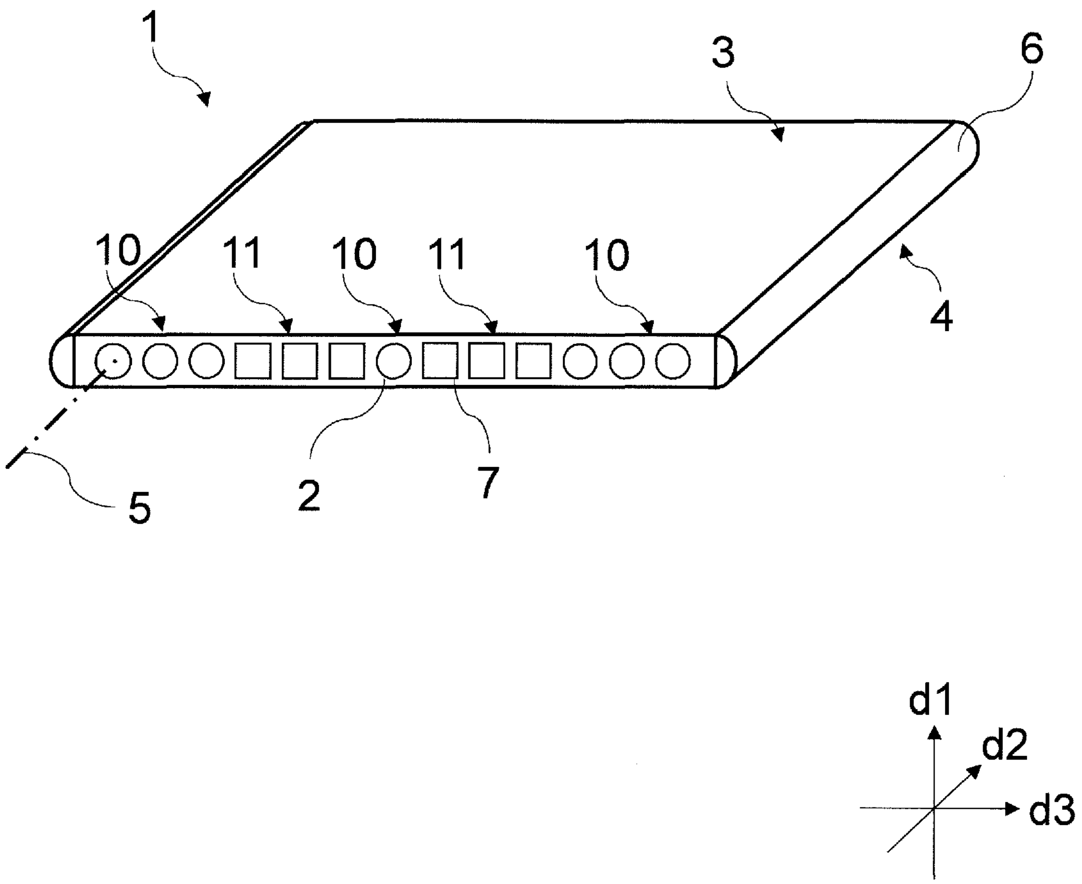


Fig. 6

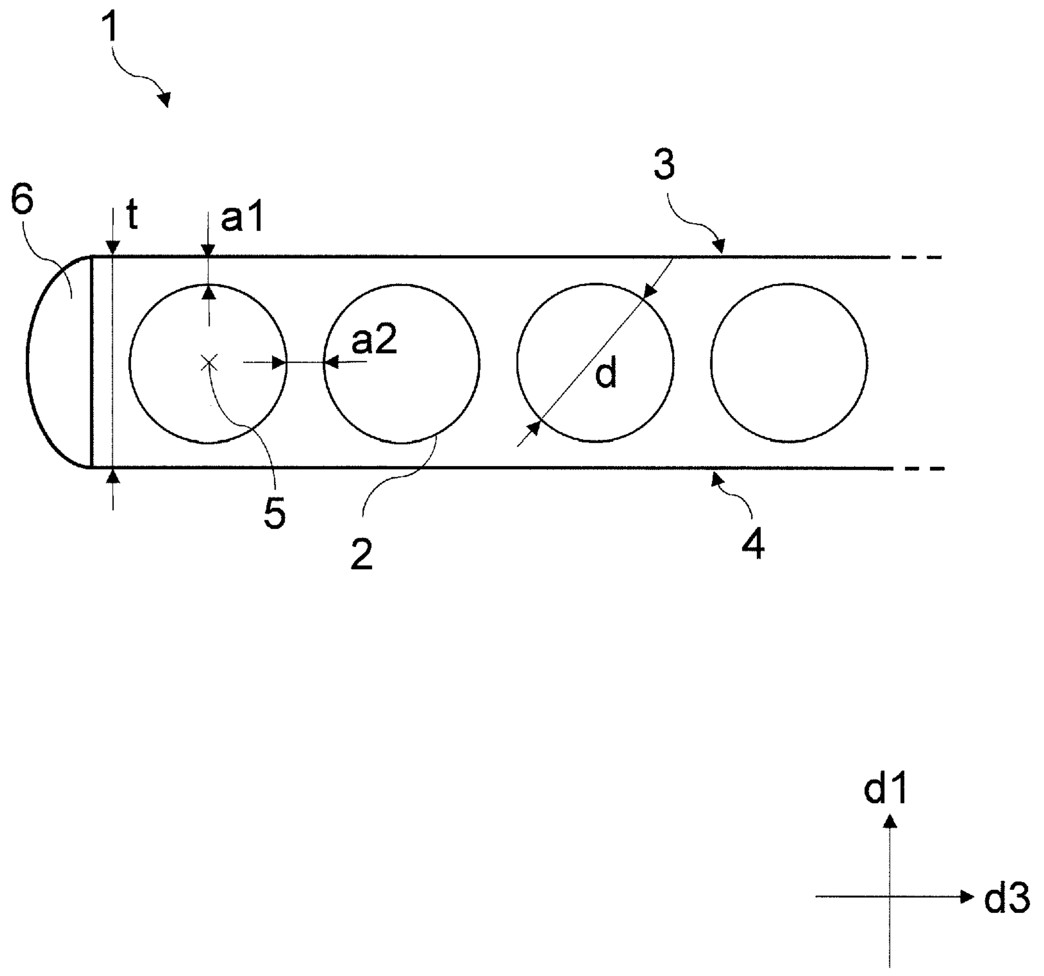


Fig. 7

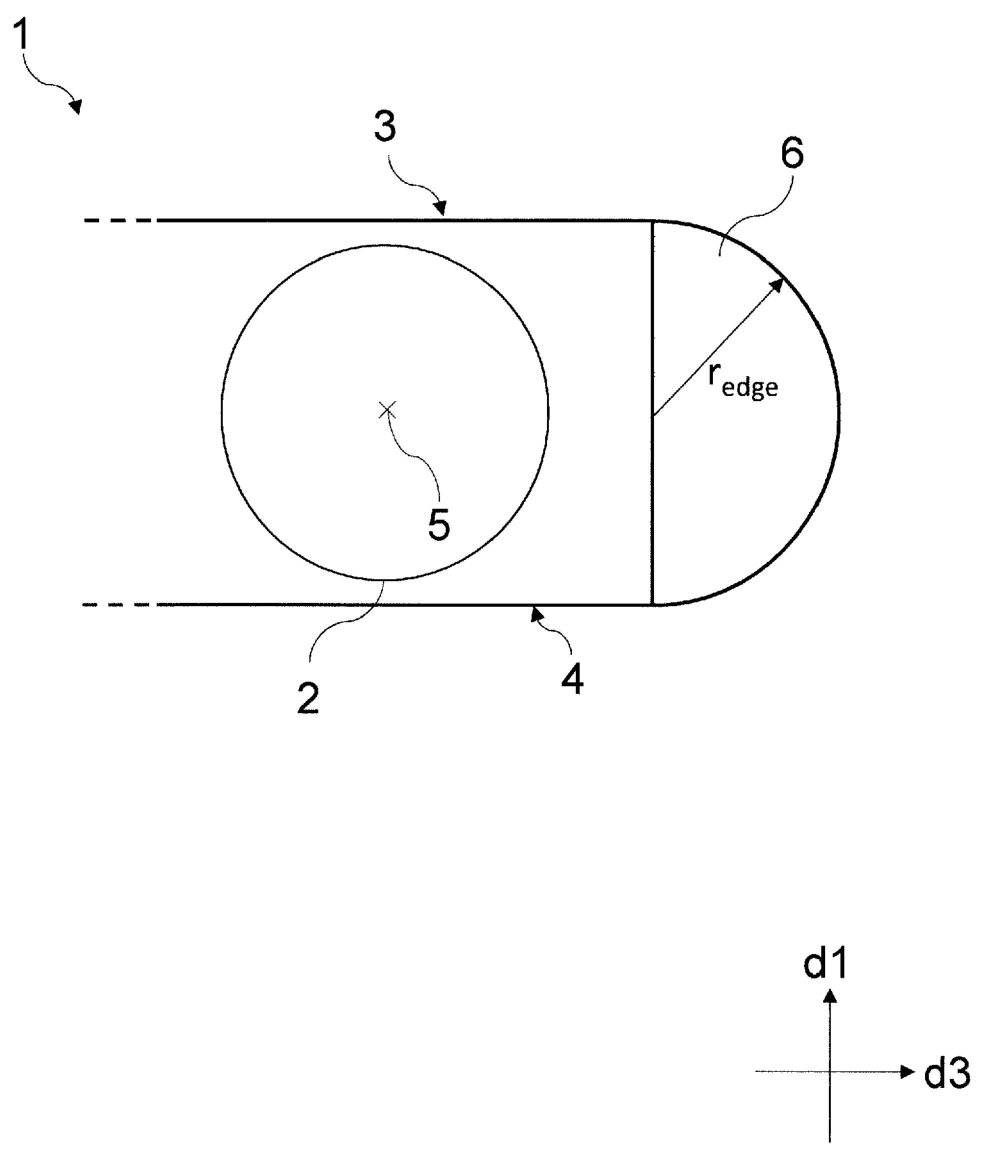


Fig. 8

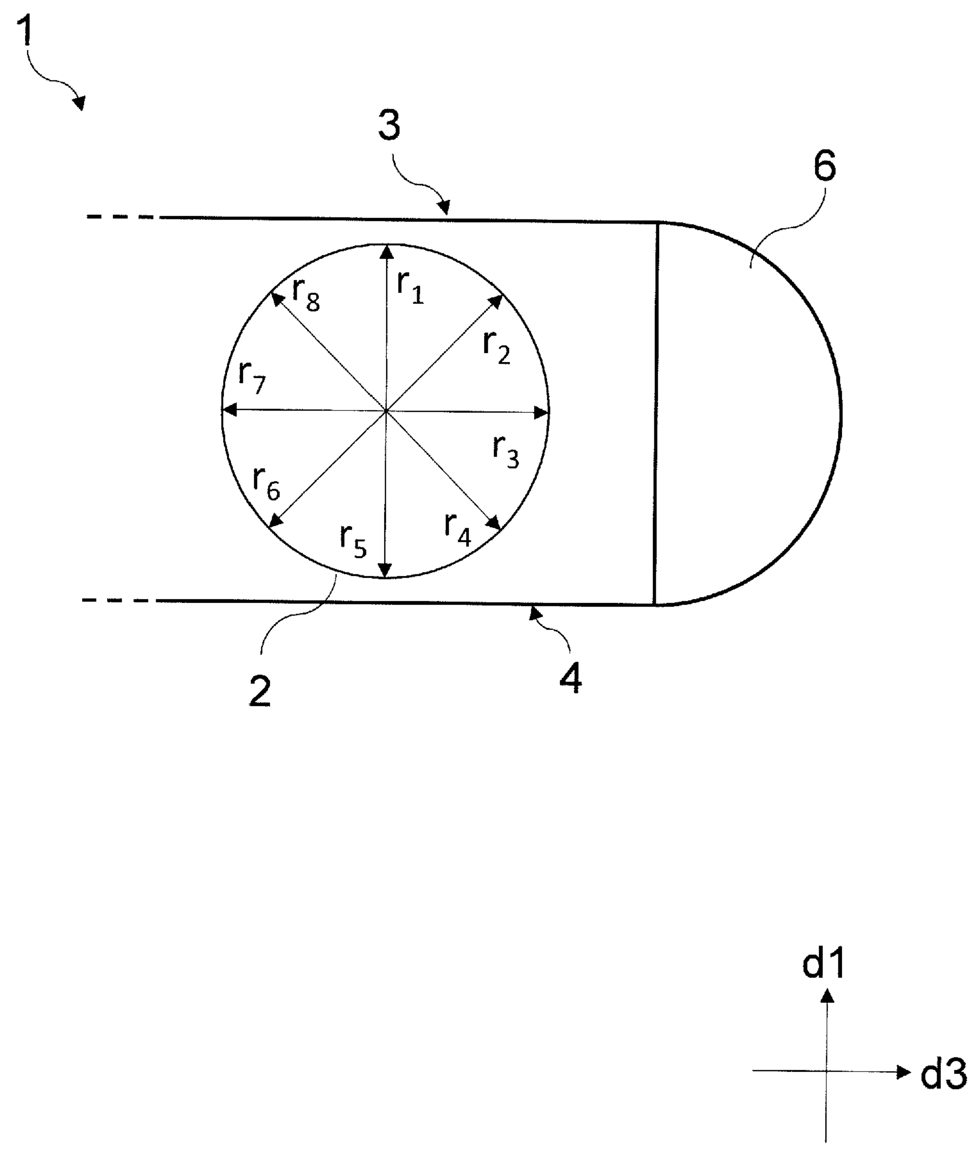
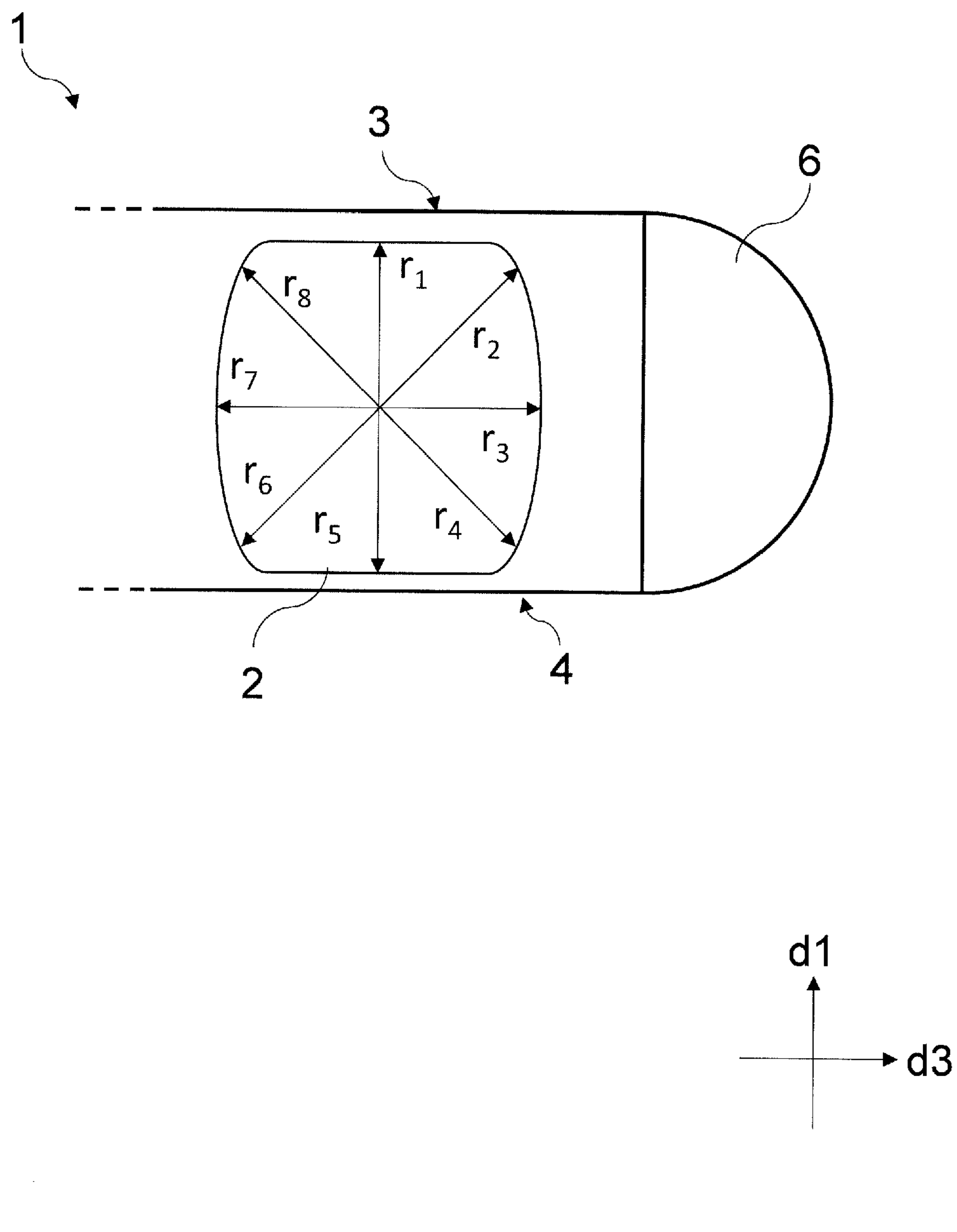


Fig. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 21 17 9235

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	GB 2 427 185 A (ILLINOIS TOOL WORKS [US]) 20 December 2006 (2006-12-20) * page 4, line 21 - page 5, line 5; figures 1, 3 * -----	1-15	INV. B65D71/70 B65D81/127
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TECHNICAL FIELDS SEARCHED (IPC)

B65D

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

Place of search	Date of completion of the search	Examiner
Munich	8 December 2021	Derrien, Yannick

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