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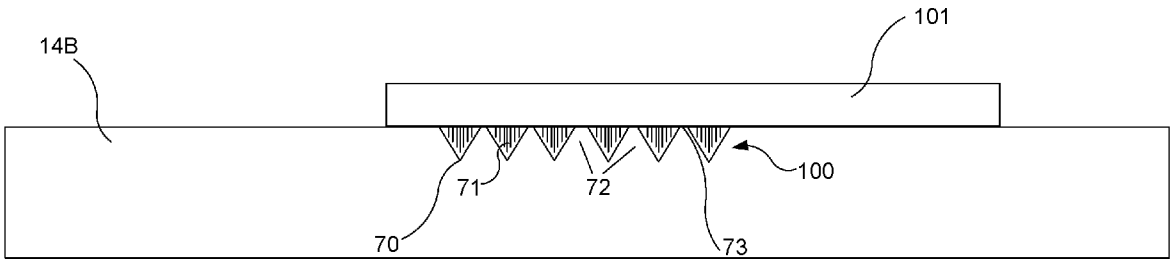

FIG. 2B

(57) Abstract: An injection mold for manufacturing an injection over-molded article comprises one or more existing part having a textured surface characterized by a plurality of fibers. The injection mold comprises a first mold component and a second mold component together defining existing part positioning members and a cavity into which a molten material is injected to form additional structure on the one or more existing part to form the injection over-molded article and a texture conforming structure comprising a plurality of fiber-receiving channels for receiving and protecting the fibers during over-molding.

WO 2019/200467 A1

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APPARATUS AND METHOD FOR INJECTION OVER-MOLDING OF ARTICLES COMPRISING INJECTION MOLDING PROCESS-SENSITIVE STRUCTURES

TECHNICAL FIELD

[0001] The present invention relates generally to injection molding of articles and, more specifically, to apparatuses and methods for injection molding of articles comprising textured components.

BACKGROUND

[0002] Injection molding is a manufacturing process in which a molten plastic or rubber material is injected into a mold cavity where it solidifies into a shape that conforms to the interior of the mold cavity.

[0003] In some applications molded articles are manufactured by over-molding or joint-molding parts that have been manufactured separately. For example, an extruded ethylene propylene diene methylene (EPDM) rubber or thermoplastic elastomer (TPE) part may be inserted in an injection mold wherein EPDM or TPE is injected to over-mold or joint-mold the extrusions. For certain types of molded articles, the part to be over-molded or joint-molded may comprise a textured surface or component. The texture can be in the form of a substrate on the surface of the article being over-molded such as flock (flock fibers). Flock is frequently used on parts incorporated in the manufacture of vehicles such as window seals for example. The flock fibers may play an aesthetic, textural and/or functional role.

[0004] One of the challenges in manufacturing TPE or EPDM over-molded/joint-molded articles comprising a substrate arises when the substrate is made of a material that is sensitive to the conditions within the mold. Pressure and temperature, in particular, can represent a challenge.

[0005] As mentioned, flock is an important material in the manufacture of sealing parts of automotive vehicles. The incorporation of flock fibers onto a surface is a relatively complex process. Flock fibers can be deposited directly on the surface of an article or can be incorporated

on an adhesive substrate such as tape to produce so-called flock tape which is then applied to the article. In either case, the flock fibers are retained on the substrate by an adhesive. The nature of the adhesive, its properties and uniformity influence the strength of the bond between the fibers and the substrate and the orientation and density of the fibers all of which influence in turn the aesthetic and functionality of the flocked article. Therefore, when flocked surfaces are subjected to harsh conditions, it is not only the fibers that can be affected but also the adhesive and underlying substrate.

[0006] Over-molding or joint-molding of articles comprising flocked surfaces can therefore compromise the integrity and functionality of these surfaces. For example, during the heating part of the curing cycle for rubber injection molding, flocked surfaces present on or near the part to be over-molded/joint-molded can suffer temperature damage.

[0007] The textured surface may also be sensitive to pressure. Indeed, the part(s) to be over-molded/joint-molded must be secured within the mold to prevent its displacement during the injection cycle. In over-molding/joint-molding of automotive parts such as door seals rubber extrusions for example, the structures within the injection mold required to position and immobilize the extrusion to ensure a good sealing of the injection cavity can be complex and can impart pressure stress on the extrusions. The immobilization sometimes requires clamping that can further damage the substrate.

[0008] In the present state of the art, there have been some texture damage mitigation approaches developed such as trying to minimize the pressure applied to immobilize the over-molded/joint-molded article or to reduce the size of the clamped area so as to reduce the area of the textured article that is damaged. Other solutions involve subjecting damaged flocked surfaces to post molding processes such as brushing to “straighten” the flock fibers. All the prior art approaches fail to address the full extent of the nature of the damage to the flock surface which may include partial melting of the flock fibers adhesive during over-molding/joint-molding therefore disrupting the flock fibers orientation and density.

[0009] Furthermore, the process of over-molding/joint-molding implies binding affinity between the injected molten thermoplastic and the article being over-molded. The presence of flocked surfaces near the boundaries of the over-molded/joint-molded surface(s) may compromise binding and prevents the design of articles with flocked surfaces near or on the over-molded/joint-molded sections of the finished article.

[0010] There is therefore a need in the molding industry for an improved method and apparatus to address the technical problems identified above associated with injection over-molding/joint-molding of articles comprising process-sensitive structures such as flock fibers.

SUMMARY

[0011] In an aspect of the invention there is provided an injection mold for manufacturing an injection over-molded article comprising one or more existing part having a textured surface characterized by a plurality of fibers, the injection mold comprising: a first mold component and a second mold component together defining existing part positioning members and a cavity into which a molten material is injected to form additional structure on the one or more existing part to form the injection over-molded article; and a texture conforming structure comprising a plurality of fiber receiving channels for receiving and protecting the fibers during over-molding.

[0012] In another aspect of the invention there is provided a method of manufacturing an injection-molded article comprising at least one part that is over-molded and wherein said part comprises a process-sensitive substrate, the method comprising: providing a first mold component and a second mold component together defining a cavity; providing a substrate protection structure to protect the process sensitive substrate; positioning the part to be over-molded within the mold such that the process sensitive substrate is protected by the substrate protection structure; and injecting a molten material into the cavity to form the article.

[0013] Other aspects of the invention may become apparent from the detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The invention will be better understood by way of the following detailed description of embodiments of the invention with reference to the appended drawings, in which:

[0015] Figure 1 is a cross-sectional view of an injection mold having a substrate protection structure in accordance with another embodiment of the present invention.

[0016] Figure 2A is a cross-sectional view of an injection mold having a plurality of fiber-receiving channels in accordance with another embodiment of the invention.

[0017] Figure 2B is a cross-sectional view of another injection mold having a plurality of fiber-receiving channels in accordance with another embodiment of the invention.

[0018] Figure 3 is a top view of fiber-receiving channels.

[0019] Figure 4A is a side view of the fiber-receiving channels.

[0020] Figure 4B is a photomicrograph of a cross-section of a part of a mold showing two laser-cut fiber-receiving channels.

[0021] Figure 4C is a photograph showing a mold part with texture conforming structures (top) and a part comprising a flocked surface (bottom) comprising gray areas corresponding to a flocked surface that has been burnt and flattened and also showing dark areas corresponding to a flocked surface that has been protected.

[0022] Figure 5 is a perspective view of a mesh structure in accordance with another embodiment of the invention.

[0023] Figure 6 is a cross-sectional view of an injection mold having a mesh structure that provides the fiber-receiving channels.

[0024] Figure 7 is a cross-sectional view of an injection mold having a mesh structure that provides the fiber-receiving channels in which strands of the mesh are rounded at the top.

[0025] Figure 8 is a perspective view of an embodiment of the lower part of a mold with texture-conforming structures.

[0026] Figure 9 is a perspective view of an embodiment of the lower part of a mold with extrusions to be joint-molded.

[0027] Figure 10 is a cross-sectional view of an embodiment of a mold with an extrusion.

[0028] It will be noted that throughout the appended drawings, like features are identified by like reference numerals.

DETAILED DESCRIPTION

[0029] Disclosed herein is a novel injection mold (or injection mold system or apparatus) for manufacturing an article comprising a textured surface.

[0030] By textured surface it is meant a surface characterized by having projections, strands, filaments, or fibers such as but not limited to flock fibers. The strands, filaments or fibers are elongated, slender and omnidirectionally flexible relative to the substrate to which they are attached. An example of a textured surface is a flocked surface which comprises fibers such as polyester or nylon fibers for example. In some textured surface embodiments, the fibers are attached to a substrate by an adhesive. An example of a substrate/adhesive/fibers arrangement is flock tape.

[0031] In one aspect of the invention the novel injection mold is useful for manufacturing an article that comprises at least one part, section or a surface having a substrate such as a textured surface thereon and which article is an over-molded article.

[0032] By over-molding it is meant the process by which a molten thermosetting plastic or rubber is injected onto an existing article(s) placed within an injection mold to add additional layers or shape or structure to the existing article(s). The process may in particular be used to permanently

join existing articles together. This latter process may be termed joint-molding. It will be understood that the term over-molding may encompass joint-molding.

[0033] One example of a textured surface is a flocked surface. Thus, the novel mold of the invention can be a thermoplastic elastomer (TPE) or ethylene propylene diene methylene (EPDM) injection mold for over-molding or joint-molding a part or parts such as an extruded thermoplastic part comprising a flocked surface. The flocked surface may have been applied to the part(s) to be over-molded/joint-molded in the form of flock tape for example.

[0034] The stringent specifications in modern manufacturing industries in general, and the automotive industry in particular, require that functional structures such as the flock fibers on parts remain essentially intact or at least that any alterations to the fibers be limited to a strict minimum compatible with proper function and/or aesthetic.

[0035] The novel injection mold is particularly useful for, although not limited to, EPDM (rubber) injection over-molding/joint-molding of a part (or parts) with a textured surface such as a flocked surface. The conditions within the mold for TPE or EPDM injection can be harsh for the textured surface as a result of the high pressures and high temperatures involved. These harsh conditions may result in damage to functional structures of textured surfaces. In the case where the textured surface is a flocked surface, damage can be in the form of flattening of the fibers as a result of the pressure exerted by the insertion of the part(s) in the mold. Furthermore, the mold must be heated as part of the curing process of the EPDM. Mold temperatures in typical heating cycles may reach 100 to 200°C. To give an example of the conditions used in a typical EPDM injection molding process, the following parameters may be used: injection pressure of 165 psi, injection speed of 25 mm/s, decompression pressure of 35 psi, decompression speed 15 mm/s, screw rotation pressure 20 Nm, screw rotation speed 30 RPM, curing time (cooling) 120 sec, holding time 6 sec, injection time 1.2 sec, lower mold part temperature 190°C, upper mold part 190°C, Head/screw heater 50°C. Temperature-sensitive substrates such as flocked surfaces may be damaged during the heating cycle. Not only are the flocked fibers susceptible to temperature but also the adhesive that anchors the fibers on their attachment substrate.

[0036] In certain over-molding process the flow of the molten thermoplastic may also cause the textured surface to be compressed by the pressure generated within the injection cavity and to be heated by the flow, even in molding processes that do not require heating of the mold itself such as in TPE or TPV injection molding.

[0037] Thus, in an aspect of the invention there is provided an injection mold comprising a texture conforming structure having fiber-receiving channels.

[0038] In an injection mold system **2**, shown in FIG. 1 having a cavity **14** formed by a first mold component **14A** and a second (lower) mold component **14B**, there is provided a texture conforming structure **100** located under the region of the part **101** to be over-molded or joint-molded that comprises the textured surface **20**. The mold is shown in cross-section and the flow of molten material such as molten rubber **18** is schematically represented with its front **19**.

[0039] Referring to Figure 2A, an exemplary embodiment is schematically represented in which the texture conforming structure **100** comprises a plurality of fiber receiving channels **70**. The fiber receiving channels have walls **72** defining a textured surface supporting tip **73**. The fiber receiving channels provides a multi-function protective structure including fiber protection, temperature control and lateral stabilizing of part **101**. Texture such as flock fibers are substantially protected from flattening and/or from heat damage while sufficient support is provided to prevent the part that is being over-molded/joint-molded from bending under the pressure of immobilizing structures or during injection. Furthermore, the insertion of fibers in the fiber-receiving channels, as will further be described below, also contributes to stabilizing part **101** in the mold by creating a resistance to lateral displacement of part **101** during injection.

[0040] In one aspect, the fiber-receiving channels **70** are embedded in lower mold component **14B** just underneath a flocked surface comprising flock fibers **71**. The fiber-receiving channels **70** are dimensioned to accommodate the length of flocking fibers **71** optionally with some extra space at the bottom to allow for variations in length of the fibers and/or slight downwards displacement when subjected to the pressure of mold components or the flow of melted material. Thus, the depth of the fiber-receiving channels **70** may be, for example, between about

0.2 and 1 mm, a range comprising typical length of flock fibers. The extra space at the bottom may be of the order of about 10-20% of the length of the flock fibers.

[0041] While Figure 2A represents an embodiment in which there is an indentation **21** in the mold surface to accommodate the substrate to which the fibers are bonded, this indentation need not be present. Figure 2B exemplifies an embodiment in which the textured surface contacting tips **73** of the fiber-receiving channels are at the same level as the surface of the mold.

[0042] The fiber-receiving channels **70** also provide thermal shielding for the flock fibers **71** (or any type of fibers that could be damaged at temperatures used in rubber injection molding). In one aspect, the thermal shielding is in part due to the minimization of contact surface between the fibers and the surface of the mold provided by the positioning of the fibers within the channels. But, in addition, other thermal mechanisms may be at play. For example, the fibers located near the walls of the channels may insulate the fibers that are more centrally located. Thus, in one aspect of the invention the ratio of channel wall surface to density of fibers may be adjusted to optimize this thermal shielding mechanism.

[0043] In another aspect each fiber receiving channel **70** is separated from its neighbors by a distance commensurate with minimizing flattening of fibers and minimizing heating of the fibers and of the adhesive layer while still providing an adequate support of the flocked surface. That is to say, the walls **72** of the lower mold component **14B** between the channels contribute to flattening of the flock fibers (or substantial displacement from their original generally vertical arrangement). Thus, the area, defined by the textured surface contacting tip surface **73**, occupied by these sections is preferably minimized while retaining sufficient supportive strength to withstand the pressure generated on the part **101** by the mold components used to maintain the part in position during injection.

[0044] What constitutes acceptable damage to the fibers depends on the required specifications of the final product. For the automotive industry this may represent no more than about 10% and preferably about 1% to 5% of the flocked area being damaged (fibers being flattened and/or fibers and adhesive layer burnt). This can perhaps be better appreciated by referring to Figure 3

where a top view of the area of lower mold component **14B** comprising the fiber receiving channels **70** is shown. Thus, the total area of the textured surface supporting tips **73** would be no more than about 10% and preferably about 1% to 5% of the surface occupied by flocked surface. Less stringent product specifications may permit tips **73** to occupy a greater total surface area. The distance (occupied by tips **73**) between any two the fiber-receiving channels is preferably between about 0.05 mm and 0.3 mm.

[0045] Figure 3 exemplifies a regular pattern of disposition of fiber receiving channels **70** with rounded-corners squares openings but it will be appreciated that other patterns may also be used such as a honeycomb pattern (see Figure 5) or a pattern where the openings for fiber receiving channels **70** are round for example. Also, the pattern need not necessarily be regular and may be designed to adapt to the shape of the textured surface for example. Furthermore, the edges of surface **73** between channels **70** may be rounded so that the top of walls **72** is dome-shaped. Such a shape may advantageously force flock fibers to deviate into one or another flock receiving channel **70** thereby further reducing flattening of the fibers.

[0046] In yet another aspect, when the injection molding is EPDM injection molding, the thickness of walls **72** may be optimized to minimize heat buildup near the fibers and/or to maximize cooling rate during the curing process to eliminate or reduce thermal damage to the fibers and the adhesive layer to which the fibers are bonded. In this respect the mold may comprise a cooling system including built-in cooling channels that are thermally coupled to the fiber-receiving channels **70**.

[0047] The fiber-receiving channels **70** can be created with a laser. The channels may have a generally conical shape as illustrated in Figure 2A. The shape may be obtained by laser engraving. The tapering can be designed to provide sufficient volume to accommodate the fibers. The fibers may tolerate a certain level of crowding within the channel to the extent that they are resilient enough to regain their original orientation once the molded object is removed from the mold. An exemplary set of laser parameters to manufacture the channels in a stainless-steel mold may comprise: Frequency 100 kHz; Power: 20 W for an initial hatching of the channels followed by 30 W for fine tuning the shape of the channels; laser beam displacement speed 3mm/sec for initial

hatching and 75 mm/sec for fine tuning. The laser may be, for example, a LXQ-100 (Laserax) with a source fiber IPG YLP-HP with nominal power of 100 W with a scanning type laser head. Other geometries for the fiber-receiving channels **70** are also contemplated such as cylindrical, cubic and the like. The orientation of the channels **70** within the lower mold component **14B** may depend on the shape of part **101** in the region comprising the textured surface.

[0048] Other means of creating the channels **70** include, without being limited to, electrical discharge machining (EDM), plasma cutting and the like.

[0049] Figures 3 and 4A are illustrations of a mold having a plurality of conically shaped flock-receiving channels **70** that have been engraved, such as by laser engraving, into the lower mold component **14B**. In some embodiments, the flock-receiving channels **70** are paraboloid as exemplified in Figure 4B which is photomicrograph of a cross-section of part of a mold showing two fiber receiving channels **70**. The textured surface contacting tip **73** is shown having a dome or partially domed shape when viewed in cross-section. In other words, they are shown with rounded edges. The width (0.23 mm) and depth (0.59 and 0.58 mm) are also shown. The configuration (in terms of size and spacing) of the channels **70** is merely illustrative of the concept and may be varied for different operating parameters, materials, pressures, etc. and/or to achieve different results. In one specific implementation, which is presented solely to illustrate one particular configuration that is believed to provide excellent results, the height (or length) of the paraboloid-shaped channels is 0.3-1 mm and the width is 0.05-0.3 mm. When the part **101** is a sealing extrusion for automobile windows the dimensions of the fiber receiving channels **70** are more preferably approximately 0.6 mm in height (or length) and approximately 0.25 mm in width. Other geometries and dimensions may be used as further described below.

[0050] The density of fibers on flocked surfaces required by the automotive industry is typically of the order of about 10^4 fibers/cm^2. It has been discovered that a texture conforming structure configured to receive between about 10 to 50 fibers per fiber-receiving channel **70** provides good results. Figure 4C provides an example of the efficacy of an embodiment of the texture conforming structure of the invention. A partial section of a mold having two sections of texture conforming structure **100** of fibers receiving channels **70** with dimensions and shape

similar to those shown in Figure 4B and areas **80** without fiber receiving channels is shown at the top of the figure. Below the partial mold section is a part **101** completely covered by a flocked surface which has been subjected to injection over-molding/joint-molding for EPDM (mold heated to cure the EPDM with conditions similar to those described above) on the partial mold section. The sections **82** and **83** of the part **101** which were facing the mold texture conforming structure **100** comprising the fiber receiving channels **70** during molding are clearly darker than areas **84**. The gray areas **84** correspond to flocked surface that has been burnt and flattened while the dark areas **82** and **83** correspond to flocked surface that has been protected and exhibit no difference from a flocked surface that has not been subjected to over-molding/joint-molding mold conditions.

[0051] In an alternative embodiment shown in Figure 6, the fiber-receiving channels may be created with a mesh structure **76** superimposed (as an insert or replaceable insert) on the lower mold component **14B** or inserted in a cavity **17**. In this case the fiber-receiving channels **70** are the pores or sieves of the mesh while walls **72** represent the scaffold of the mesh. Advantageously, the mesh structure may be removed and replaced by a mesh of different dimension allowing the same mold to be re-used for substrates and/or flocking fibers of different dimensions. The mesh, for use in EPDM injection molding, may be made of any suitable material such as stainless steel, titanium, carbon nanotubes and the like provided the material has a melting point that is higher than the maximum temperature reached inside the mold during the curing cycle and has a strength sufficient to withstand pressures exerted in the area of the insert. One advantageous material that can be used in the present invention for TPE injection over-molding (in which no heating of the mold is required) is acrylonitrile butadiene styrene (ABS). In one advantageous embodiment, the material is one that does not bind to the rubber material used for the injection. Thus, in case of infiltration of the rubber in the mesh, it is easily cleanable. Mesh structures can be made by methods known to persons skilled in the art. More recent technologies such as 3D printing can advantageously be used.

[0052] Furthermore, the material may be chosen to minimize thermal conductivity to reduce as much as possible heating of the textured surface.

[0053] The dimensions of the pores or sieves are in the same ranges as described for the fiber-receiving channels **70** created in the lower mold component **14B**. Thus, the mesh size is preferably between about 45 to 300 mesh and more preferably about 60 mesh which corresponds to a pore or sieve aperture size of about 0.05 mm to about 0.35 mm and more preferably about 0.25 mm. In one embodiment shown in Figure 7, the textured surface supporting tip **73** of the walls **72** of the mesh may be rounded as was described above in the case where the fiber-receiving channels **70** are made directly in lower mold component **14B**.

[0054] The insert or mesh structure **76** may advantageously be made of a different material than the mold itself to provide thermal insulation. Thus, the mesh structure **76** may provide at least two mechanisms of heat protection for the fibers by providing a space **70** that reduces surface contact and by insulating the fibers by preventing all or part of the heat generated in the mold from propagating into the mesh structure **76**.

[0055] The mesh structure may be retained by retaining means to avoid displacement and/or facilitate the positioning of the substrate thereon. The cavity **17** alone may be enough to achieve that effect or it may cooperate with additional retention structures.

[0056] An exemplary embodiment of the invention is depicted in Figure 8 in which the lower mold part **14B** used to joint-mold a corner on two extrusions having flock on one of their surfaces is shown in a simplified schematic representation. The mold comprises extrusions receiving grooves **300** and **301** to bring the extremities in the molding cavity **14** in position to mold the corner between them. The extrusion-receiving grooves comprise texture conforming structures **100** which, in turn, comprise fiber-receiving channels **70**.

[0057] A more detailed perspective view is shown in Figure 9. The extrusions **302** and **303** are inserted in their respective extrusion receiving grooves **300** and **301**. The extrusion-receiving grooves are configured according to the shape and size of the extrusions and comprise a number of positioning members. Such positioning members are well known in the art. Among the positioning members is a moveable clamping mold insert **306** which comprises clamping teeth **308** which are shown in cross-section in Figure 10. Over-molding or joint-molding of parts often

requires clamping of the part in the mold to avoid displacement of the latter during injection. This clamping generates additional pressure, which can be a localized pressure, that can further damage substrate like flock fibers. The texture conforming structure **100** described above can provide protection against this type of damage as well.

[0058] The shaded gray area indicates the general position of the texture conforming structures **100**.

[0059] A cross-sectional view of the mold from Figure 9 with the extrusion and top mold part **14A** in addition to the bottom mold part **14B** is shown in Figure 10. The extrusion is maintained held in place by positioning member **305** and top mold part **14A** as well as the moveable clamping mold insert **306** which comprises clamping teeth **308**. The fiber-receiving channels **70** are shown underneath extrusion lip **304** of extrusion **302**. The mold may also comprise a cooling system, a part of which is shown at **310** and insulating air gaps **320**.

[0060] The fiber-receiving channels **70** can also contribute to the stabilization of the part to be over-molded. The fibers once inserted in the fiber-receiving channels **70** contribute to resist lateral displacement of the part to be over-molded.

[0061] In another aspect, there is also provided a method of manufacturing an injection-molded article comprising at least one part that is over-molded and wherein said part comprises a process-sensitive substrate, the method comprising: providing a first mold component and a second mold component together defining a cavity; providing a texture-conforming structure to protect the process sensitive substrate; positioning the part to be over-molded within the mold such that the process sensitive substrate is protected by the texture-conforming structure; and injecting a molten material into the cavity to form the article. The method may be applied to over-molding existing parts comprising fibers such as flocked surfaces. In this case the method comprises the step to positioning the fibers into fiber-receiving channels.

[0062] The method may be related to rubber injection molding and may comprise a curing cycle involving heating and cooling of the mold. It can also relate to thermoplastics injection molding in which the mold does not require heating.

[0063] In another aspect of the invention, it has been surprisingly found that the texture conforming structure can create molded projections that have properties similar to flock fibers. One of the problems with over-molding/joint-molding articles having flocked surfaces is that the over-molded/joint-molded section of the article does not have flock. This may create a flocked surface discontinuity. These unflocked surfaces often have an intricate geometry, such as a corner of a sealing frame for automobile windows and post-molding application of flock is often forgone because it is too difficult.

[0064] In an embodiment of the invention fiber receiving channels are provided within the molding cavity in areas free existing parts. When the thermoplastic is injected in the cavity comprising fiber receiving channels **70** that are not occupied by a textured surface, the molten thermoplastic penetrates in the channels and it has been surprisingly found that the resulting molded projections exhibit properties similar to flock fibers. When injecting EPDM, the appearance and the tactile properties are nearly identical. These properties are obtained despite the fact that the density of molded fibers is lower than the density of flock fibers acceptable for automobile sealing applications for example. Thus, EPDM molded fibers having flock-like properties can be obtained using fiber receiving channels 70 having densities, shapes and sizes as described above. Therefore, the mold of the invention may be used to manufacture articles with molded fibers surfaces. In particular, molded fibers that are integral to the molded article. Thus, in one aspect of the invention the mold comprises fiber-receiving channels not only in the regions where the flocked surface of the over-molded article is located but also elsewhere in the mold and especially in the molding cavity to allow molding of fibers to take place. In one preferred embodiment the fiber-receiving channels **70** used to manufacture molded flock fibers have shapes and dimensions similar to those shown in Figure 4B.

[0065] In one example, TPE or EPDM extrusions for automobile window sealing comprising flocked surfaces are joint-molded to create a corner between the two extrusions. In addition to comprising fiber-receiving channels in the extrusion receiving grooves, the mold comprises fiber-receiving channels **70** that are positioned in the molding cavity **14** so that molded fibers will be created on the joint-molded corner and contiguous to the flocked surface of the extrusions. The

dimensions of the fiber-receiving channels can be adjusted to create molded fibers with the desired functional and aesthetic properties. Thus, in one aspect of the invention there is provided an automotive window sealing article comprising two extrusions such as EPDM and TPE extrusions and a joint molded corner, the article further comprising one or more flocked surface on at least one extrusion and molded fibers on the joint molded corner. The flocked surface substantially free of heat damaged flocked surface or flattened flock fibers. The molded fibers on the joint molded corner in the flocked extrusion(s) creating a continuous fiber comprising surface that is substantially visually uniform. That is to say, the flocked surface and the surface with molded fibers are visually substantially uniform. Furthermore, preferably the continuous fiber comprising surface has a substantially uniform tactile properties. By tactile properties it is meant bending, compression, friction, thermal transfer and the like. By substantially uniform it is meant that one or more of these properties for flocked surface and molded fibers, such as EPDM molded fibers, are similar.

[0066] It is to be understood that the singular forms “a”, “an” and “the” include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to “a device” includes reference to one or more of such devices, i.e. that there is at least one device. The terms “comprising”, “having”, “including”, “entailing” and “containing”, or verb tense variants thereof, are to be construed as open-ended terms (i.e., meaning “including, but not limited to,”) unless otherwise noted. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of examples or exemplary language (e.g. “such as”) is intended merely to better illustrate or describe embodiments of the invention and is not intended to limit the scope of the invention unless otherwise claimed.

[0067] While several embodiments have been provided in the present disclosure, it should be understood that the disclosed systems and methods might be embodied in many other specific forms without departing from the scope of the present disclosure. The present examples are to be considered as illustrative and not restrictive, and the intention is not to be limited to the

details given herein. For example, the various elements or components may be combined or integrated in another system or certain features may be omitted, or not implemented.

[0068] This invention has been described in terms of specific embodiments, implementations and configurations which are intended to be exemplary only. Persons of ordinary skill in the art will appreciate, having read this disclosure, that many obvious variations, modifications and refinements may be made without departing from the inventive concept(s) presented herein. The scope of the exclusive right sought by the Applicant(s) is therefore intended to be limited solely by the appended claims.

WHAT IS CLAIMED IS:

1. An injection mold for manufacturing an injection over-molded article comprising one or more existing part having a textured surface characterized by a plurality of fibers, the injection mold comprising:

a first mold component and a second mold component together defining existing part positioning members and a cavity into which a molten material is injected to form additional structure on the one or more existing part to form the injection over-molded article; and

a texture conforming structure comprising a plurality of fiber-receiving channels for receiving and protecting the fibers during over-molding.

2. The injection mold of claim 1 wherein the article is an over-molded article comprising a textured surface and the fiber-receiving channels are equally sized and spaced to receive and protect the textured surface.

3. The injection mold of claim 1 or 2 wherein the fiber-receiving channels comprise walls defining a textured surface supporting tip.

4. The injection mold of claim 3 wherein the textured surface supporting tip is rounded.

5. The injection mold of any one of claims 1-4 wherein the fiber-receiving channels are conical.

6. The injection mold of any one claims 1-4 wherein the fiber-receiving channels are paraboloid.

7. The injection mold of any one of claims 1-6 wherein the textured surface is a flocked surface.

8. The injection mold of any one of claims 3-7 wherein the textured surface supporting tip has a contact surface area with the flocked surface of between about 1 and 10% of the flocked surface.

9. The injection mold of any one of claims 1-8 wherein the fiber receiving channels are integral to the cavity.

10. The injection mold of any one of claims 1-8 wherein the texture conforming structure is a removable insert.

11. The injection mold of any one of claims 1-10 wherein the texture conforming structure is a thermal protection structure.

12. The injection mold of claim 11 wherein the fiber-receiving channels are thermally coupled to a cooling system.

13. The injection mold of claim 10 wherein the removable insert is made of a material different from the mold and wherein said material provides thermal insulation.

14. The injection mold of any one of claims 1-13 wherein the fiber-receiving channels are between 0.2 to 1 mm in depth and 0.05 and .3 mm in width

15. The injection mold of any one of claims 1-14 wherein a plurality of fibers are received into each of the fiber-receiving channels.

16. The injection mold of claim 15 wherein the textured surface is flock and wherein the plurality of fibers received into each of the fiber-receiving channels is between about 10 to about 50 fibers.

17. The injection mold of any one of claims 1-16 wherein a maximum diameter of each channel is greater than a wall thickness separating adjacent channels.

18. The injection mold of any one of claims 1-17 further comprising fiber-receiving channels in the molding cavity for molding projections on the additional structure on the one or more existing part.

19. A method of manufacturing an injection-molded article comprising at least one part that is over-molded and wherein said part comprises a process-sensitive substrate, the method comprising:

providing a first mold component and a second mold component together defining a cavity;

providing a texture conforming structure to protect the process sensitive substrate;

positioning the part to be over-molded within the mold such that the process-sensitive substrate is protected by the texture conforming structure; and

injecting a molten material into the cavity and subjecting the material to a curing cycle to form the article.

20. The method of claim 19 wherein the process-sensitive substrate comprises fibers and wherein the texture conforming structure comprises fiber-receiving channels for receiving and protecting the fibers.

21. An injection molded article comprising molded projections having, collectively, properties similar to flock fibers on a flocked surface.

22. The injection molded article of claim 21 wherein the molded projections are integral to the molded articles.

23. The injection molded article of claim 21 or 22 further comprising a flocked surface and wherein the molded projections are substantially visually undistinguishable from the flocked surface.

24. An injection molded automotive window seal article comprising two or more extrusions joined together by a joint-molded corner, wherein the two or more extrusions comprise one or more flocked area that is substantially free of heat damage of flattened flock fibers.

25. The injection molded automotive window seal article of claim 24 further comprising molded fibers on the joint-molded corner.

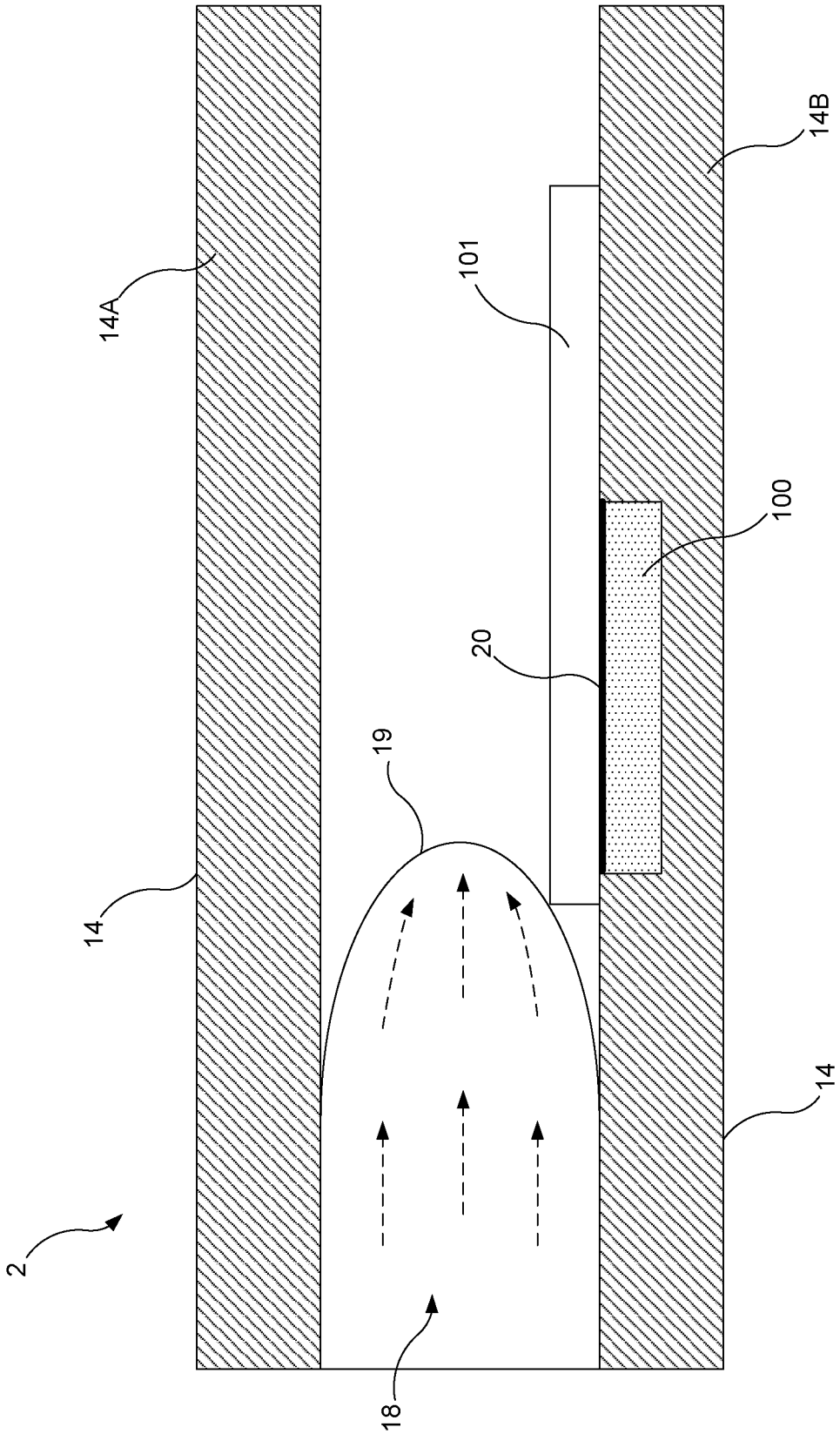

FIG. 1

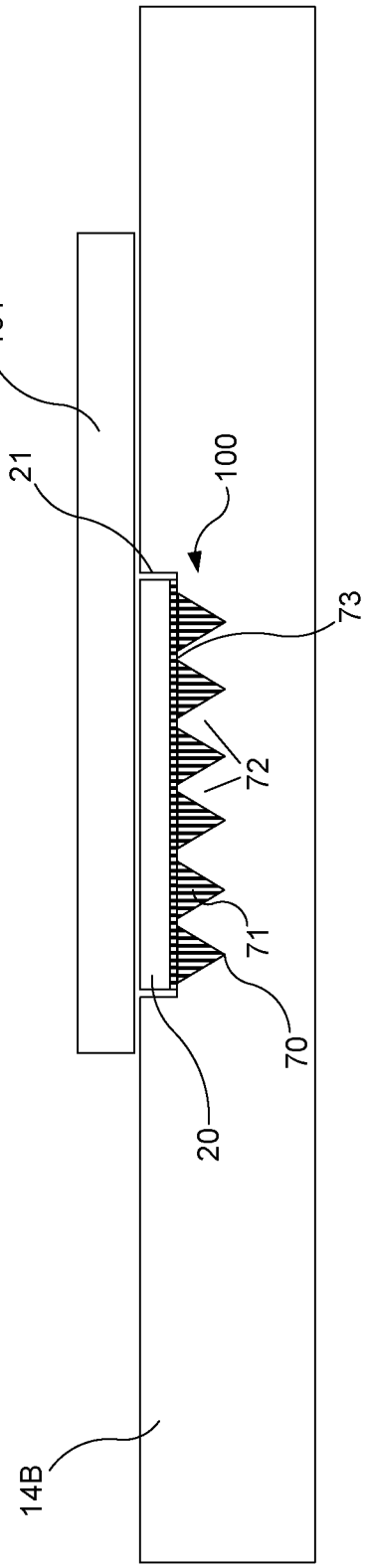

FIG. 2A

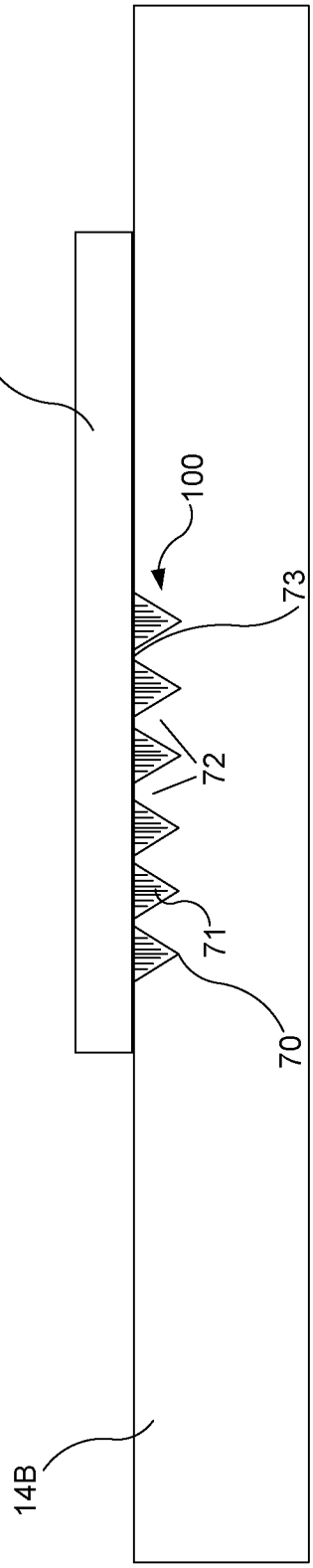

FIG. 2B

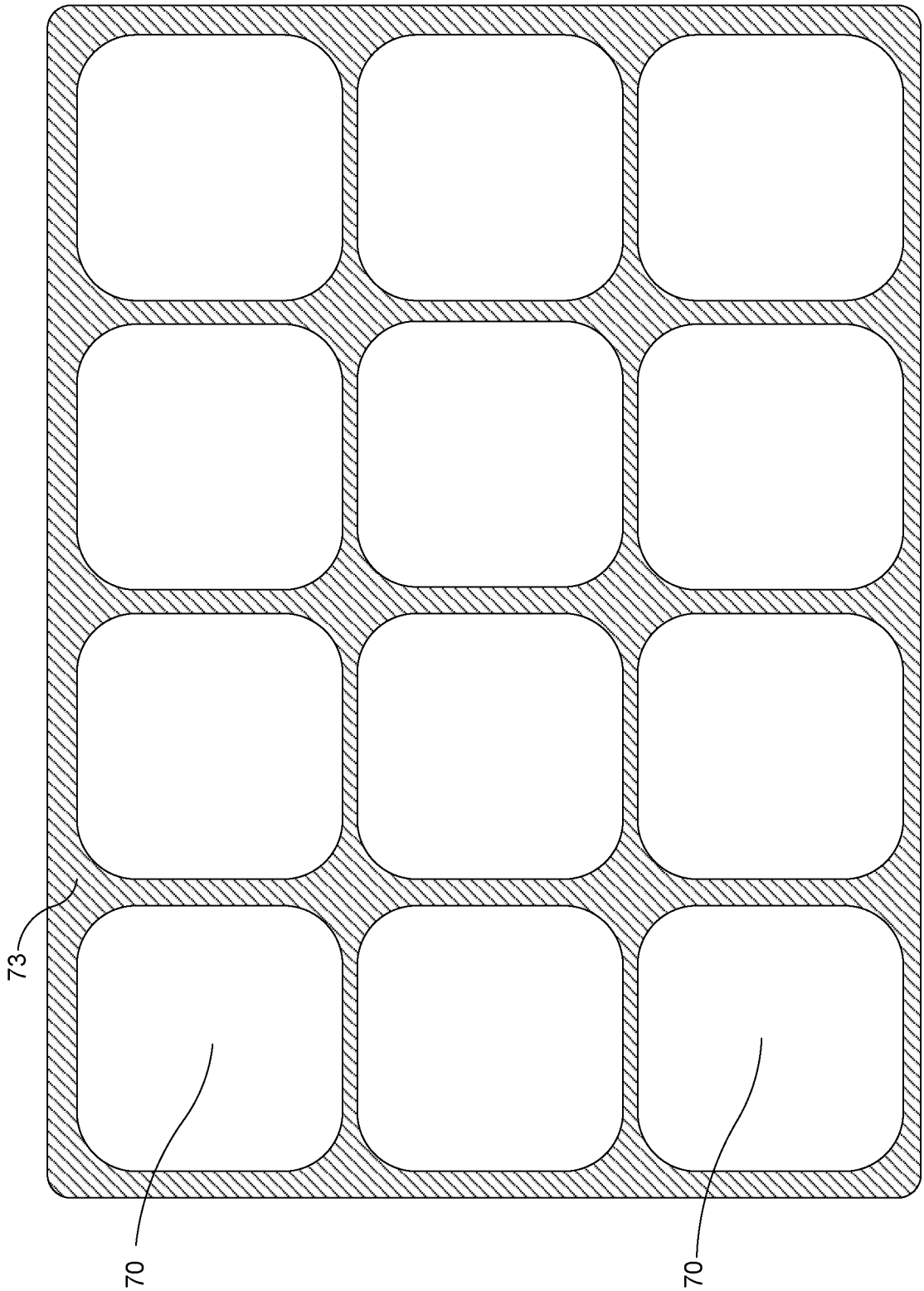

FIG. 3

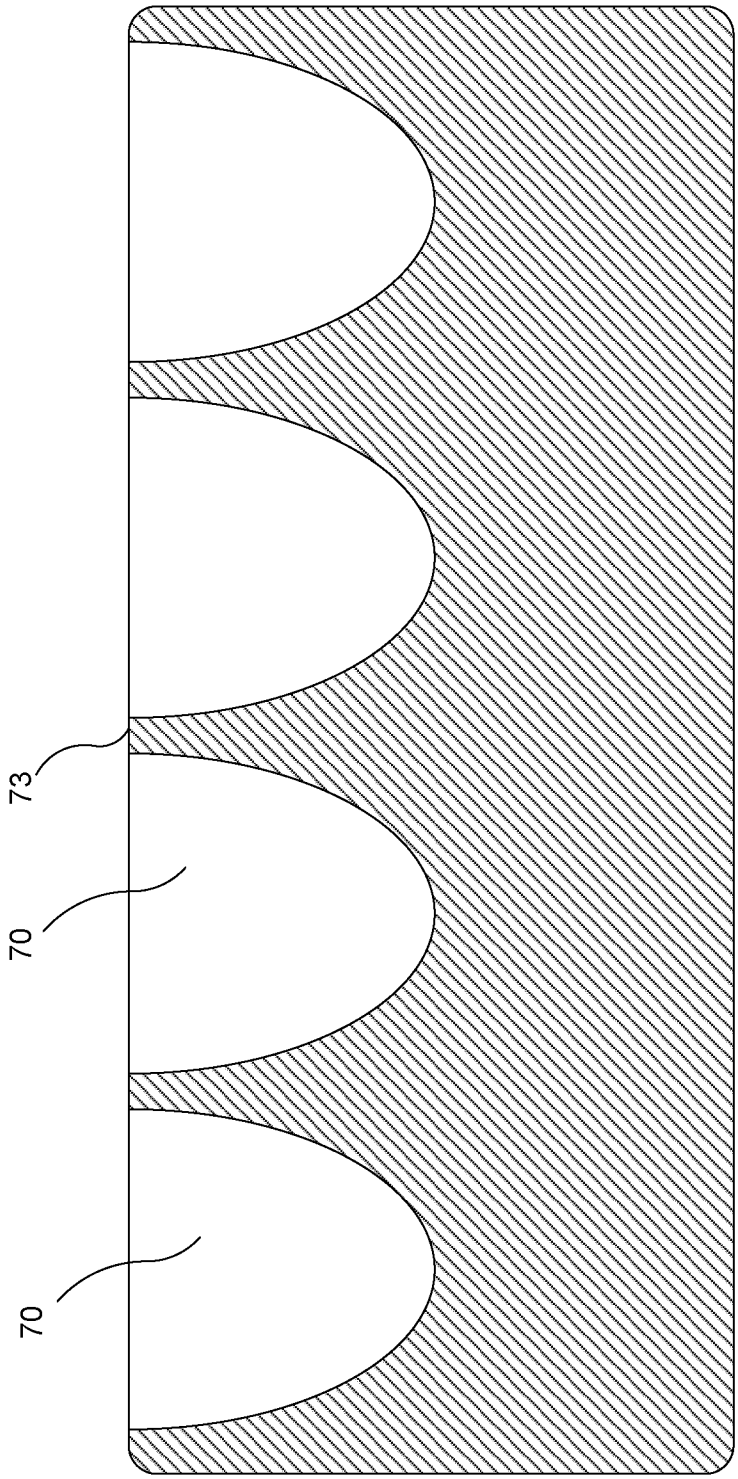

FIG. 4A

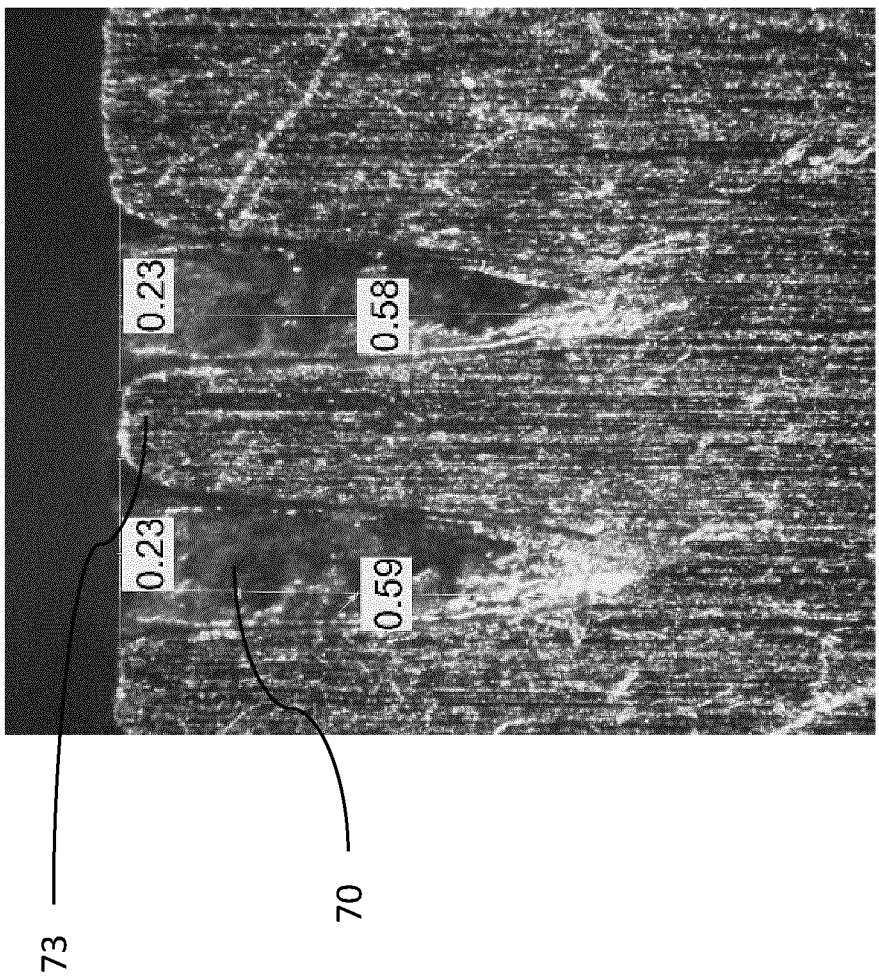

FIG. 4B

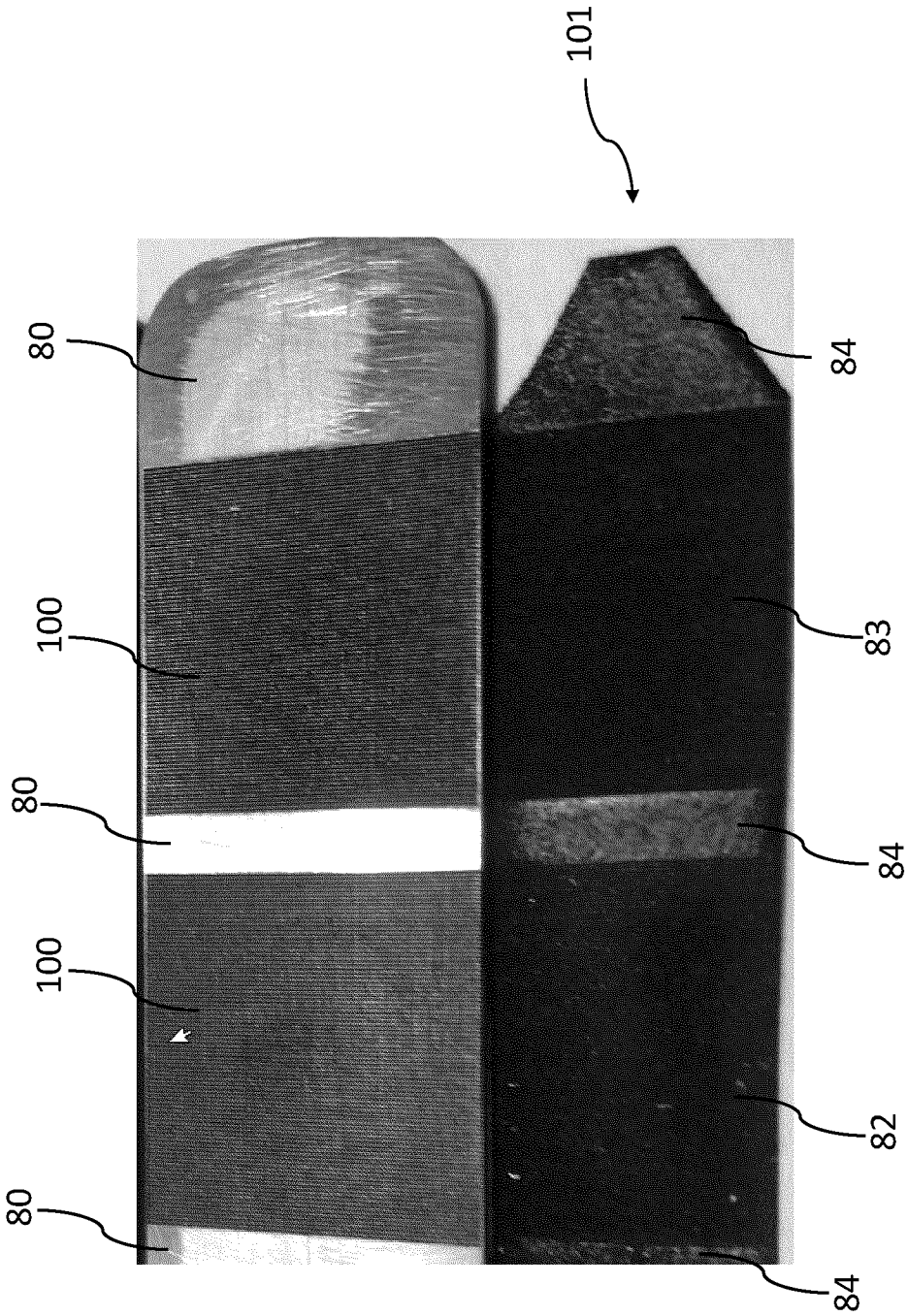

FIG. 4C

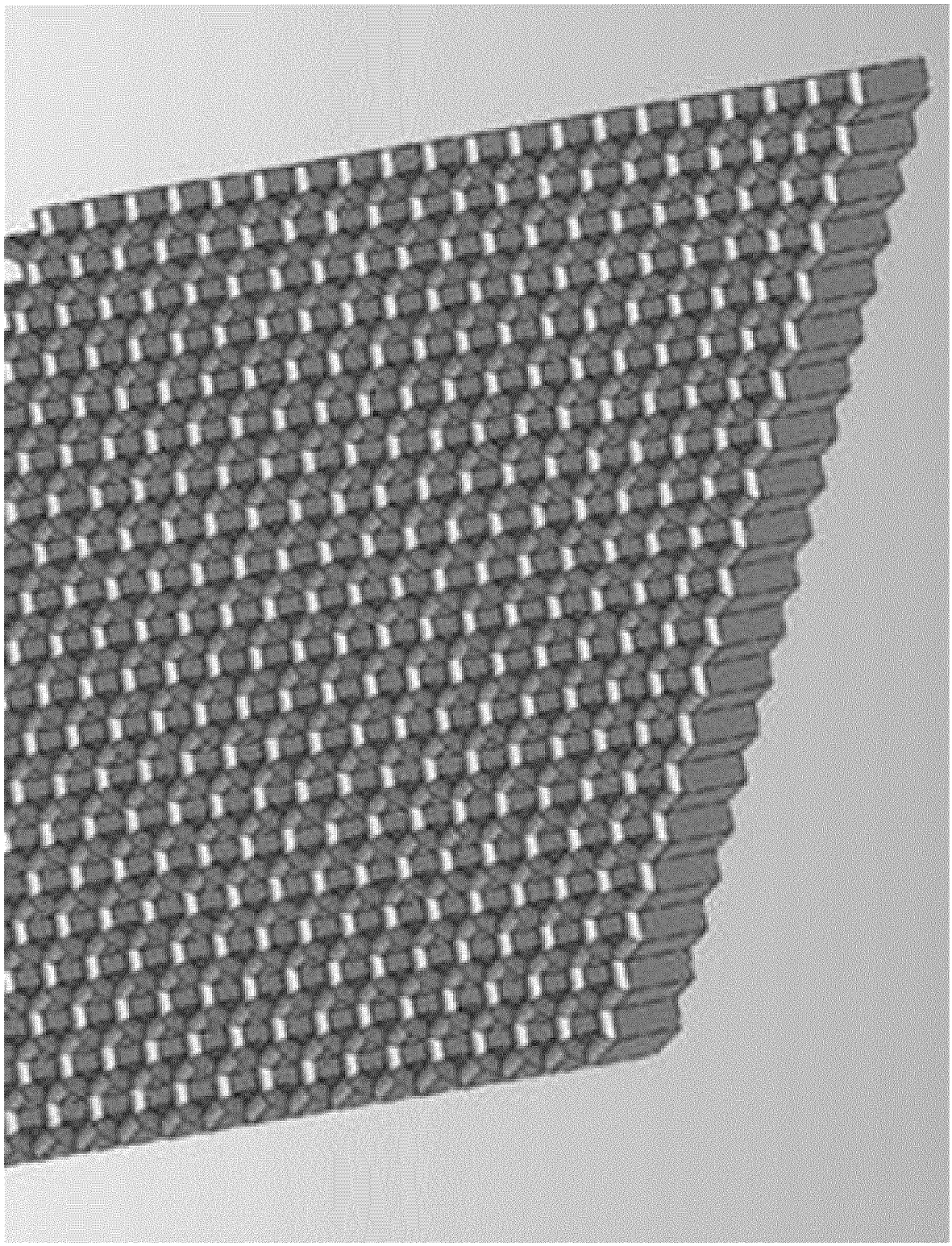

FIG. 5

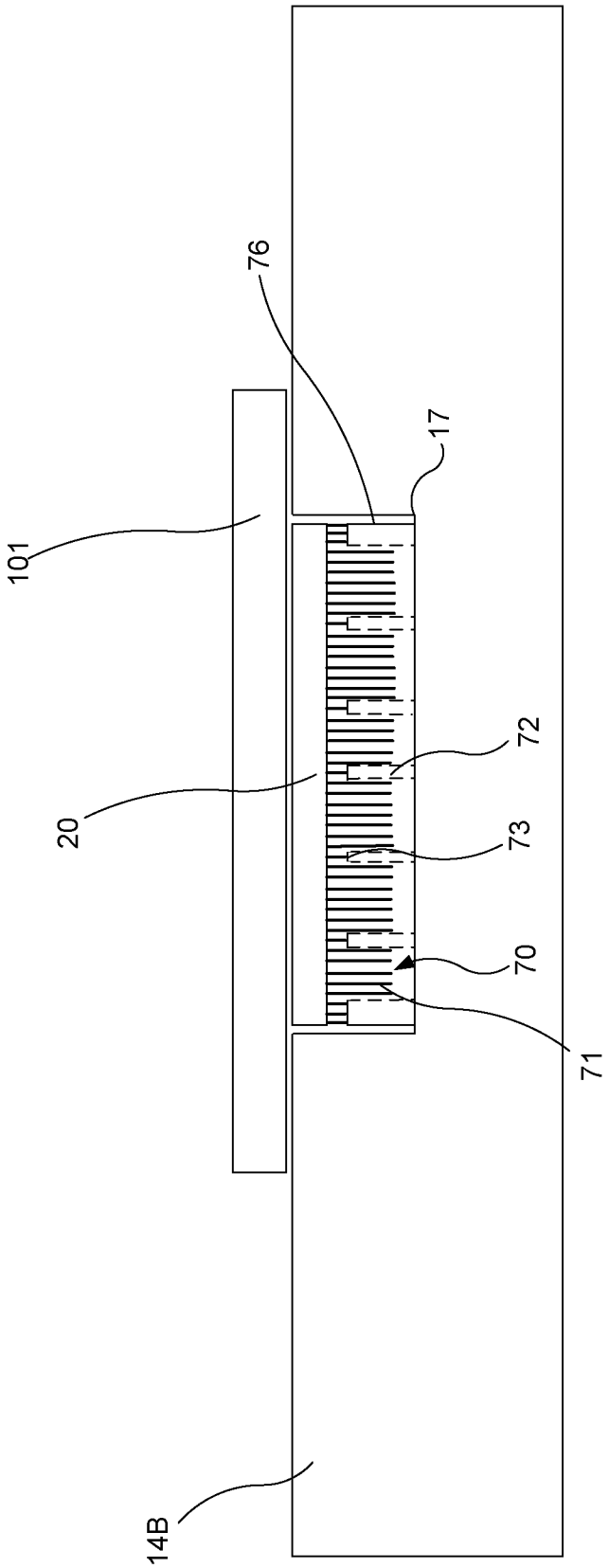

FIG. 6

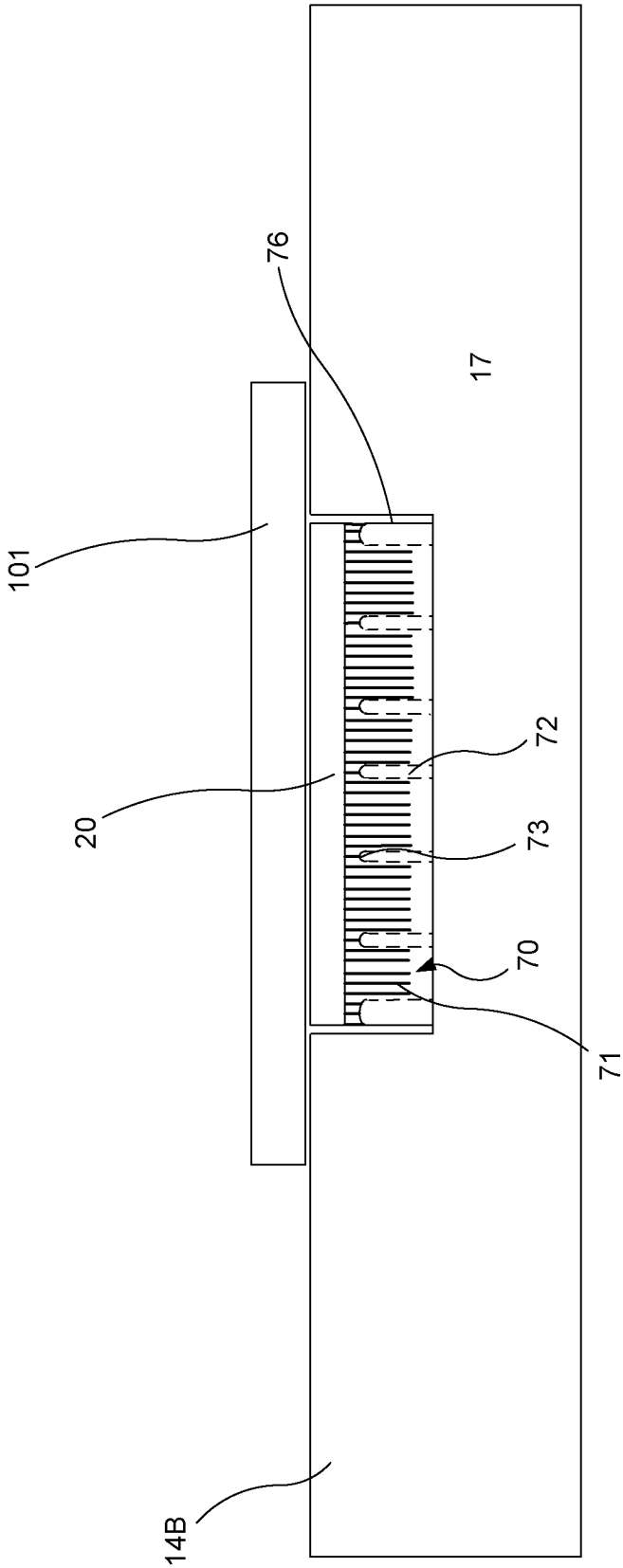

FIG. 7

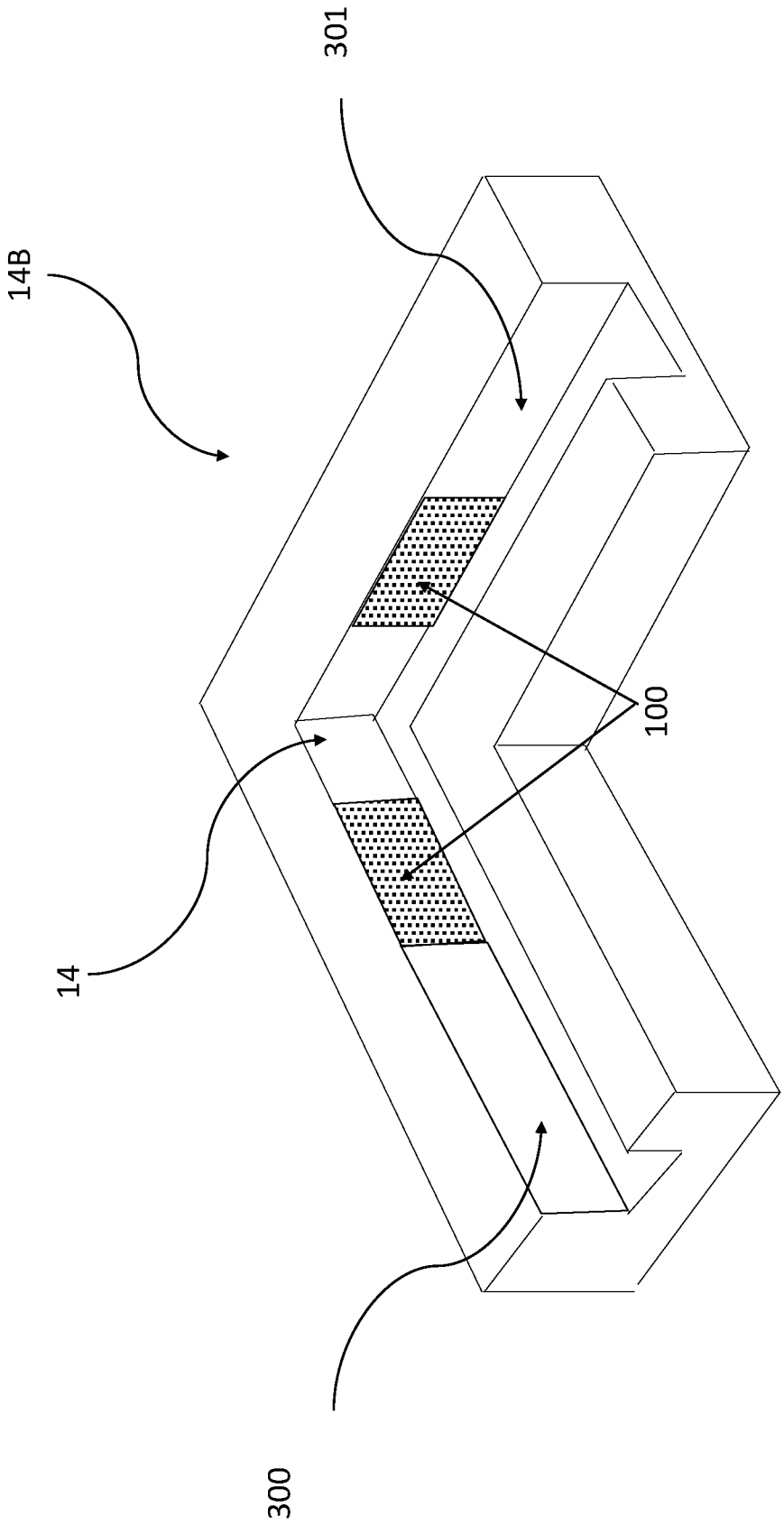

FIG. 8

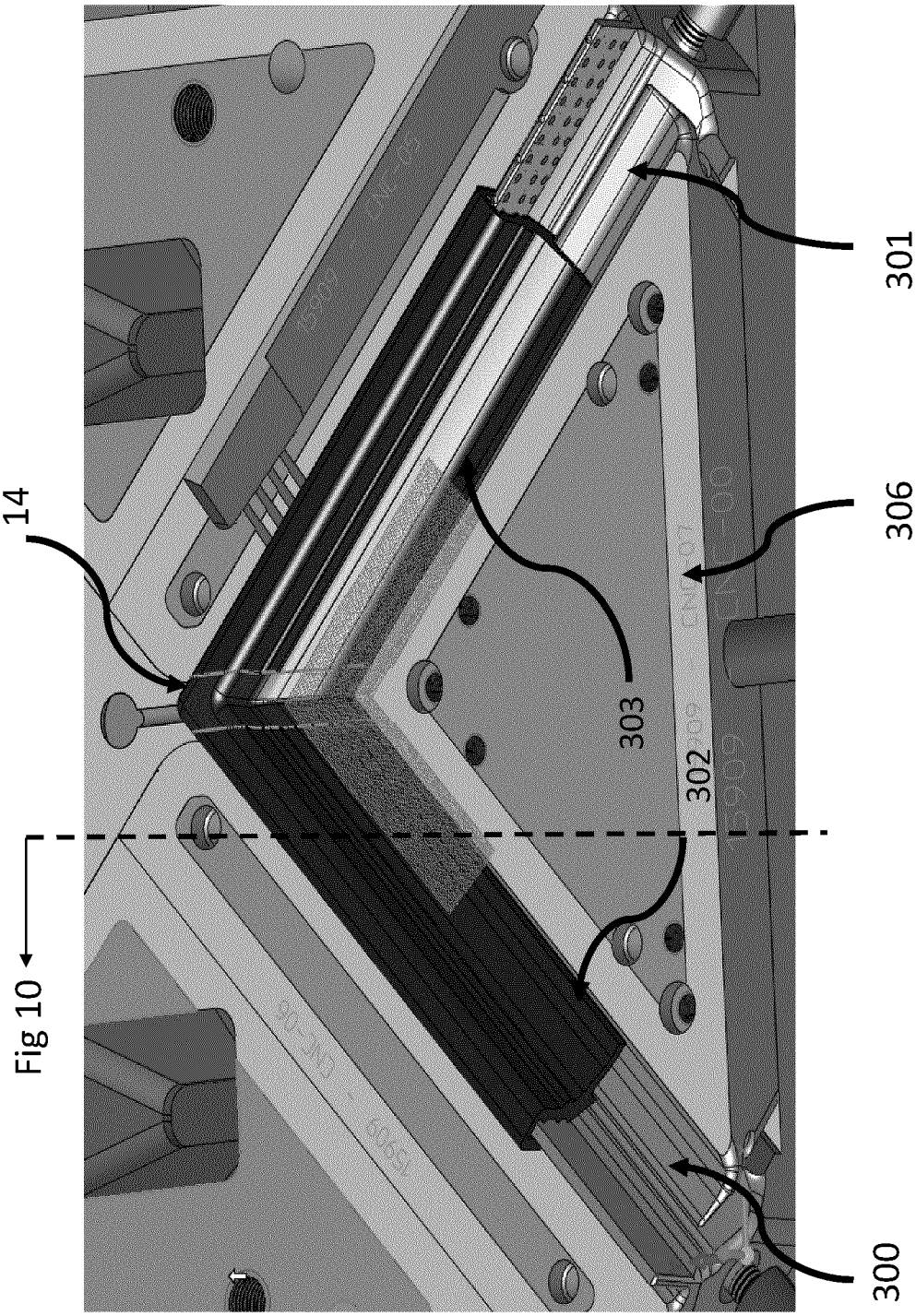

FIG. 9

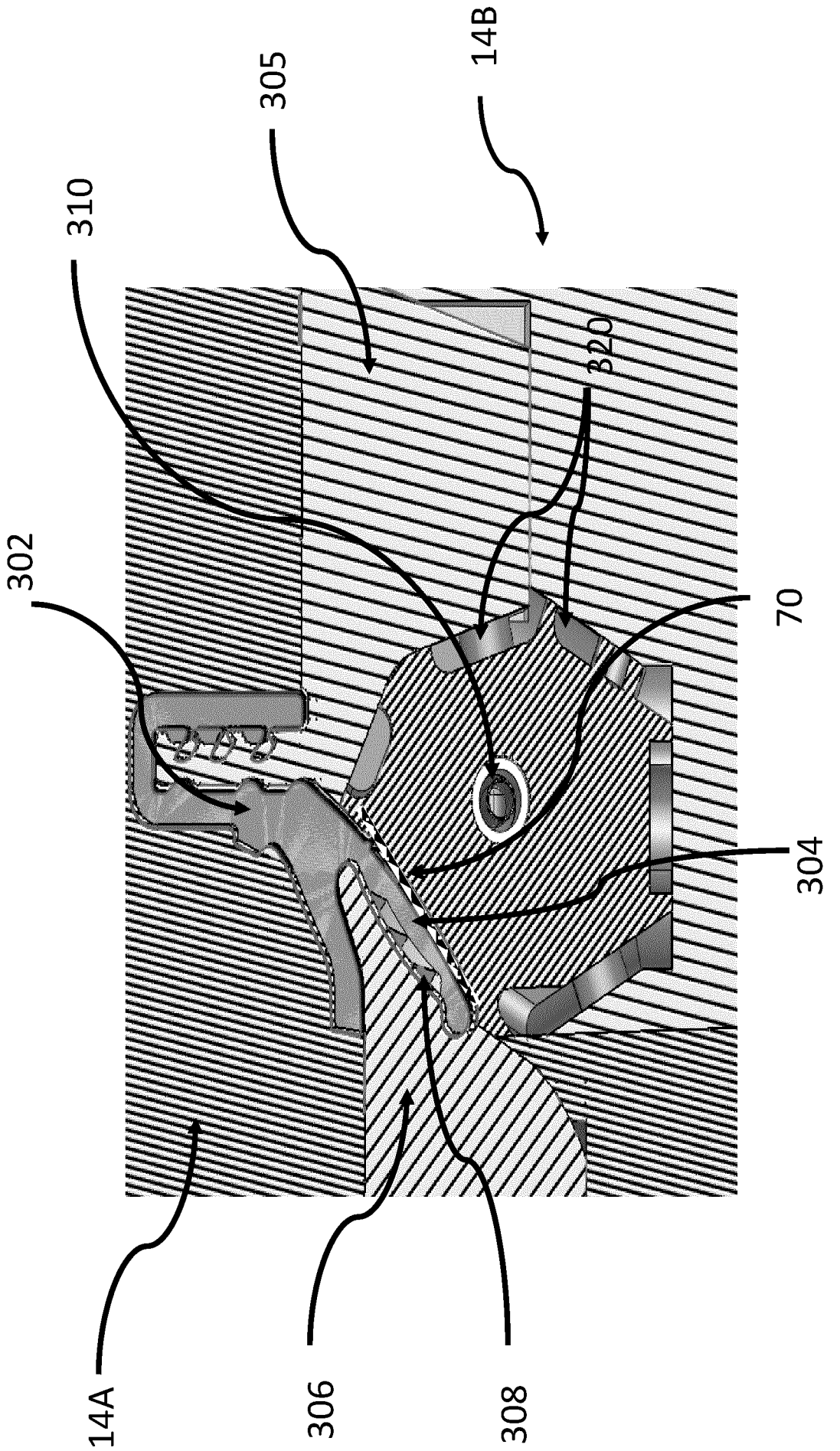

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2019/050466

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***B29C 45/14*** (2006.01) , ***B29C 45/17*** (2006.01) , ***B29C 45/26*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: B29C 45/14 (2006.01) , B29C 45/17 (2006.01) , B29C 45/26 (2006.01), B29C 33/42 (2006.01), B29C 45/+, B29C 33/+, B29C+

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Questel-Orbit (FAMPAT): IPC, with keywords: flock, fiber, fibre, bristle, channel, protect

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5606781 B (PROVOST, G.A. et al.) 4 March 1997 (04-03-1997) -abstract; columns 5-9; figures 4-10	1-3, 7-9, 11, 12, 14-20
X	CA 2187095 A1 (BOUCHERIE, B.G.) 19 October 1995 (19-10-1995) -whole document	1-7, 9-10, 12, 13, 15, 16, 19-20
X	US 5540970 B (BANFIELD, D.L. et al.) 30 July 1996 (30-07-1996) -abstract; columns 5-7; figures 3-11	19
X	US 2008/0150186 A1 (ABRAMS, L.B.) 26 June 2008 (26-06-2008) -abstract; pages 2-8; figures 1-2	19
X P, X	WO 2018/213914 A1 (LONGPRE, Y. et al.) 29 November 2018 (29-11-2018) -paragraphs 73-91; claims 30-32; figures 18-22	12, 14, 16, 18 1-11, 13, 15, 17, 19-20

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

*	Special categories of cited documents:
"A"	document defining the general state of the art which is not considered to be of particular relevance
"D"	document cited by the applicant in the international application
"E"	earlier application or patent but published on or after the international filing date
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O"	document referring to an oral disclosure, use, exhibition or other means
"P"	document published prior to the international filing date but later than the priority date claimed
"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&"	document member of the same patent family

Date of the actual completion of the international search 12 July 2019 (12-07-2019)	Date of mailing of the international search report 18 July 2019 (18-07-2019)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Elizabeth Gojkovic (819) 934-3468

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 8-57880 A (HIROYUKI, K. et al.) 5 March 1996 (05-03-1996) (abstract) -abstract; figures	19
A	US 2002/0079605 A1 (PEARSON, L.S. et al.) 27 June 2002 (27-06-2002) -whole document	1-20
A	EP 2248649 A1 (TALAVERA BARCELO, J.) 10 November 2010 (10-11-2010) -whole document	1-20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2019/050466

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
The claims are directed to a plurality of inventive concepts as follows:

Group A - Claims 1-20 are directed to a method and mold for manufacturing an injection over-molded article, where an existing part with a textured surface is placed in first and second mold components, where a texture conforming structure comprising a plurality of fiber-receiving channels protects the textured surface;

Continued on extra sheet (page 10).

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos.:

4. ☑ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos.:
1-20

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Continuation of: Box No. III

Group B - Claims 21-23 are directed to an injection molded article comprising molded projections with properties similar to flock fibers; and
Group C - Claims 24-25 are directed to an injection molded window seal comprising two or more extrusions joined together by a joint-molded corner, with one or more flocked area that is substantially free of heat damage.

The claims must be limited to one inventive concept as set out in PCT Rule 13.

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US5606781A	04 March 1997 (04-03-1997)	WO9625063A1	22 August 1996 (22-08-1996)
CA2187095A1	19 October 1995 (19-10-1995)	AT160969T	15 December 1997 (15-12-1997)
		AU2256595A	30 October 1995 (30-10-1995)
		BR9507301A	30 September 1997 (30-09-1997)
		CN1147222A	09 April 1997 (09-04-1997)
		CZ290996A3	12 March 1997 (12-03-1997)
		DE69501173D1	22 January 1998 (22-01-1998)
		EP0676268A1	11 October 1995 (11-10-1995)
		EP0676268B1	10 December 1997 (10-12-1997)
		GB9406867D0	01 June 1994 (01-06-1994)
		GB2288140A	11 October 1995 (11-10-1995)
		IL113220D0	31 July 1995 (31-07-1995)
		JPH09511462A	18 November 1997 (18-11-1997)
		KR970702137A	13 May 1997 (13-05-1997)
		MX9604631A	29 November 1997 (29-11-1997)
		NZ284065A	24 April 1997 (24-04-1997)
		TW283113B	11 August 1996 (11-08-1996)
		WO9527605A1	19 October 1995 (19-10-1995)
		ZA9502170B	12 December 1995 (12-12-1995)
US5540970A	30 July 1996 (30-07-1996)	AU7323094A	06 February 1995 (06-02-1995)
		CA2086326A1	04 November 1992 (04-11-1992)
		CA2086326C	25 December 2001 (25-12-2001)
		CN1126943A	17 July 1996 (17-07-1996)
		CN1231585A	13 October 1999 (13-10-1999)
		CN1212786C	03 August 2005 (03-08-2005)
		DE537333T1	03 February 1994 (03-02-1994)
		DE713369T1	15 May 1997 (15-05-1997)
		DE69205112D1	02 November 1995 (02-11-1995)
		DE69205112T2	30 May 1996 (30-05-1996)
		DE69428362D1	25 October 2001 (25-10-2001)
		DE69428362T2	04 July 2002 (04-07-2002)
		DE69723272D1	07 August 2003 (07-08-2003)
		DE69723272T2	27 May 2004 (27-05-2004)
		EP0537333A1	21 April 1993 (21-04-1993)
		EP0537333B1	27 September 1995 (27-09-1995)
		EP0713369A1	29 May 1996 (29-05-1996)
		EP0713369B1	19 September 2001 (19-09-2001)
		EP0921739A1	16 June 1999 (16-06-1999)
		EP0921739B1	02 July 2003 (02-07-2003)
		ES2079191T3	01 January 1996 (01-01-1996)
		ES2161772T3	16 December 2001 (16-12-2001)
		JPH09506559A	30 June 1997 (30-06-1997)
		JP3700727B2	28 September 2005 (28-09-2005)
		JPH06501187A	10 February 1994 (10-02-1994)
		JP2000516485A	12 December 2000 (12-12-2000)
		KR20000029782A	25 May 2000 (25-05-2000)
		KR100469562B1	02 February 2005 (02-02-2005)
		KR960703531A	31 August 1996 (31-08-1996)
		US5286431A	15 February 1994 (15-02-1994)
		US5736217A	07 April 1998 (07-04-1998)
		US5786061A	28 July 1998 (28-07-1998)
		US5922436A	13 July 1999 (13-07-1999)
		US5942177A	24 August 1999 (24-08-1999)
		WO9219119A1	12 November 1992 (12-11-1992)
		WO9501741A1	19 January 1995 (19-01-1995)

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
		WO9501863A1	19 January 1995 (19-01-1995)
		WO9805232A1	12 February 1998 (12-02-1998)
US2008150186A1	26 June 2008 (26-06-2008)	US8354050B2	15 January 2013 (15-01-2013)
		AT416041T	15 December 2008 (15-12-2008)
		AU7799101A	13 February 2002 (13-02-2002)
		AU8071101A	05 February 2002 (05-02-2002)
		AU2001277991B2	15 June 2006 (15-06-2006)
		AU2001280711B2	20 July 2006 (20-07-2006)
		AU2002249810B2	01 February 2007 (01-02-2007)
		AU2003247922A1	23 January 2004 (23-01-2004)
		AU2003247922A8	23 January 2004 (23-01-2004)
		AU2003251790A1	23 January 2004 (23-01-2004)
		AU2003258991A1	23 January 2004 (23-01-2004)
		AU2003258991A8	23 January 2004 (23-01-2004)
		AU2004279825A1	21 April 2005 (21-04-2005)
		BR0113019A	02 March 2004 (02-03-2004)
		CA2415680A1	31 January 2002 (31-01-2002)
		CA2415680C	17 January 2012 (17-01-2012)
		CA2489868A1	15 January 2004 (15-01-2004)
		CA2541821A1	21 April 2005 (21-04-2005)
		CN1486223A	31 March 2004 (31-03-2004)
		CN1264612C	19 July 2006 (19-07-2006)
		CN1455724A	12 November 2003 (12-11-2003)
		CN1280081C	18 October 2006 (18-10-2006)
		CN1649725A	03 August 2005 (03-08-2005)
		CN1678454A	05 October 2005 (05-10-2005)
		CN101380864A	11 March 2009 (11-03-2009)
		CN101380864B	13 March 2013 (13-03-2013)
		DE60136850D1	15 January 2009 (15-01-2009)
		EP1309446A1	14 May 2003 (14-05-2003)
		EP1309446A4	20 January 2010 (20-01-2010)
		EP1309446B1	03 April 2013 (03-04-2013)
		EP1311380A1	21 May 2003 (21-05-2003)
		EP1311380A4	10 June 2009 (10-06-2009)
		EP1351779A1	15 October 2003 (15-10-2003)
		EP1351779A4	01 March 2006 (01-03-2006)
		EP1351779B1	03 December 2008 (03-12-2008)
		EP1539488A2	15 June 2005 (15-06-2005)
		EP1551629A1	13 July 2005 (13-07-2005)
		EP1551629A4	22 July 2009 (22-07-2009)
		ES2315319T3	01 April 2009 (01-04-2009)
		GB0608282D0	07 June 2006 (07-06-2006)
		GB2421710A	05 July 2006 (05-07-2006)
		HK1055708A1	27 September 2013 (27-09-2013)
		HK1128662A1	28 June 2013 (28-06-2013)
		JP2005532923A	04 November 2005 (04-11-2005)
		JP4280493B2	17 June 2009 (17-06-2009)
		JP2004524956A	19 August 2004 (19-08-2004)
		JP4388744B2	24 December 2009 (24-12-2009)
		JP2005503936A	10 February 2005 (10-02-2005)
		JP5220977B2	26 June 2013 (26-06-2013)
		JP2005532202A	27 October 2005 (27-10-2005)
		JP2005532203A	27 October 2005 (27-10-2005)
		KR20060103964A	09 October 2006 (09-10-2006)
		KR100794604B1	14 January 2008 (14-01-2008)
		KR20030086244A	07 November 2003 (07-11-2003)

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
		KR100887331B1	05 March 2009 (05-03-2009)
		KR20050044885A	13 May 2005 (13-05-2005)
		US6929771B1	16 August 2005 (16-08-2005)
		US2003072889A1	17 April 2003 (17-04-2003)
		US6977023B2	20 December 2005 (20-12-2005)
		US2003207072A1	06 November 2003 (06-11-2003)
		US7338697B2	04 March 2008 (04-03-2008)
		US7344769B1	18 March 2008 (18-03-2008)
		US2004081791A1	29 April 2004 (29-04-2004)
		US7351368B2	01 April 2008 (01-04-2008)
		US2002009571A1	24 January 2002 (24-01-2002)
		US7364782B2	29 April 2008 (29-04-2008)
		US2003186019A1	02 October 2003 (02-10-2003)
		US7381284B2	03 June 2008 (03-06-2008)
		US2004058120A1	25 March 2004 (25-03-2004)
		US7390552B2	24 June 2008 (24-06-2008)
		US2003211279A1	13 November 2003 (13-11-2003)
		US7402222B2	22 July 2008 (22-07-2008)
		US2004055692A1	25 March 2004 (25-03-2004)
		US7410682B2	12 August 2008 (12-08-2008)
		US2004053001A1	18 March 2004 (18-03-2004)
		US7413581B2	19 August 2008 (19-08-2008)
		US2008113144A1	15 May 2008 (15-05-2008)
		US7632371B2	15 December 2009 (15-12-2009)
		US2004050482A1	18 March 2004 (18-03-2004)
		US2005081985A1	21 April 2005 (21-04-2005)
		US2007289688A1	20 December 2007 (20-12-2007)
		US2008006968A1	10 January 2008 (10-01-2008)
		US2010092719A1	15 April 2010 (15-04-2010)
		US2011052859A1	03 March 2011 (03-03-2011)
		US2013115408A1	09 May 2013 (09-05-2013)
		WO0207959A1	31 January 2002 (31-01-2002)
		WO0209925A1	07 February 2002 (07-02-2002)
		WO02058854A1	01 August 2002 (01-08-2002)
		WO03031083A1	17 April 2003 (17-04-2003)
		WO2004005023A1	15 January 2004 (15-01-2004)
		WO2004005415A2	15 January 2004 (15-01-2004)
		WO2004005415A3	24 June 2004 (24-06-2004)
		WO2004005600A2	15 January 2004 (15-01-2004)
		WO2004005600A3	25 March 2004 (25-03-2004)
		WO2005035235A2	21 April 2005 (21-04-2005)
		WO2005035235A3	27 October 2005 (27-10-2005)
WO2018213914A1	29 November 2018 (29-11-2018)	None	
JP857880 A	5 March 1996 (05-03-1996)	None	

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US2002079605A1	27 June 2002 (27-06-2002)	DE60106159D1	11 November 2004 (11-11-2004)
		DE60106159T2	08 September 2005 (08-09-2005)
		EP1182024A1	27 February 2002 (27-02-2002)
		EP1182024B1	06 October 2004 (06-10-2004)
		GB0021009D0	11 October 2000 (11-10-2000)
		GB2366230A	06 March 2002 (06-03-2002)
		US2005140056A1	30 June 2005 (30-06-2005)
EP2248649A1	10 November 2010 (10-11-2010)	ES1093155U	15 November 2013 (15-11-2013)
		ES1093155Y	05 February 2014 (05-02-2014)