(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 January 2016 (07.01.2016)

(10) International Publication Number
WO 2016/001763 A2

(51) International Patent Classification: *B29C 43/00* (2006.01)

(21) International Application Number: PCT/IB2015/001744

(22) International Filing Date: 1 July 2015 (01.07.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10 2014 109 174.4 1 July 2014 (01.07.2014) DE

(71) Applicant: **JOHNSON CONTROLS INTERIORS MANAGEMENT GMBH** [DE/DE]; Jagenbergstrasse 1, 41468 Neuss (DE).

(72) Inventor: **GALAN, Jesus**; Eifgenweg 11, 40625 Dusseldorf (DE).

(74) Agent: **MEISSSNER BOLTE & PARTNER GBR**; Depotstrasse 5 1/2, 86199 Augsburg (DE).

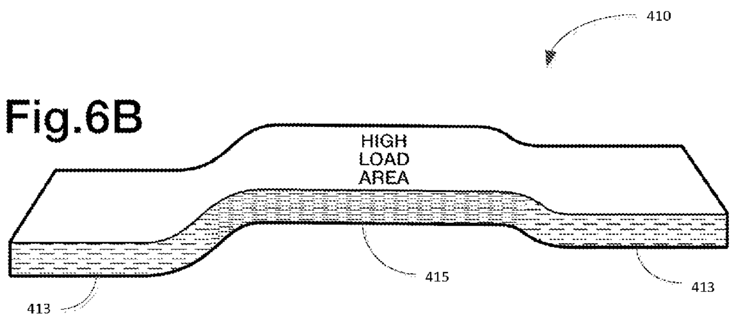
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

(54) **Title**: METHOD FOR PRODUCING A MOLDED BODY FROM A MATERIAL COMPRISING FIBERS AND A DEVICE FOR REALIZING THE METHOD

Fig.6B



(57) **Abstract**: A component for use within an interior of a vehicle comprising a first section having a first density and a first thickness; a second section having a second density and a second thickness; and a transition between the first section and the second section. The first section comprises a material comprising fibers having an orientation, and the second section comprises a material comprising fibers having an orientation. Across the transition the orientation of fibers of the first section and the orientation of fibers of the second section are generally maintained, and the fibers are supplied to the first section and to the second section in an operation.

WO 2016/001763 A2

METHOD FOR PRODUCING A MOLDED BODY FROM A MATERIAL COMPRISING FIBERS AND A DEVICE FOR REALIZING THE METHOD

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This application claims the benefit of and priority to German Patent Application No. 10 2014 109 174.4, filed on July 1, 2014, the entire disclosure of which is hereby incorporated by reference.

TECHNICAL FIELD

[0002] This application relates generally to a molded body and a method for producing the molded body from a material comprising fibers, as well as a corresponding device for realizing the method.

BACKGROUND

[0003] Particularly in automotive manufacturing, different molded parts needing to have a plurality of properties are required in the realm of vehicle interior fittings. On the one hand, it is necessary for them to be durable and varied, even having more complex three-dimensional forms, in order to satisfy the functional and aesthetic demands of consumers. On the other hand, they must at the same time have low mass and be as simple as possible to manufacture and install so as to keep the costs low for the manufacturer.

[0004] Forming such molded bodies from a material comprising fibers is known from the prior art and associated with the advantage of good durability and the molded bodies being of very low weight.

[0005] A method for producing a three-dimensional molded part is thus for example known from printed publication DE 10 2012 019 534 A1, which uses a multi-part mold into which a material comprising fibers is blown. The mold comprises a plurality of holes in its lower part for the necessary pressure equalization and, in so doing, only allows a so-called semi-finished product; i.e. a preform, to be formed in this relatively lightweight forming tool. After the blow-in procedure, a flow of air to heat the material comprising fibers is directed through the mold or, alternatively, an adhesive is added to bond the fibers together. To create the final form, these semi-finished products are first brought to their final production site and then molded in a further, heavier tool, for example in a drawing press.

[0006] A method for producing a three-dimensional molded part using a multi-part mold is likewise known from printed publication DE 103 24 735 B3. A material comprising fibers aerated with a binding agent is thereby blown into the mold; solidifying upon a pressing force being applied to the molded part and, subsequent to the pressing operation, heated air is introduced into the mold so that the binding agent melts and lends the molded part the necessary dimensional stability. The bottom mold is also provided with holes for pressure equalization which connect the intermediate mold space, within which the molded part is formed, to the surrounding atmosphere.

[0007] These conventional solutions known from the prior art have the disadvantage of not enabling any continuous thermosetting molding process. In one case, a semi-finished product is first produced, to subsequently be deep-drawn, which requires the use of several differently designed tools and in some cases entails an additional transport step. In another case, the pressing ensues prior to heating the binding agent. The bottom mold used in the conventional solutions has holes which impedes the handling of the material comprising fibers to be introduced into the mold.

SUMMARY

[0008] One exemplary embodiment relates to a component for use within an interior of a vehicle. The component includes a first section having a first density and a first thickness, and a second section extending from the first section and having a second density and a second thickness. Each section includes a material comprising fibers having an orientation, and at least one of the orientation, the density, and the second thickness of the second section is configured relative to the orientation, the density, and the second thickness of the first section to provide an integrity of the second section that is greater than an integrity of the first section.

[0009] Another exemplary embodiment relates to a component for use within an interior of a vehicle. The component includes a first section having a first density and a first thickness; a second section having a second density and a second thickness; and a transition between the first section and the second section. The first section comprises a material comprising fibers having an orientation, and the second section comprises a material comprising fibers having an orientation. The orientation of fibers of the first section and the orientation of fibers of the second section are generally maintained across the transition. The fibers are also supplied to the first section and to the second section in an operation.

[0010] Another exemplary embodiment relates to a method of making a component for use in a vehicle from a material comprising fibers utilizing a mold that includes at least a first part and a second part, wherein each of the first and second parts includes a surface that defines a cavity. The method includes heating at least one of the first and second parts of the mold to a first temperature; supplying a material comprising fibers into the cavity; and compressing the material using at least one of the first and second parts of the mold to form the component.

[0011] Another exemplary embodiment relates to a system for producing a component for use in a vehicle from a material comprising fibers. The system includes a first mold, a second mold, a feeder, and a heater. The first mold includes a first part having a surface and a second part that is movable relative to the first part between a closed position and an open position. The second part has a surface, and the surfaces of the first and second parts define a first cavity. The feeder is configured to introduce the fibers of the material into the first cavity when the first mold is in the closed position. The second mold includes the first part and a third part that is movable relative to the first part between an open position and a closed position. The third part has a surface. The heater is configured to heat at least one of the first, second and third parts to a first temperature. When the second part is in the open position, the first part is movable from the first mold to the second mold to move the fibers from the first mold to the second mold for compression between the surfaces of the first and third parts when the second mold is in the closed position.

[0012] Another exemplary embodiment relates to method of making a panel of a vehicle from a material comprising fibers utilizing a mold comprising first and second parts and movable between an open position and a closed position, where each of the first and second parts includes a mold surface. The method includes heating at least one of the first and second parts of the mold to a first temperature that is at least equal to a threshold activation temperature of the material comprising fibers; introducing a supply of the material comprising fibers into the mold when in the open position; and moving the mold to the closed position to apply a compression force to the material comprising fibers in a cavity between the mold surfaces of the first and second parts. The method may be carried out in the order provided.

[0013] Another exemplary embodiment relates to a device for producing a panel of a vehicle from a material comprising fibers. The device includes a first mold, a feeder, a second mold, and a heating mechanism. The first mold includes a first part having a first mold surface and a second part that is movable relative to the first part between a closed position and an open position. The second part has a second mold surface. The feeder is configured to introduce the material comprising fibers into a cavity defined by the first and second mold surfaces when in the closed position. The second mold includes the first part of the first mold and a third part that is movable relative to the first part between a closed position and an open position. The heating mechanism is configured to heat at least one of the first part, second part, and the third part to a first temperature that is at least equal to a threshold activation temperature of the material comprising fibers. When the second part is in the open position, the first part is movable from the first mold to the second mold to move the material comprising fibers from the first mold to the second mold.

[0014] Yet another exemplary embodiment relates to a panel for use in an interior of a vehicle that is subjected to a first load at a first location and a second load at a second location that is higher than the first load. The panel includes a first section including a material comprising fibers and having a first density and a first thickness. The panel also includes a second section extending from the first section. The second section includes the material comprising fibers and has a second density and a second thickness. At least one of the second density and the second thickness is greater than the, respective, first density and the first thickness, such that the second section is configured to be subjected to the second load and the first section is configured to be subjected to the first load.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1A is a perspective view of an exemplary embodiment of a vehicle containing an embodiment of the invention.

[0016] FIG. 1B is an interior of the vehicle shown in FIG. 1A containing an embodiment of the invention.

[0017] FIG. 2 is a schematic sectional side view of a device for realizing an inventive method, according to an exemplary embodiment, while material comprising fibers is being introduced into the bottom part of the mold.

[0018] FIG. 3 is a schematic sectional side view of the device of FIG. 2 shown in a closed state within a pressing device.

[0019] FIG. 4 is a schematic diagram illustrating an inventive method, according to another exemplary embodiment.

[0020] FIG. 5A is a perspective view of an exemplary embodiment of a component (e.g., a panel) for use with a vehicle, such as the vehicle shown in FIG. 1.

[0021] FIG. 5B is a perspective view of the component shown in FIG. 5A used with a support.

[0022] FIG. 6A is a perspective view of another exemplary embodiment of a component for use with a vehicle, such as the vehicle shown in FIG. 1.

[0023] FIG. 6B is a perspective view of yet another exemplary embodiment of a component for use with a vehicle, such as the vehicle shown in FIG. 1.

[0024] FIG. 7A is a schematic diagram of an exemplary embodiment of a method of making a component, such as a panel of a vehicle.

[0025] FIG. 7B is a schematic diagram of another exemplary embodiment of a method of making a component, such as a panel of a vehicle.

[0026] FIG. 8 is a schematic diagram of another exemplary embodiment of a method of making a component, such as the component shown in FIG. 5A.

[0027] FIG. 9 is a schematic diagram of another exemplary embodiment of a method of making a component for use in a vehicle.

[0028] FIG. 10 is a schematic diagram of another exemplary embodiment of a method of making a component, such as a panel of a vehicle.

[0029] FIG. 11 is a section view of the component shown in FIG. 7A showing a random orientation of fibers of the mat.

[0030] FIG. 12 is a section view of the component shown in FIG. 7B showing a longitudinal orientation of fibers of the material.

[0031] FIG. 13 is a graph illustrating a change in density of a component.

[0032] FIG. 13B is a schematic of a component having two stacked mats of fibers prior to compression.

[0033] FIG. 13C is a schematic of the component of FIG. 13B after compression.

[0034] FIG. 13D is a schematic of another exemplary embodiment of a component of FIG. 13B showing partial integration of the two mats.

[0035] FIG. 14 is a graph illustrating a change in density of a component.

[0036] FIG. 14B is a schematic of a component having a change in thickness.

[0037] FIG. 14C is a schematic of a component having a change in density.

DETAILED DESCRIPTION

[0038] Referring generally to the FIGURES, this application discloses various components (e.g., molded bodies, panels, etc.) for use in vehicles and methods for producing the components from a material comprising fibers, as well as devices suitable to realize the methods, which can be configured to reduce the manufacture expense to produce the components. The components may be produced having different densities and/or different thicknesses in different sections (e.g., regions, portions, parts, etc.) of the component to better manage the load condition of the component when assembled in an application.

[0039] The methods for producing molded bodies from a material comprising fibers utilize a mold that includes at least one bottom part and at least one top part able to be moved toward one another to exert a pressing force on the material comprising fibers, such that they define an intermediate mold space for the molded body to be produced. According to one example, the method includes the following three method steps or processes in the order provided. The first step involves bringing or holding at least one of the mold parts to/at a first and/or the first process temperature able to at least partly activate the respective material comprising fibers. The second step involves introducing the material comprising fibers into the at least partly open mold. The third step involves bringing the mold into its closed position and exerting the pressing force to form the molded body.

[0040] The mold can be moved from an open into a closed position, wherein the closed (or partly closed) position is to be understood as that position at which the introducing of the material comprising fibers for the molded body to be produced – for example blowing in by means of a blow nozzle – is as unobstructed as possible. The pressing force required for molding is not applied until the mold is in its closed position.

[0041] At least one of the mold parts (i.e., at least the top part or the bottom part), or also both parts, is configured to already be at a temperature suitable to at least partly activate the material comprising fibers at least in the areas which come into contact with the material comprising fibers to be pressed when the material comprising fibers is introduced into the intermediate mold space. This temperature constitutes the first process temperature.

[0042] If the respective part or respective parts of the mold are already at this first process temperature prior to the first method step, it is of course not necessary to initially bring them to said first process temperature. If, however, different process temperatures are employed, as will be described further below, the respective part or respective parts of the mold are thus brought to this first process temperature in the first method step.

[0043] The activating of the material comprising fibers is generally a thermal activation of a duroplastic binding agent in the material comprising fibers to the temperature which the parts of the mold are already at. Before the setting process is finished, the mold is then brought into its closed position and the pressing force applied so that a very stable molded body having outstanding mechanical properties is formed in the desired three-dimensional shape.

[0044] It is pointed out that the intermediate mold space can by all means be hereby formed in the partly open state of the mold; i.e., the material introduced into the intermediate mold space, for example blown in. The contact pressure is just not applied on the mold until the material comprising fibers is introduced; i.e., this state at which the contact pressure is applied is then designated the closed state of the mold.

[0045] The inventive solution yields numerous advantages.

[0046] Since no separate heated flow of air needs to be introduced into the closed mold in order to heat up the fibers – as in the conventional solutions – the entire molding process can transpire directly in one suitable (heavyweight) molding tool able to be subjected to high pressing force in a press. This pressing force can for example be in the range of approximately 2 tons.

[0047] The molded body does not need to be transported between multiple molding tools to be formed and, particularly, does not need to be brought into different molding tools, which reduces the amount of work required. In other words: Producing a semi-finished product is unnecessary; the inventive method enables forming the finished molded body directly.

[0048] Furthermore, directly heating at least one of the parts of the mold, i.e., the molding tool, ensures a continuous duroplastic molding process, which may improve the mechanical properties of the molded body produced.

[0049] Advantageous further developments of the inventive solution are set forth herein.

[0050] For example, the first process temperature is in a range of between 150° C and 300° C and preferably approximately 220° C. This is a suitable temperature range to enable the curing process of the advantageously utilized binding agents. It is at the same time ensured that the entire molding process proceeds reliably and consistently so as to be able to obtain a uniform material quality to the molded body to be produced.

[0051] It can moreover be provided for at least one of the parts of the mold, e.g., both parts of the mold, to be brought to or held at a second process temperature during the method step of bringing the mold into its closed position and applying the pressing force for forming the molded body. This second process temperature is higher than the first process temperature. Doing so can first achieve a pre-activation and then a final activation of the components of the material comprising fibers – particularly when various different binding agents are used – whereby even better material properties can be obtained and/or various more complex forms be able to be achieved.

[0052] The temporal aspect to the method step of bringing the mold into its closed position and applying the pressing force for forming the molded body is hereby to be understood as the second process temperature being reached at the same time as or prior to this step.

[0053] According to one advantageous further development of the invention, it is provided for all the parts of the mold; i.e., the top and bottom part, to be brought to or held at the first process temperature in the first method step. When provision is made for a second process temperature, it can then be additionally provided for all the mold parts to be brought to or held at this second process temperature.

[0054] A particularly homogenous molding and a shortening of the molding time is thereby achievable.

[0055] It can further be provided for the part or parts of the mold to be brought to or respectively held at the first and/or second process temperature particularly by flowing a heat-transmitting liquid through them. This heat-transmitting liquid is advantageous a thermal oil which serves as a heat-transfer medium and is transported through the mold part, advantageously through all the mold parts. The thermal oil can be transported through a heat source by means of a circulation pump. This thereby enables a particularly simple and safe – by virtue of being non-pressurized – supplying of the mold parts with the heat required to reach the respective process temperature. However, other solutions for warming the part(s) are of course also conceivable, such as for instance an electric heater able to be integrated into the part(s) or by induction.

[0056] According to a further aspect of the invention, the bottom part of the mold comprises a surface impermeable to the material comprising fibers to be introduced. In other words: No air outlet openings are provided in the bottom part of the mold. Same are not necessary since in contrast to conventional molding tools, no hot air needs to be introduced into the mold in the inventive method to thermally activate the binding agent. Instead, the mold part(s) themselves are heated to the required process temperature. Thus, a complex discharge and/or recirculation of material comprising fibers inadvertently blown out during the blowing process is no longer necessary at the bottom part of the mold.

[0057] In contrast, the top part of the mold can be designed to be air-permeable; i.e. provided with air outlet holes. However, these then only serve in equalizing pressure when the mold is brought from its open into its closed state.

[0058] According to a further aspect of the invention, the material comprising fibers can contain a percentage of synthetic fibers, particularly polymer fibers and/or carbon fibers. Particularly polyethylene (PE), polypropylene (PP) and/or polyethersulfone (PES) are conceivable as polymer fibers.

[0059] According to a further aspect of the invention, the material comprising fibers can also contain a percentage of natural fibers, for example wood fibers and/or cotton fibers.

[0060] With respect to the device for realizing the inventive method, it is provided for the device to comprise a mold having a bottom part and at least one top part able to move in relation thereto for applying a pressing force on a material comprising fibers introducible into an intermediate mold space formed between the parts, whereby the bottom part of the mold has a surface which is impermeable to the material comprising fibers to be introduced, and whereby at least one of the mold parts is designed to be brought to a selectable process temperature by means of a heat-transmitting liquid flowing through said part, particularly a thermal oil.

[0061] According to a further development of the invention, it is provided for the bottom part of the mold to be able to move between an introducing position and a pressing position, whereby at least one top part of the mold is provided at the introducing position and at least one top part of the mold is provided at the pressing position.

[0062] In other words: According to this further development, a suitable top part – for example heated to the first process temperature – can be furnished to the bottom part for realizing the method steps up to and including the introduction of the material comprising fibers. To this end, a blow molder supplied with material comprising fibers at a blowing station by a material comprising fibers feed device, and which then dispenses it to a blow nozzle arranged in the mold, can for example be used.

[0063] The bottom part is then subsequently transported to a further top part which can for example be a part of a pressing device and used to realize the method step of exerting the pressing force. In any case, however, the molded body is fully formed without interrupting the curing process so as to enable the achieving of a continuous duroplastic process.

[0064] In conjunction hereto, it is also possible for only one pressing device to be provided, same being successively fed correspondingly prepared bottom parts by a plurality of blowing stations. Doing so takes advantage of the fact that introducing the material comprising fibers takes longer than the subsequent pressing process. This thereby enables the inventive method to be executed more economically.

[0065] FIGS. 1A and 1B illustrate an exemplary embodiment of a vehicle 100 having an interior passenger compartment 101 configured to include to include one or more components (e.g., trim panels). For example, the vehicle 100 may include a door assembly including one or more door trim panels 110 and an instrument panel (IP) assembly including one or more IP panels 112. Also for example, the vehicle 100 may include a seat assembly including one or more seat trim panels. The vehicle 100 may also include a center console assembly that includes one or more trim panels 114. The vehicle 100 may include additional trim panels associated with other assemblies of the vehicle 100. Any of the components of the vehicle 100 may be configured according to any of the embodiments disclosed herein and/or may be manufactured (e.g., made) according to any of the methods disclosed herein.

[0066] FIG. 2 shows a schematic sectional side view of a device for realizing the inventive method according to a first embodiment of the invention.

[0067] By way of a schematically suggested line, a blow molder 41 supplies a blow nozzle 42 with material comprising fibers which, for its part, is supplied by a material comprising fibers feed device of the blow molder 41.

[0068] The blow nozzle is arranged with its outlet opening at the bottom part 21 of a mold identified as a whole by 20 so that material comprising fibers 15 will be blown out onto said bottom part 21. The material comprising fibers may comprise a percentage of natural fibers (e.g., cotton fibers), as well as a proportion of a binding agent which can be thermally activated and hardens duroplastically.

[0069] A top part 22 of the mold 20 is provided opposite the bottom part 21 and spaced from said bottom part 21 so as not to impede the introduction of the material comprising fibers 15. The distance between bottom part 21 and top part 22 is exaggerated in FIG. 2; as the two parts can in fact be arranged very close together when the material comprising fibers 15 is being blown in. The distance of separation between the parts 21, 22 is such that no pressing force is applied in this state.

[0070] Both the bottom part 21 as well as the top part 22 of the mold 20 are each provided with a respective fluid channel 26, 27 through which heated thermal oil is conducted. The thermal oil serves as a heat-transfer medium and is circulated through a heating device so that the top part 22 and the bottom part 21 are heated to a temperature of approximately 220° C. The material comprising fibers 15 is thus deposited on hot mold surfaces when blown out, whereby its binding agent component is already activated upon being blown onto the mold parts 21, 22. The bottom part 21 of the mold is of solid configuration, thus constitutes a heavyweight tool, and has no air openings or the like on its surface receiving the material comprising fibers 15 so that no recirculating (discharging or the like) needs to be provided for surplus material comprising fibers 15.

[0071] As is evident from FIG. 3, the inventive method according to the first embodiment continues as set forth below. Before the duroplastic hardening of the portion of binding agent in the material comprising fibers 15 no longer permits any further simple forming action, the mold 20 is brought into a closed position so that an intermediate mold space 25 forms between the top part 22 and the bottom part 21. A pressing device 50 thereafter applies a pressing force on the material comprising fibers in the intermediate mold space 25 so that a molded body 10 having the corresponding outstanding material properties is produced completely by duroplastic action, which is finished following curing. The applying of the pressing force is suggested schematically in FIG. 3 by the arrows.

[0072] FIG. 4 shows a schematic diagram to illustrate the inventive method according to a second embodiment of the invention. Each of the individual parts can be designed as described above in conjunction with the first embodiment. However, the method according to the second embodiment only provides for one pressing device 50 for alternatingly pressing molds 20a, 20b, in each case associated with their own blow molder 41a, 41b, respectively supplied by its own material comprising fibers feed device 40a, 40b.

[0073] The background hereby is that blowing material comprising fibers into the hot molds 20a, 20b takes a longer period of time than the subsequent pressing. In this way, one blow molder 41a having a cycle time of 60 seconds and a further blow molder 41b also having a cycle time of 60 seconds can for example respectively supply a single pressing device 50, which improves cost-effectiveness.

[0074] FIGS. 5A and 5B illustrate an exemplary embodiment of a component 210 (e.g., panel) for use in a vehicle. The component is made from a material comprising fibers. The component 210 may be made utilizing one of the methods disclosed in this application. As shown, the component 210 includes a pair of ends 213 and an intermediate portion 215 extending between the ends 213. The intermediate portion 215 may be offset from the ends 213, such that the intermediate portion 215 is non-planar relative to the ends 213. As shown, the component 210 has a substantially uniform (e.g., constant) thickness throughout the component. Thus, the thickness of the intermediate portion 215 is substantially the same as the thickness of each end 213. The component 210 has a substantially uniform (e.g., constant) density throughout the component. Thus, the density of the intermediate portion 215 is substantially equal to the density of each end 213. Since the component 210 is configured to carry a relatively constant load throughout the component, if the component 210 is used in an assembly where a portion of the component 210 is subjected to a high load area (e.g., a load that would otherwise be higher than the load carrying ability of the component), then the component 210 has to modified to accommodate the high load. One example of such a modification is to increase the thickness of the entire component 210 to accommodate the high load. This increases the weight of the component and over designs the portions of the component not subjected to the high load. Another example of such a modification is to include a support (e.g., a structural support, support member, etc.) that reinforces the component 210 local to the location where the component is subjected to the high load. As shown in FIG. 5B, a support 220 is located behind the portion of the component 210 that is subjected to the high load, which is shown to be the intermediate portion 215, such that support 220 carries load transferred into the portion of the component 210. For example, the support 220 may be coupled to a back side (e.g., a rear surface) of the intermediate portion 215 of the component 210. Yet other examples of such modifications are provided by the components 310, 410 shown in FIGS. 6A and 6B.

[0075] FIG. 6A illustrates an exemplary embodiment of a component 310 made using material comprising fibers (e.g., loose fibers). The component 310 may be made utilizing one of the methods disclosed in this application. The component 310 may include a pair of ends 313 and an intermediate portion 315 extending between the ends 313. As shown, the intermediate portion 315 has a thickness T_1 that is larger than a thickness T_2 of the ends 313, such that the intermediate portion 315 is configured to carry a relative higher load compared to the ends 313. Thus, the density of the intermediate portion 315 may be the same as the density of the ends 313 and the component 310 still provides a higher load carrying ability through the intermediate portion 315. The thicknesses T_1 and T_2 (and, therefore, the difference between these thicknesses) may be tailored to the specific application of the component.

[0076] FIG. 6B illustrates another exemplary embodiment of a component 410 made using material comprising fibers, which may be made utilizing one of the methods disclosed in this application. The component 410 may include a pair of ends 413 and an intermediate portion 415 extending between the ends 413. As shown, the intermediate portion 415 has a thickness that is substantially the same as the thickness of the ends 413. The intermediate portion 415 has a density that is higher (e.g., larger, etc.) compared to the density of the ends 413, such that the intermediate portion 415 is configured to carry a relative higher load compared to the ends 413. The densities of the intermediate portion 415 and the ends 413 (and, therefore, the difference between these densities) may be tailored to the specific application of the component.

[0077] With reference to FIGS. 6A and 6B, the intermediate portions 315, 415 of the components 310, 410 can be subjected to a higher load relative to the ends 313, 413 of the components 310, 410 by increasing the thickness and/or the density of the intermediate portions 315, 415 compared to the thickness/density of the ends 313, 413. The sections having increased thickness and/or density are configured to increase (e.g., improve) the integrity (e.g., strength, durability, etc.) of the component. It is noted that one or both ends of the components 310, 410 may be configured having a larger thickness and/or density relative to intermediate portion to allow for carrying the relative higher load in other portions of the components. In other words, each component may have a greater thickness and/or density at a location other (or in addition to) than the intermediate portions shown. The components may also be configured having more than one location having a greater thickness and/or density to provide a component that can carry a relative high load in one or more locations and carry a relative low load in one or more locations. The components may include a plurality of sections configured with more than two different thicknesses and/or densities, such as to carry more than two different loads in three or more different sections.

[0078] FIGS. 7A and 7B illustrate exemplary embodiments of methods (e.g., processes) for making (e.g., manufacturing) components (e.g., panels) for use with a vehicle, such as, for example, door panels 510, 610 that are configured to be subjected to more than one load. In the method of FIG. 7A, a fiber mat 515 is utilized to produce the door panel 510. As shown, the first step is producing the fiber mat 515 in accordance with conventional techniques. In a second step, the fiber mat 515 is formed into the door panel 510 having a substantially uniform thickness and density throughout the panel. To allow the door panel 510 to withstand more than one load condition at different locations of the panel, a support (e.g., the support 220) is injection molded to a backside of the door panel 510 at each location of relative high loading in a third step.

[0079] In the method of FIG. 7B, loose fibers 615 are utilized to produce the door panel 610. As shown, the first step is blowing the loose fibers 615 into a tool (e.g., molding equipment) that produces a door panel 610 having an increased thickness and/or an increased density at each location of relative high loading of the panel. In a second step, the door panel 610 is produced by the tool. Since the door panel 610 can withstand a similar load condition as the door panel 510 without having the support, the cost and timing (e.g., to manufacture) associated with adding the support can be eliminated.

[0080] FIG. 8 illustrates an exemplary method for producing a component 710 (e.g., a panel) for a vehicle in five steps (e.g., processes). In the first step (labeled A), loose fibers 715 (e.g., separate fibers) are blown (e.g., injected, introduced, disposed such as by a fluid medium, etc.) into a cavity 725 of a tool 720 (e.g., mold), such as by a feeder 740. The fibers 715 may be blown into the cavity 725 with other elements. For example, the separate fibers may be blown into the cavity along with a binder, a reinforcing material (e.g., carbon fibers, glass fibers, etc.), and/or a filler. A nozzle 741 may be fluidly connected to a compartment of the feeder 740 that holds the loose fibers 715 by a fluid conduit 743 (e.g., hose, tube, pipe, etc.). The separate fibers 715 are blown into the cavity 725 via the nozzle 741, which may be coupled to a part of the tool 720.

[0081] As shown, the tool 720 includes a first (e.g., upper, top) part 721 and a second (e.g., bottom, lower) part 722, where at least one of the first and second parts is movable relative to the other part between an open position and a closed position. In the first step, loose fibers 715 are blown into the cavity 725 formed between the first and second parts 721, 722 in the closed position. As shown, the fibers 715 are deposited on a mold surface of the second part 722 between the mold surface of the second part 722 and a mold surface of the first part 721. According to an exemplary embodiment, at least one mold surface is permeable to air, but impermeable to the separate fibers of the material comprising fibers being blown into the mold. This arrangement allows the air medium that is blown in with the separate fibers to escape without the cavity without the fibers escaping the cavity. As shown in FIG. 8, the first part 721 includes a mold surface 724 that is configured to be permeable to air, but impermeable to the separate fibers 715. For example, the mold surface 724 of the first part 721 may include a screen that has a shape that conforms the fibers to a specific geometry without allow the fibers to pass through apertures in the screen. Air is permitted to pass through the apertures of the screen in the mold surface 724. According to an exemplary embodiment, at least one mold surface is impermeable to both air and to the fibers. As shown in FIG. 8, the second part 722 includes a mold surface 727 that is impermeable to both air and to the fibers 715 blown into the cavity 725. Thus, the mold surface 727 may be solid (e.g., continuous).

[0082] One or both of the first and second parts 721, 722 may be heated to a first temperature prior to introducing the fibers 715 into the cavity. The first temperature may be configured to activate at least some of the fibers 715, such as, for example, where polymerization and/or cross-linking of fibers 715 occurs. In other words, the first temperature is above a threshold temperature of the material comprising fibers to begin activating the material comprising fibers. Activating at least some of the fibers may advantageously help retain all of the fibers 715 in place until all of the fibers are activated.

[0083] As shown in FIG. 8, the second and third parts 722, 723 of the tool 720 are heated, while the first part 721 remains unheated. For example, the second part 722 may be preheated to a first temperature, which is above the threshold temperature of the material comprising fibers, prior to blowing in the fibers 715, then may be heated to a second temperature that is greater than the first temperature between blowing in the fibers 715 and compressing the fibers 715 into the component 710. Also for example, the third part 723 of the tool 720 may be similarly preheated, then heated to the second temperature while compressing the fibers 715 between the second part 722.

[0084] Also shown in FIG. 8, the system includes a heater 760 (e.g., heating mechanism, etc.) that is configured to heat the tool 720, such as one or more parts thereof. As shown, the heating mechanism is configured to heat the second part 722 and the third part 723 of the tool 720. However, the heater 760 can be configured to heat any one part or any combination of parts of the tool. According to one example, the heater 760 utilizes a heated fluid to heat the tool. The heater 760 may include a heater and a pump where the heater heats the fluid and the pump pumps it through the system. According to other examples, the heater 760 may utilize electric heat or any suitable conventional heating technique.

[0085] One or both of the first and second parts 721, 722 may be configured as heavyweight tool parts. A heavyweight tool part is configured having a mold surface 724, 727 for forming the part (e.g., the component 710) that is continuous or unbroken by openings (e.g., holes, apertures, etc.), such as to allow air flow into/out of the cavity 725. This arrangement advantageously prevents the fibers 715 from flowing through any such openings, which could otherwise lead to voids in the parts being formed and/or damage to the tool 720. Thus, the mold surface of a heavyweight tool is devoid of any openings, other than an opening that forms a feature on the component, such as a protrusion, tab, or similar element.

[0086] In the second step (labeled B in FIG. 8), one of the first and second parts 721, 722 of the tool 720 moves to the open position. As shown, the first part 721 moves in an upward (e.g., vertical) direction away from the second part 722 until the first part 721 clears the fibers 715 to allow, for example, the second part 722 (and the fibers 715 on top of the second part 722) to move relative to the first part 721 in a direction transverse to the direction that the first part 721 moves in.

[0087] In the third step (labeled C in FIG. 8), the part of the tool 720 having the fibers 715 is moved. As shown, the second part 722 moves in a transverse direction (e.g., horizontal) relative to the direction that the first part 721 moves in the second step to position the second part 722 and the fibers 715 disposed thereon under a third part 723 of the tool 720.

[0088] In the fourth step (labeled D in FIG. 8), the third part 723 of the tool 720 is moved downward relative to the second part 722 to bring the third and second parts into a closed position, in which mating mold surfaces of the second and third parts 722, 723 compress the fibers 715 with a pressure from force F to form a component 710 therebetween. The length of time that the first and second parts 722, 723 are in the closed position may depend on the temperature of the tool (e.g., each part) and the pressure used to compress the fibers 715. The third part 723 may be heated to a temperature (e.g., the first temperature) prior to moving to the closed position with the second part 722. During the fourth step, such as following closing of the tool, one or both of the second and third parts 722, 723 may be heated to a temperature, such as a second temperature that is higher than the first temperature, to facilitate activating all of the fibers 715. The third part 723 of the tool 720 may be configured as a heavyweight tool part.

[0089] In the fifth step (labeled E in FIG. 8), the third part 723 of the tool 720 is moved from the closed position to the open position to allow the component 710 to be removed from the second part 722 of the tool 720. The component 710 can be removed manually (e.g., by an operator) or automatically (e.g., by the tool 720). As shown, the shapes of the mating mold surfaces of the second and third parts 722, 723 define the geometry (e.g., shape) of the component 710. For example, the mating mold surfaces may form a component 710 having a uniform thickness.

[0090] FIG. 9 illustrates producing a component 810 (e.g., a panel) for a vehicle having different sized (e.g., thickness) portions using the same five steps (e.g., processes) described in the process shown in FIG. 8. For consistency, the steps of the process shown in FIG. 9 are labeled A-E, which correspond to the counterpart step (i.e., A, B, C, D, and E) of the process shown in FIG. 8. Also for consistency, the reference numerals having the same last two numbers as the element of the process of FIG. 8 (but having an "8" as the first number) correspond to the counterpart element described above and, therefore, are configured the same as the counterpart element, except where noted otherwise. For example, the nozzle 841 corresponds to the nozzle 741.

[0091] As shown in FIG. 9, the fibers 815 form a shape that is generally similar to the shape of the finished component 810 in the first two steps A, B via the first and second parts 821, 822 of the tool 820. Then, the partially activated fibers 815 forming the general shape is moved with the second part 822 in the third step C. Then, the component 810 is formed between the second and third parts 822, 823 of the tool 820 in the fourth and fifth steps D, E. The relative spacing between the mold surface 827 of the second part 822 and the mold surface 826 of the third part 823 defines the thickness of the component 810 in that specific location (e.g., section, region, area, etc.). Accordingly, the component 810 may be formed having different thicknesses in different sections of the component. According to the example shown in FIG. 9, the component 810 includes a first end 811 having a thickness of T_1, a second end 812 (opposite to the first end 811) having a thickness of T_2, and an intermediate section 813 located between the first and second ends that has a thickness of T_3. The thicknesses T_1, T_2, and T_3 are different from one another. For example, the thickness T_1 may be less than the thickness T_2, which may be less than the thickness T_3. Also shown in FIG. 9, a first transition section 818 extends between the first end 811 and the intermediate section 813, and a second transition section 819 extends between the second end 812 and the intermediate section 813. Each transition section 818, 819 may have a thickness that varies along the section, such as transitioning from the thicknesses of the respective connected sections (e.g., end, intermediate section, etc.). According to other examples, the thicknesses of the sections of other components may be different than what is shown in the component 810, which is intended to be illustrative and not limiting in nature.

[0092] The component 810 is configured having different thicknesses in different sections of the component, which may be tailored to the load conditions that each section is subject to in vehicle. Moreover, the component 810 may carry different levels of loading in the different sections of the component without having to vary the density of the component from section to section. For example, the third part 823 may be configured to compress the fibers 815 in the different sections by approximately the same amount to maintain a relatively constant density throughout the component 810.

[0093] FIG. 10 illustrates another exemplary method for producing a component 910 (e.g., a panel) for a vehicle having different densities in different sections (e.g., portions) using the same five steps (e.g., processes) described in the process shown in FIG. 8. Again for consistency, the steps of the process shown in FIG. 10 are labeled A-E, which correspond to the counterpart step (i.e., A, B, C, D, and E) of the process shown in FIG. 8. Also, the reference numerals having the same last two numbers as the element of the process of FIG. 8 (but having a “9” as the first number) correspond to the counterpart element described above and, therefore, are configured the same as the counterpart element, except where noted otherwise.

[0094] As shown in FIG. 10, the component 910 produced has a relatively constant thickness, but is configured having different densities in different sections. For example, first and second sections 911, 912 of the component 910 may be configured having a first density, and a third section 913 of the component 910 may be configured having a second density that is different (e.g., greater, lower) than the first density. As shown, the process shown provides a second density that is greater than the first density, but other components may be configured differently. The component 910 may be formed having different densities by compressing more fibers into a similar cross-sectional size (e.g., thickness) in sections having relatively greater densities. This can be achieved through the tooling.

[0095] Also shown in FIG. 10, the mold surface 924 of the first part 921 is configured having a greater offset distance (e.g., recessed) relative to the mold surface 927 of the second part 922 through the region corresponding to the third section 913 of the component 910 relative to the regions corresponding to the first and second sections 911, 912 of the component. For example, the mold surface 924 may have a recess in the region of the third section 913 relative to the regions of the first and second sections 911, 912. Thus, during the first and second steps A, B, a greater number of fibers 915 are blown into the portion of the cavity 925 that forms the third section 913 of the component 910 compared to the first and second sections 911, 912. The mold surface 926 of the third part 923 of the tool is configured having a substantially similar offset distance to the mold surface 927 of the second part 922 through the first, second, and third regions corresponding to the first, second, and third sections 911, 912, 913, respectively. During step four D, the fibers 915 are compressed between the second and third parts 922, 923. Since more fibers are being compressed into a similar cross-sectional size in the third section 913 (compared to the first and second sections 911, 912), the density of the third section 913 is greater than the densities of the first and second sections 911, 912. Thus, the component 910 is produced having a substantially uniform (e.g., constant) size (e.g., thickness) between the three sections, with the third section 913 having a greater density. The component 910 is configured for use in a vehicle application where the third section 913 is subjected to a relatively higher load condition then the load conditions of the first and second sections 911, 912. It is noted that the component 910 could be made to include more than two different densities in any number of locations.

[0096] FIGS. 11 and 12 illustrate portions of exemplary embodiments of components made using the methods shown in FIGS. 7A and 7B, respectively. As shown in FIG. 11, the orientation of the fibers 515 of the component 510 formed from a mat are randomly orientated (e.g., arranged, aligned, etc.), whereas the fibers 615 of the component 610 formed by blowing loose fibers into the mold (e.g., via the methods shown in FIGS. 7B and 8) may have a longitudinal orientation and/or a stacked orientation throughout the component. For example, the fibers 615 may form layers that are stacked on top of one another. This arrangement may provide a more homogenous substrate or matrix of the material of the component 610, which may advantageously increase the integrity, such as the strength, of the component 610 or a section of the component.

[0097] FIG. 13 shows a graph illustrating the change in density of a component made using two mats of fibers (the first mat S1 and the second mat S2 shown on top of the first mat S1 in FIG. 13B) to provide a multi-density component 510 (FIG. 13C). As shown in FIG. 13B, the second mat S2 is placed on top of the first mat S1 prior to compression. Then, after compressing the two mats S1, S2 together, the section 511 (which include both mats) has a higher density D2 than the sections 511 (which included only the first mat S1) having the density D1. Typically, the section 512 will also be thicker than each section 511. This method may result in a sharp transition in density (depicted as 513 in FIG. 13) between the lower density D1 of section 511 and the higher density D2 of section 512, which may induce a weak spot (e.g., via a stress riser). FIG. 13D shows another exemplary embodiment of a component 510 showing partial integration of the two mats 511, 512, where the density is greater in the integrated portion compared to the density in the non-integrated portion.

[0098] FIGS. 14 and 14C illustrate a multi-density component made using blown fibers of material. As shown in FIG. 14C, the density of the transition 613 (located between the thinner section 611 and the thicker section 612) gradually (e.g., progressively) transitions between a relatively higher density in the section 612 to the relatively lower density in the section 611 to eliminate the potential weak spot. As shown in FIG. 14B, the thickness of the transition 613 (located between the thinner section 611 and the thicker section 612) gradually (e.g., progressively) transitions to eliminate the potential weak spot. In addition to thickness or alone, the density of the transition section 613 (located between the low density section

611 and the high density section 612 shown in FIG. 14) may gradually transition to eliminate the weak spot.

[0099] According to another exemplary embodiment, a three step method for producing a molded body from a material comprising fibers is provided. The method utilizes a mold that includes at least one bottom part and at least one top part able to be moved toward one another to exert a pressing force on the material comprising fibers. The top and bottom parts define an intermediate mold space for the molded body to be produced in. The first step of the method involves bringing or holding at least one of the parts of the mold to/at a first and/or the first process temperature able to at least partly activate the respective material comprising fibers. Then, the second step of the method involves introducing the material comprising fibers into the at least partly open mold. Then, the third step of the method involves bringing the mold into its closed position and applying the pressing force to form the molded body.

[0100] The first process temperature may be in a range of between 150° C and 300° C, such as, for example, approximately 220° C.

[0101] At least one of the parts of the mold may be brought to or held at a second and/or the second process temperature, which is higher than the first process temperature, such as during the method step of bringing the mold into its closed position and applying the pressing force for forming the molded body.

[0102] All the parts of the mold can be brought to or held at the first process temperature and/or the second process temperature, according to other examples.

[0103] The part or parts of the mold may be brought to or held at the first process temperature and/or the second process temperature by, for example, a heat-transmitting liquid, such as a thermal oil, at the respective temperature flowing through the part(s).

[0104] The bottom part of the mold may include a surface that is impermeable to the material comprising fibers introduced into the mold.

[0105] The material comprising fibers may contain a percentage of synthetic fibers, such as polymer fibers and/or carbon fibers.

[0106] The material comprising fibers may contain a percentage of natural fibers, such as wood fibers and/or cotton fibers.

[0107] An exemplary embodiment of a device for realizing any method described above may include a mold having a bottom part and at least one top part able to move in relation thereto for applying a pressing force on a material comprising fibers introduced into an intermediate mold space formed between the parts. The bottom part of the mold may have a surface that is impermeable to the material comprising fibers introduced. At least one of the parts of the mold may be configured to be brought to a selectable process temperature by means of a heat-transmitting liquid, such as a thermal oil, flowing through said part.

[0108] The bottom part of the mold may be movable between an introducing position and a pressing position. For this example, at least one top part of the mold is provided at the introducing position and at least one different top part of the mold is provided at the pressing position.

[0109] It is noted at this point that the invention is not limited to the embodiments as described, they are rather to be understood as being examples. Modifications and amendments of individual features will be familiar to the person skilled in the art.

[0110] As utilized herein, the terms "approximately," "about," "substantially", and similar terms are intended to have a broad meaning in harmony with the common and accepted usage by those of ordinary skill in the art to which the subject matter of this disclosure pertains. It should be understood by those of skill in the art who review this disclosure that these terms are intended to allow a description of certain features described and claimed without restricting the scope of these features to the precise numerical ranges provided. Accordingly, these terms should be interpreted as indicating that insubstantial or inconsequential modifications or alterations of the subject matter described and claimed are considered to be within the scope of the invention as recited in the appended claims.

[0111] The terms "coupled," "connected," and the like, as used herein, mean the joining of two members directly or indirectly to one another. Such joining may be stationary (e.g., permanent) or moveable (e.g., removable or releasable). Such joining may be achieved with the two members or the two members and any additional intermediate members being integrally formed as a single unitary body with one another or with the two members or the two members and any additional intermediate members being attached to one another.

[0112] References herein to the positions of elements (e.g., "top," "bottom," "above," "below," etc.) are merely used to describe the orientation of various elements in the FIGURES. It should be noted that the orientation of various elements may differ according to other exemplary embodiments, and that such variations are intended to be encompassed by the present disclosure.

[0113] The construction and arrangement of the elements of the panels, molded bodies, tooling, etc. as shown in the exemplary embodiments are illustrative only. Although only a few embodiments of the present disclosure have been described in detail, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited. For example, elements shown as integrally formed may be constructed of multiple parts or elements, the position of elements may be reversed or otherwise varied, and the nature or number of discrete elements or positions may be altered or varied.

[0114] Additionally, the word "exemplary" is used to mean serving as an example, instance, or illustration. Any embodiment or design described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments or designs (and such term is not intended to connote that such embodiments are necessarily extraordinary or superlative examples). Rather, use of the word "exemplary" is intended to present concepts in a concrete manner. Accordingly, all such modifications are intended to be included within the scope of the present disclosure. Other substitutions, modifications, changes, and omissions may be made in the design, operating conditions, and arrangement of the preferred and other exemplary embodiments without departing from the scope of the appended claims.

[0115] Other substitutions, modifications, changes and omissions may also be made in the design, operating conditions and arrangement of the various exemplary embodiments without departing from the scope of the present invention. For example, any element (e.g., panel, molded body, tooling part, etc.) disclosed in one embodiment may be incorporated or utilized with any other embodiment disclosed herein. Also, for example, the order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. Any means-plus-function clause is intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Other substitutions, modifications, changes and omissions may be made in the design, operating configuration, and arrangement of the preferred and other exemplary embodiments without departing from the scope of the appended claims.

[0116] According to exemplary and alternative embodiments, the methods and systems can be used to produce a wide variety of component forms and provide a wide variety of effects, for example, enhanced strength/material properties (e.g. by material selection, fiber selection/orientation, etc.), reduced weight/mass properties (e.g. by forming with composite or layered material, with voids, etc.), visual/decorative effects (e.g. color, color gradations, differing or multi-color fibers/additives, variations in surface effect, translucence, simulated stitching, simulated effects, etc.), environmental-friendly composition (e.g. use of scrap and/or recycled materials/fibers), alternative geometries/shapes (e.g. with strengthening/reinforcement such as with fiber), cost (e.g. using combinations of bulk and/or high performance materials selectively), function/performance (e.g. using materials/fibers and fiber orientation to enhance functionality such as strength, cycle life, resilience, stain/wear resistance, etc.), etc. by variations of the constituents of the component formed by the system and method. According to any of the embodiments, layers or materials can be formed as or on a substrate or base. As indicated in the FIGURES, any of a wide variety of components can be formed, including but not limited to a wide variety of automotive interior components and assemblies, such as instrument panels, consoles, door panels, trim, inserts, decorative elements, lighting, functional modules, containers, and covers, and various other modules/components of such components and assemblies.

[0117] It is noted at this point that the invention is not to be limited to the exemplary embodiments depicted in the flow charts and figures but rather yields from a synopsis of all the features disclosed herein together. Modifications and amendments will be familiar to the person skilled in the art.

[0118] The embodiments disclosed herein provide components for vehicles and methods of forming the components. Besides those embodiments depicted in the figures and described in the above description, other embodiments of the present invention are also contemplated. For example, any single feature of one embodiment of the present invention may be used in any other embodiment of the present invention. Given the disclosure of the present invention, one versed in the art would appreciate that there may be other embodiments and modifications within the scope and spirit of the invention. Accordingly, all modifications attainable by one versed in the art from the present invention within the scope and spirit of the present invention are to be included as further embodiments of the present invention.

WHAT IS CLAIMED IS:

1. A component for use within an interior of a vehicle comprising:

a first section having a first density and a first thickness;

a second section having a second density and a second thickness; and

a transition between the first section and the second section;

wherein the first section comprises a material comprising fibers having an orientation;

wherein the second section comprises a material comprising fibers having an orientation;

wherein across the transition the orientation of fibers of the first section and the orientation of fibers of the second section are generally maintained; and

wherein the fibers are supplied to the first section and to the second section in an operation.

2. The component of claim 1 wherein the first thickness of the first section is greater than the second thickness of the second section.

3. The component of claim 1 wherein the second density of the second section is greater than the first density of the first section.

4. The component of claim 1 wherein the second thickness of the second section is configured relative to the orientation, the first density, and the first thickness of the first section to provide an integrity of the second section that is greater than an integrity of the first section.

5. The component of claim 4 wherein each integrity is maintained across the transition.

6. The component of claim 4 wherein each integrity comprises structural integrity.

7. The component of claim 6 wherein the structural integrity is selected from one of a strength and a durability.

8. The component of claim 1 wherein the transition comprises a gradually progressive profile.

9. The component of claim 1 wherein the transition is a continuous transition.

10. The component of claim 1 wherein the transition comprises a discontinuity.

11. The component of claim 1 wherein the first section and second section are integrally formed.

12. The component of claim 1 wherein the operation comprises supplying fibers to form the first section and the second section.

13. The component of claim 1 wherein the operation comprises a first operation and a second operation.

14. The component of claim 13 wherein the first operation comprises supplying fibers to form the first section.

15. The component of claim 14 wherein the second operation comprises supplying fibers to form the second section.

16. The component of claim 14 wherein the second operation comprises compression.

17. The component of claim 1 wherein the operation comprises blowing of the fibers into the first section.

18. The component of claim 17 wherein the operation comprises blowing of the fibers into the second section.

19. The component of claim 1 wherein the second thickness of the second section is reduced in the operation.

20. The component of claim 1 wherein the second density of the second section is increased in the operation.

21. The component of claim 1 wherein the transition is formed in the operation.

22. The component of claim 1 wherein the operation comprises compression.

23. The component of claim 1 wherein the operation comprises an application of heat.

24. The component of claim 1 wherein the operation is performed in a tool.

25. The component of claim 24 wherein the operation is a forming operation in the tool.

26. The component of claim 1 wherein the fibers are supplied into the material of the first section and the material of the second section.

27. The component of claim 1 wherein the second section is adjacent the first section.

28. The component of claim 1 wherein the second section is adjacent the first section on a first side and a second side and the transition comprises a transition on the first side and a transition on the second side.

29. The component of claim 7 wherein the structural integrity is strength, and wherein the first section is configured to be subjected to a first load and the second section is configured to be subjected to a second load that is higher than the first load.

30. The component of claim 1 wherein the orientation of the fibers of each section is configured such that a strength of the second section is greater than a strength of the first section.

31. The component of claim 30 wherein the orientation of the fibers comprises fibers that are aligned longitudinally.

32. The component of claim 30 wherein the orientation of the fibers comprises a plurality of stacked layers of the fibers.

33. The component of any one of claims 1-32 wherein the component is selected from one of a door panel, an instrument panel, and a center console of the vehicle.

34. A method of making a component for use in a vehicle from a material comprising fibers utilizing a mold that includes at least a first part and a second part, wherein each of the first and second parts includes a surface that defines a cavity, the method comprising:

heating at least one of the first and second parts of the mold to a first temperature;

supplying a material comprising fibers into the cavity; and

compressing the material using at least one of the first and second parts of the mold to form the component.

35. The method of claim 34 wherein the surface of the first part that defines the cavity is permeable to air.

36. The method of claim 35 wherein the first part of the mold remains unheated during the process of supplying the material into the cavity.

37. The method of claim 35 further comprising:

moving the second part of the mold in a lateral direction relative to the first part to align the second part with a third part of the mold that is provided adjacent to the first part; and

moving the third part toward the second part to compress the material between the surface of the second part and a surface of the third part to form the component.

38. The method of claim 37 further comprising heating the surface of the third part of the mold to at least the first temperature prior to compressing the material between the surface of the second part and the surface of the third part to form the component.

39. The method of claim 35 wherein the surface of the second part of the mold is impermeable to the fibers of the material and to air, and wherein the surface of the third part of the mold is impermeable to the fibers of the material and to air.

40. The method of claim 37 further comprising heating at least one of the second and third parts of the mold to a second temperature prior to compressing the material between the surface of the second part and the surface of the third part to form the component, wherein the second temperature is higher than the first temperature.

41. The method of claim 40 wherein both the second and third parts of the mold are heated to the second temperature prior to compressing the material between the surface of the second part and the surface of the third part to form the component.

42. The method according to any one of claims 34-41 wherein the first temperature is at least 150° C.

43. The method of claim 42 wherein the first temperature is in a range from 150° C to 300° C.

44. The method of claim 34 wherein supplying the material comprising fibers includes blowing the fibers directly between the mold surfaces of the first and second parts.

45. The method of claim 44 wherein the fibers of the material are blown into the cavity with at least one of a binder, a reinforcing material, and a filler.

46. The method of claim 45 wherein the surface of the first part that defines the cavity is permeable to air, but is impermeable to the fibers and the at least one of the binder, the reinforcing material, and the filler.

47. The method of claim 34 wherein the first temperature is at least equal to a threshold activation temperature of the fibers of the material.

48. The method of claim 34 wherein compressing the material includes applying a compression force using at least one of the first and second parts of the mold to form the component.

49. A system for producing a component for use in a vehicle from a material comprising fibers, the system comprising:

a first mold comprising:

a first part having a surface; and

a second part that is movable relative to the first part between a closed position and an open position, the second part having a surface;

wherein the surfaces of the first and second parts define a first cavity;

a feeder configured to introduce the fibers of the material into the first cavity when the first mold is in the closed position;

a second mold comprising:

the first part; and

a third part that is movable relative to the first part between an open position and a closed position, the third part having a surface; and

a heater configured to heat at least one of the first, second and third parts to a first temperature;

wherein when the second part is in the open position, the first part is movable from the first mold to the second mold to move the fibers from the first mold to the second mold for compression between the surfaces of the first and third parts when the second mold is in the closed position.

50. The system of claim 49 wherein the first temperature is in a range from 150° C to 300° C, and wherein at least one of the first and third parts is heated to a second temperature that is higher than the first temperature.

51. The system of claim 50 wherein the first temperature is at least equal to an activation temperature of the fiber of the material.

52. The system of claim 49 wherein the surface of the second part is permeable to air, but is impermeable to the fibers of the material, and wherein the surfaces of the first and third parts are impermeable to air and to the fibers of the material.

53. The system of claim 52 wherein when the second part is in the closed position with the first part, the fibers of the material remain uncompressed.

Fig.1A

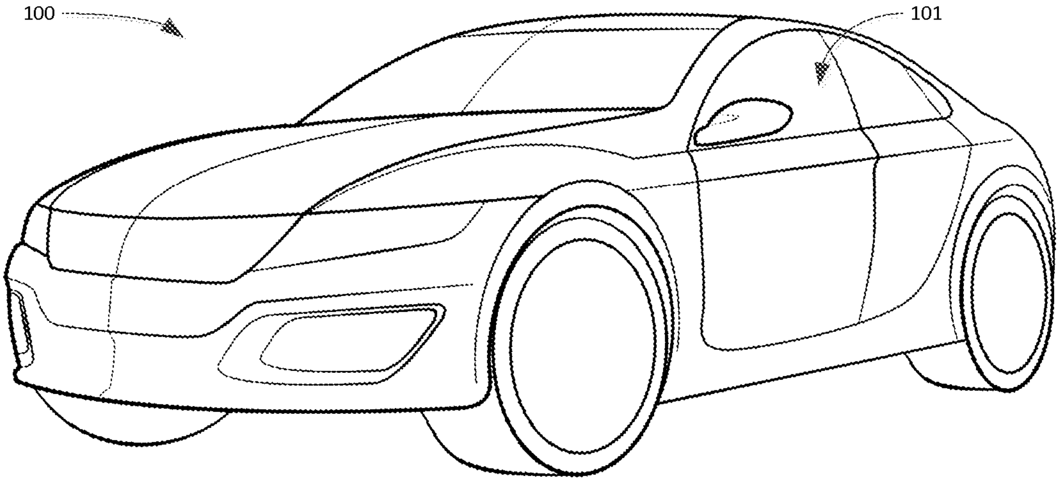
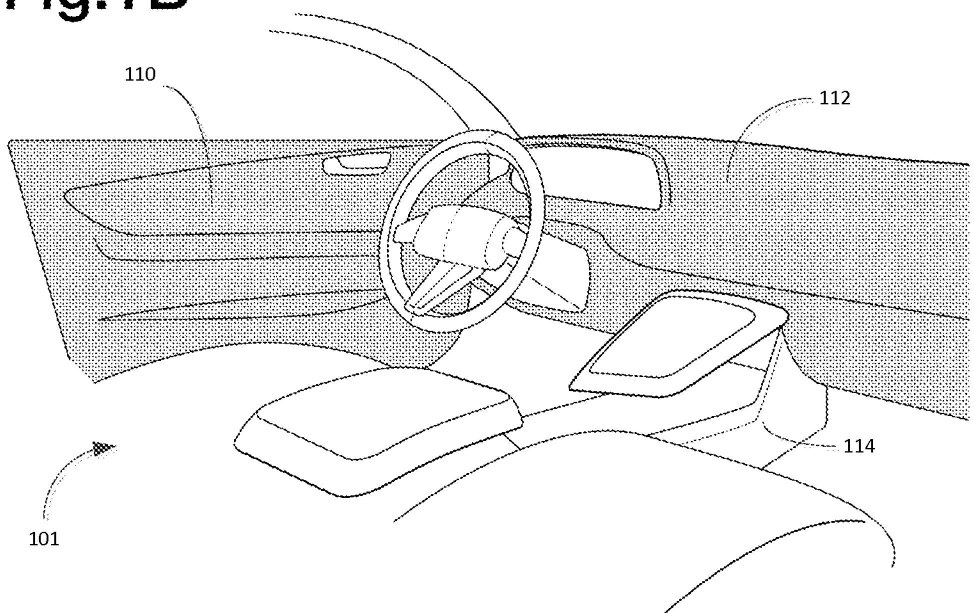


Fig.1B



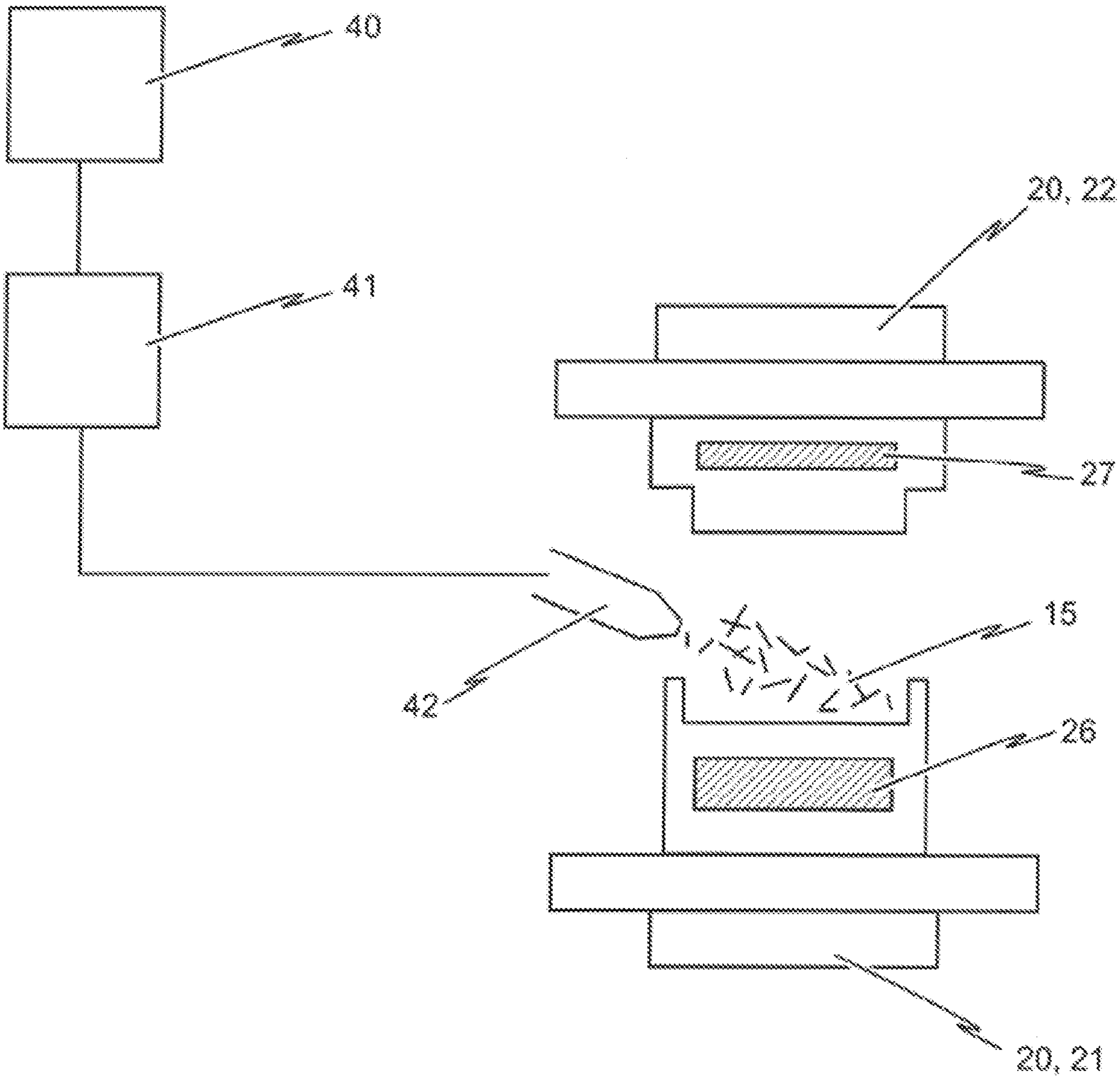


Fig. 2

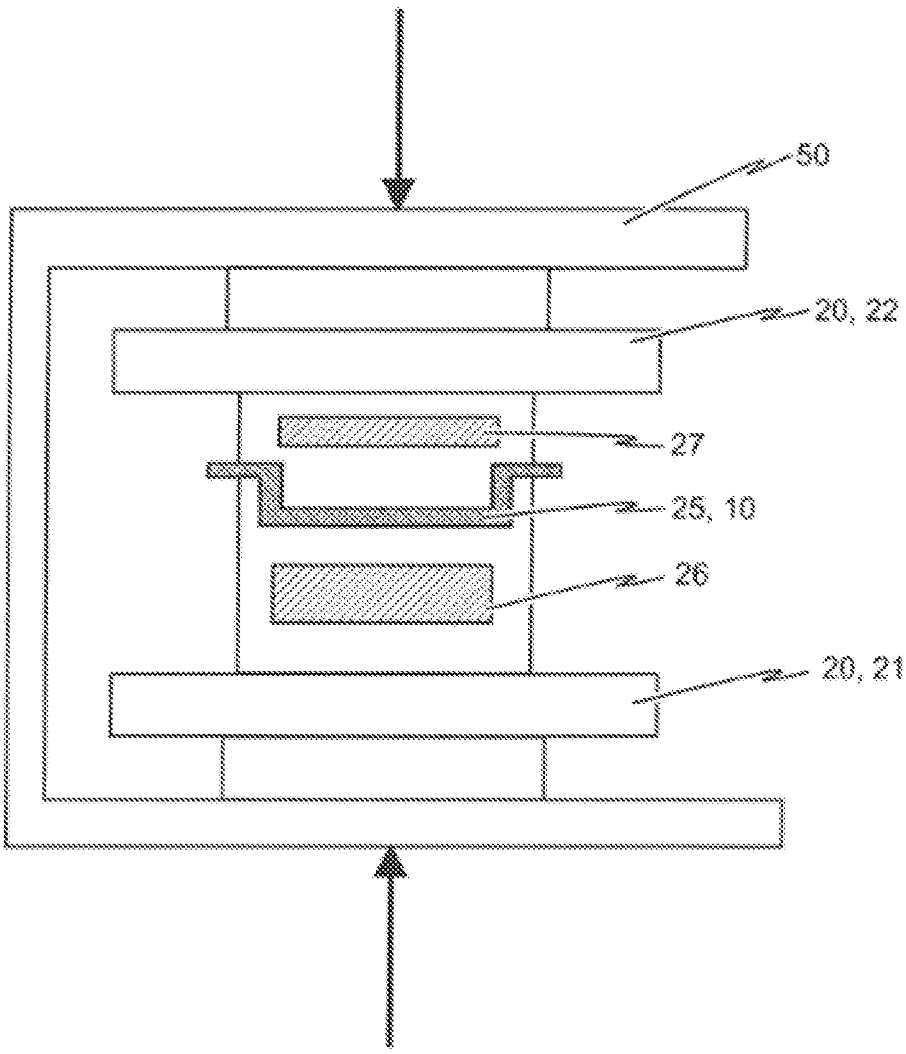


Fig. 3

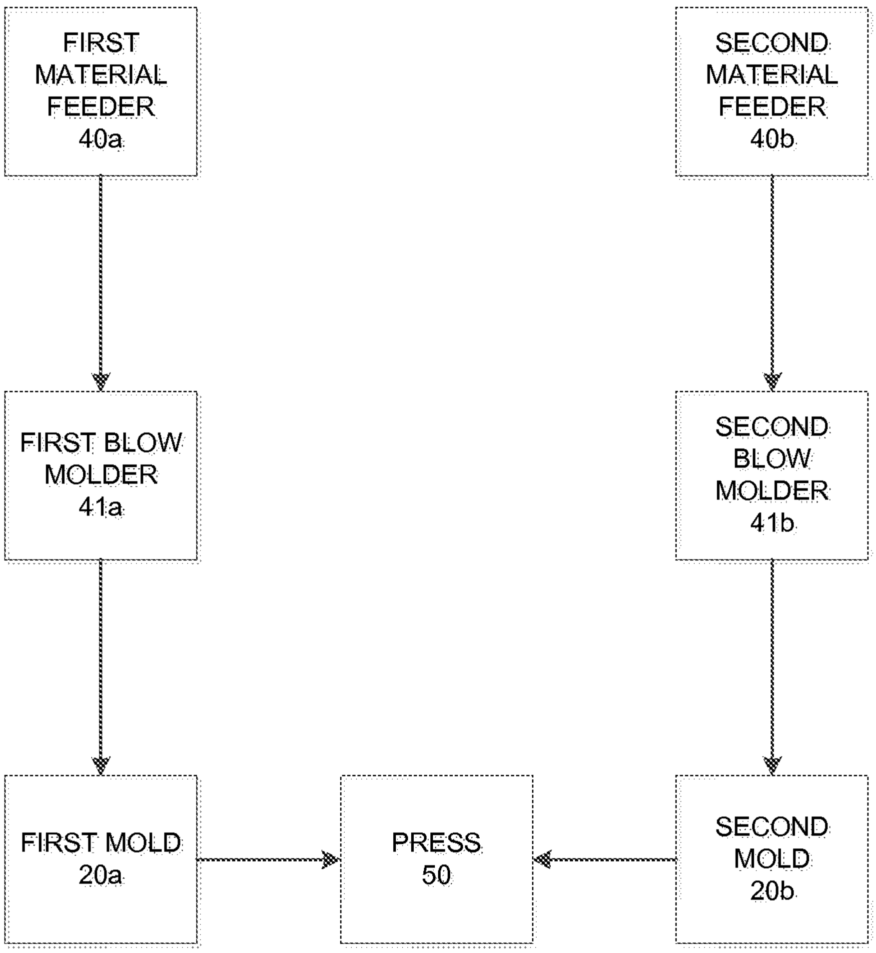

FIRST MATERIAL FEEDER 40a
SECOND MATERIAL FEEDER 40b
FIRST BLOW MOLDER 41a
SECOND BLOW MOLDER 41b
FIRST MOLD 20a
PRESS 50
SECOND MOLD 20b

Fig. 4

Fig.5A

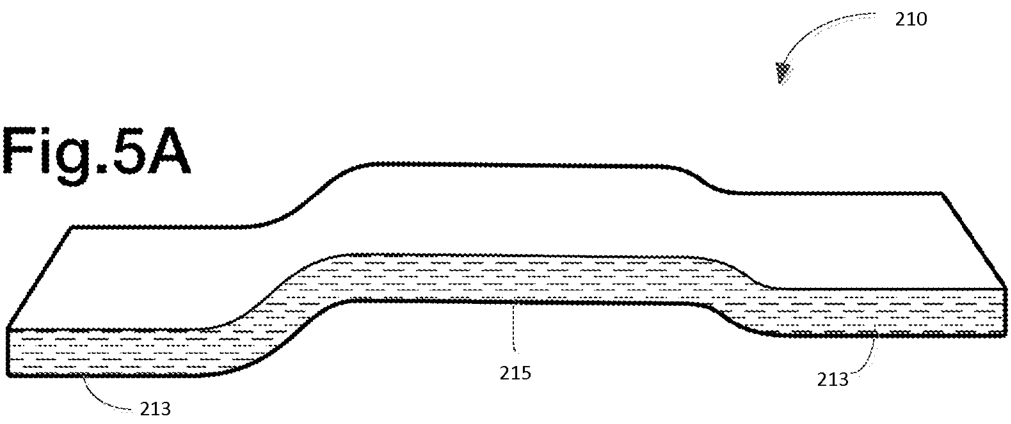


Fig.5B

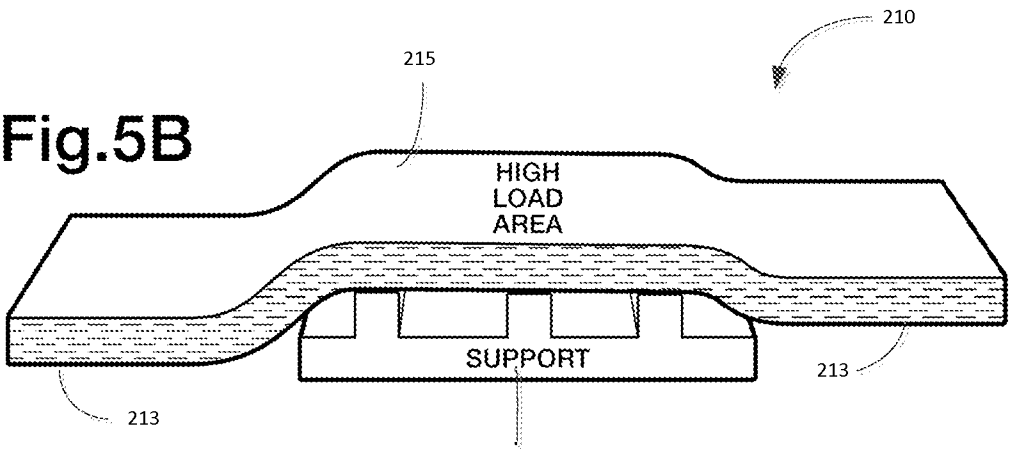


Fig.6A

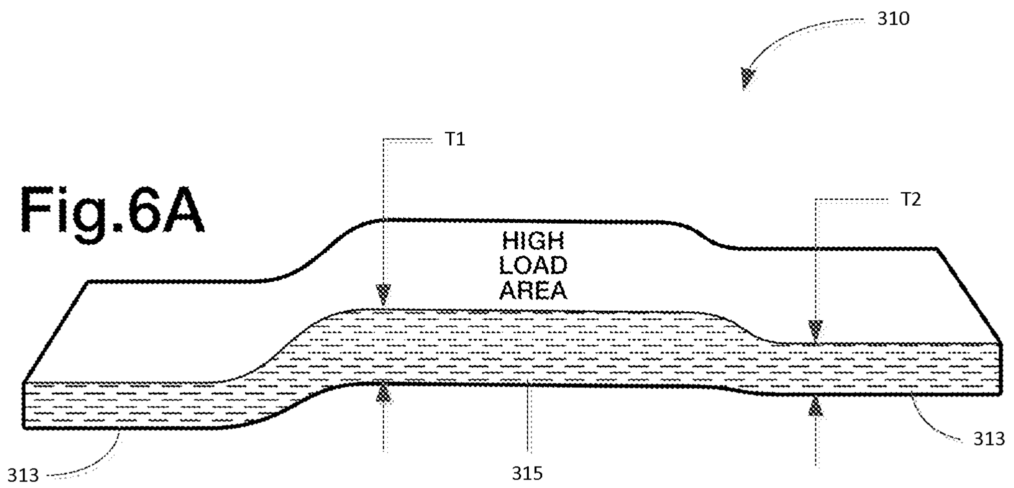

310
T1
T2
HIGH
LOAD
AREA
313
315
313

Fig.6B

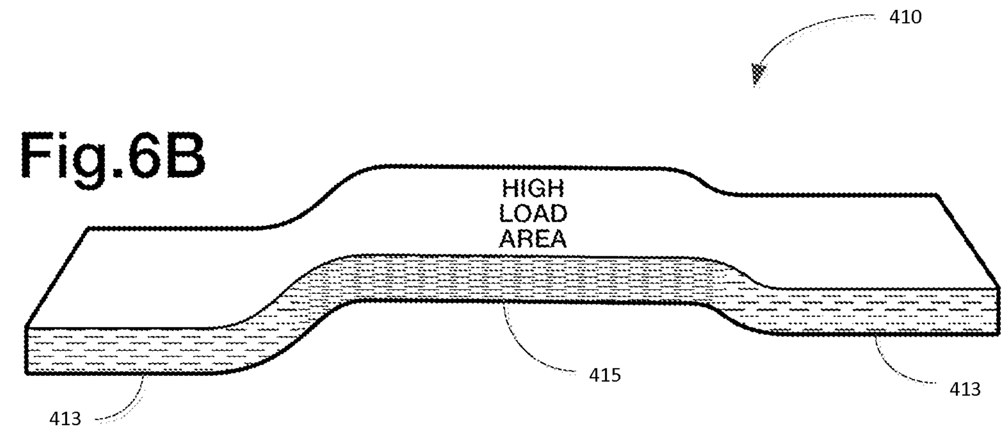

410
HIGH
LOAD
AREA
415
413
413

Fig.7A

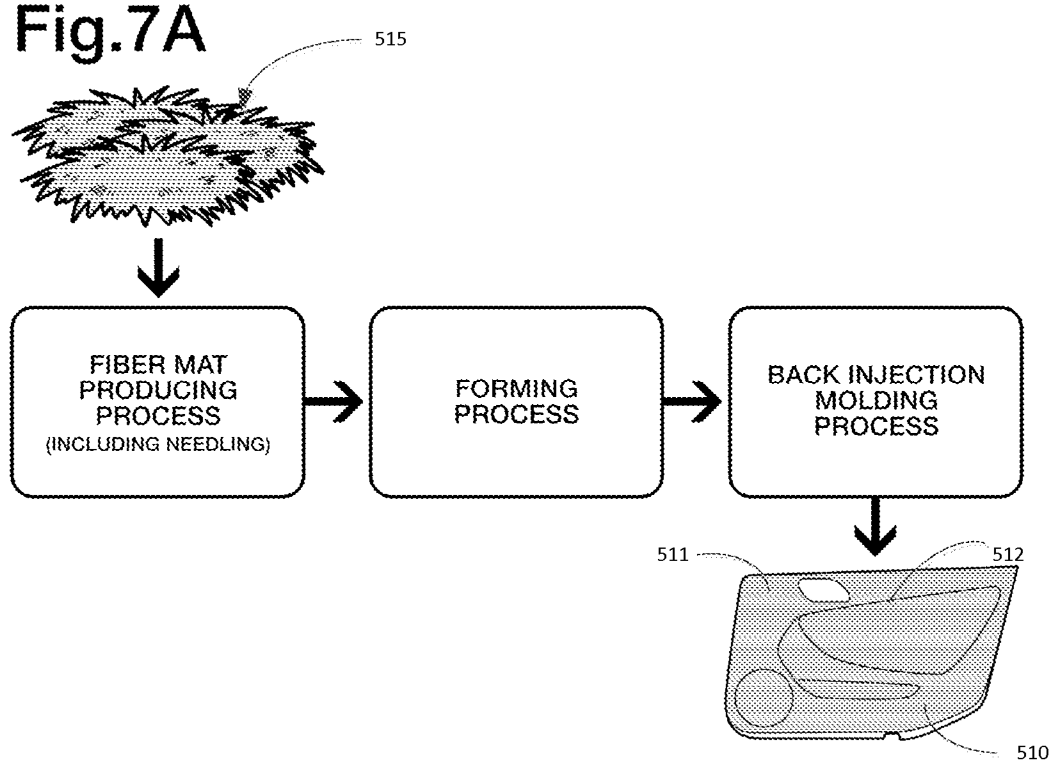

515
FIBER MAT PRODUCING PROCESS (INCLUDING NEEDLING)
FORMING PROCESS
BACK INJECTION MOLDING PROCESS
511
512
510

Fig.7B

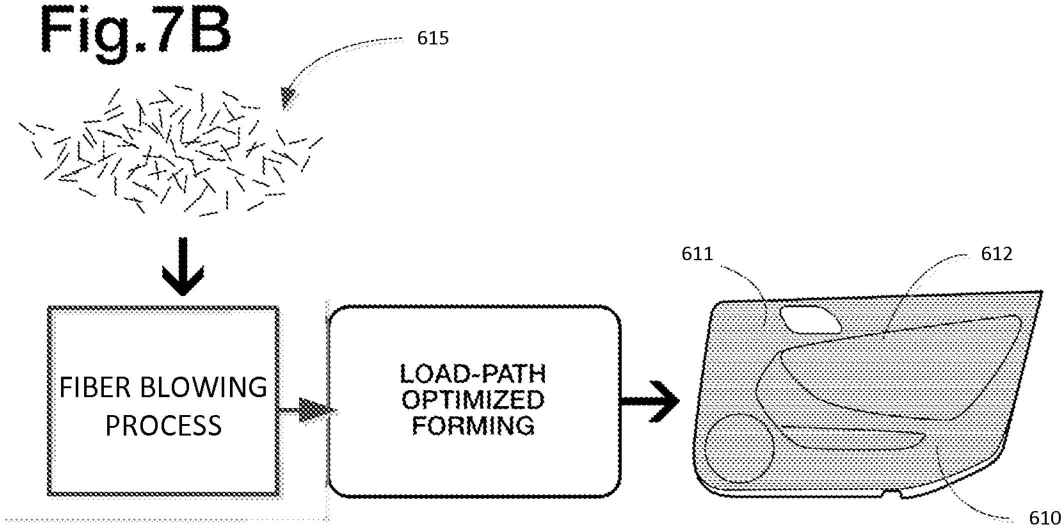

615
FIBER BLOWING PROCESS
LOAD-PATH OPTIMIZED FORMING
611
612
610

Fig.8

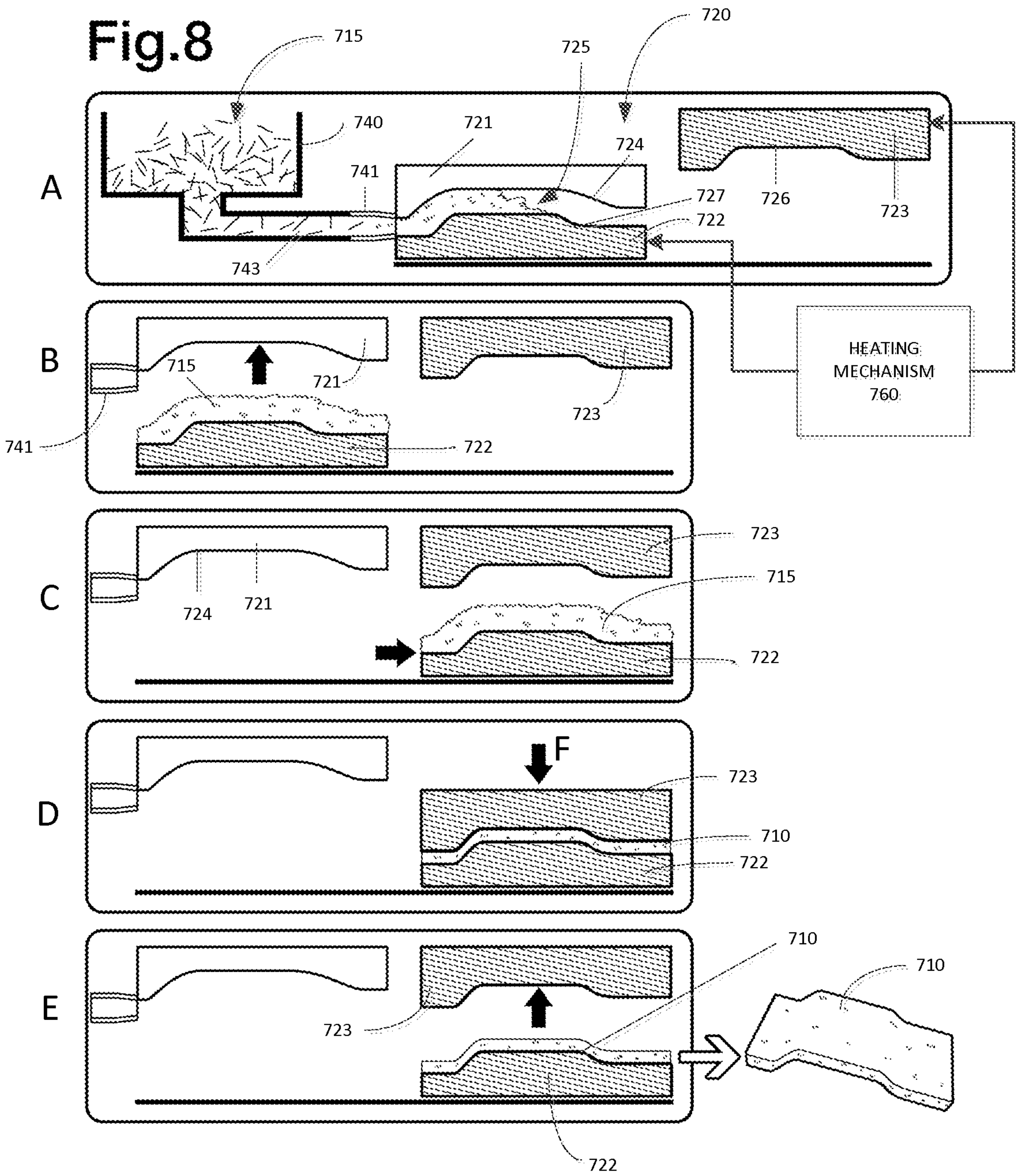

715
720
725
740
721
724
741
727
726
722
723
743
A
B
715
721
723
741
722
HEATING
MECHANISM
760
C
723
715
724
721
722
D
F
723
710
722
E
710
710
723
722

Fig.9

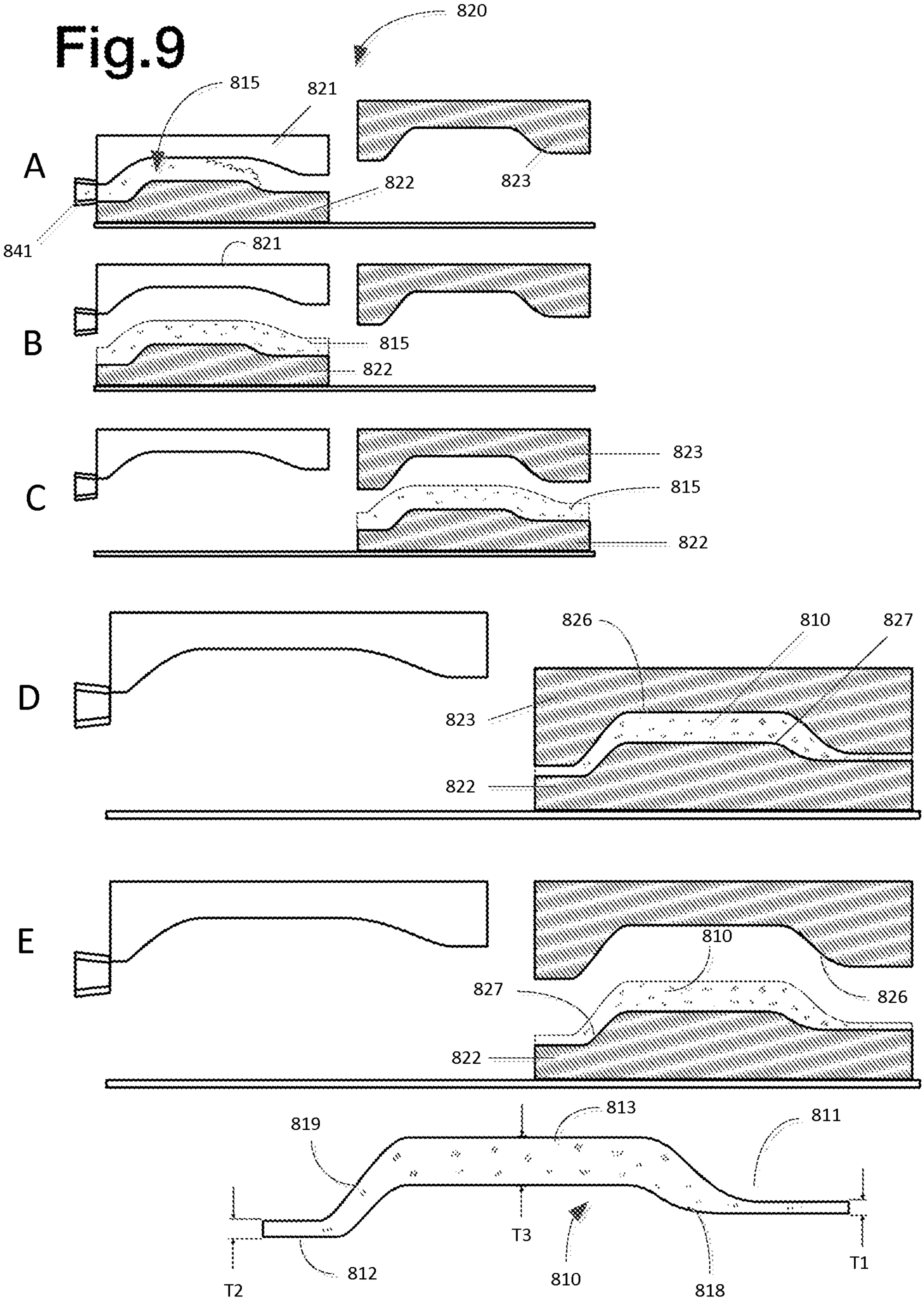
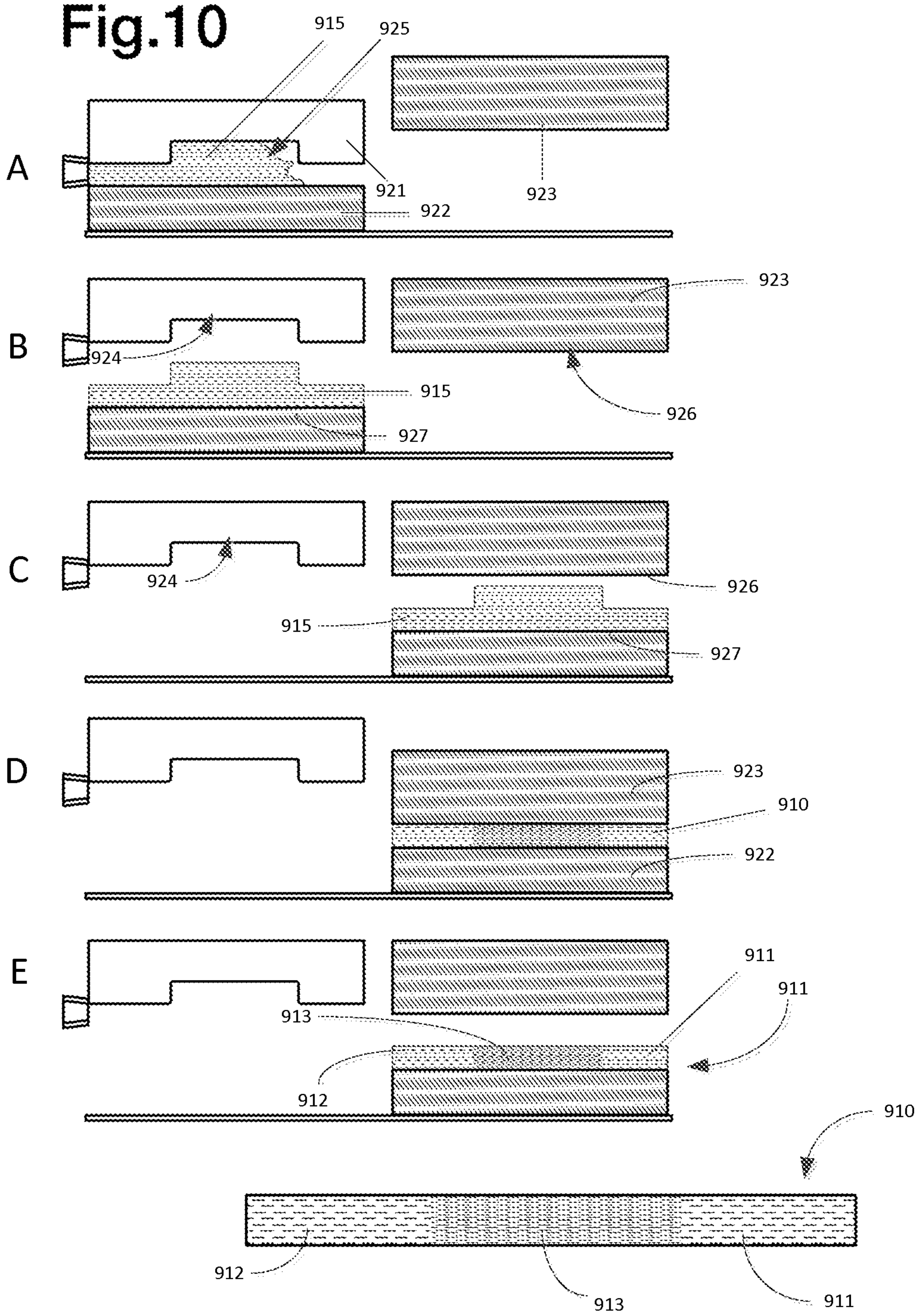

820
815
821
A
823
822
841
821
B
815
822
C
823
815
822
D
826
810
827
823
822
E
810
826
827
822
819
813
811
T2
812
T3
810
818
T1

Fig.10



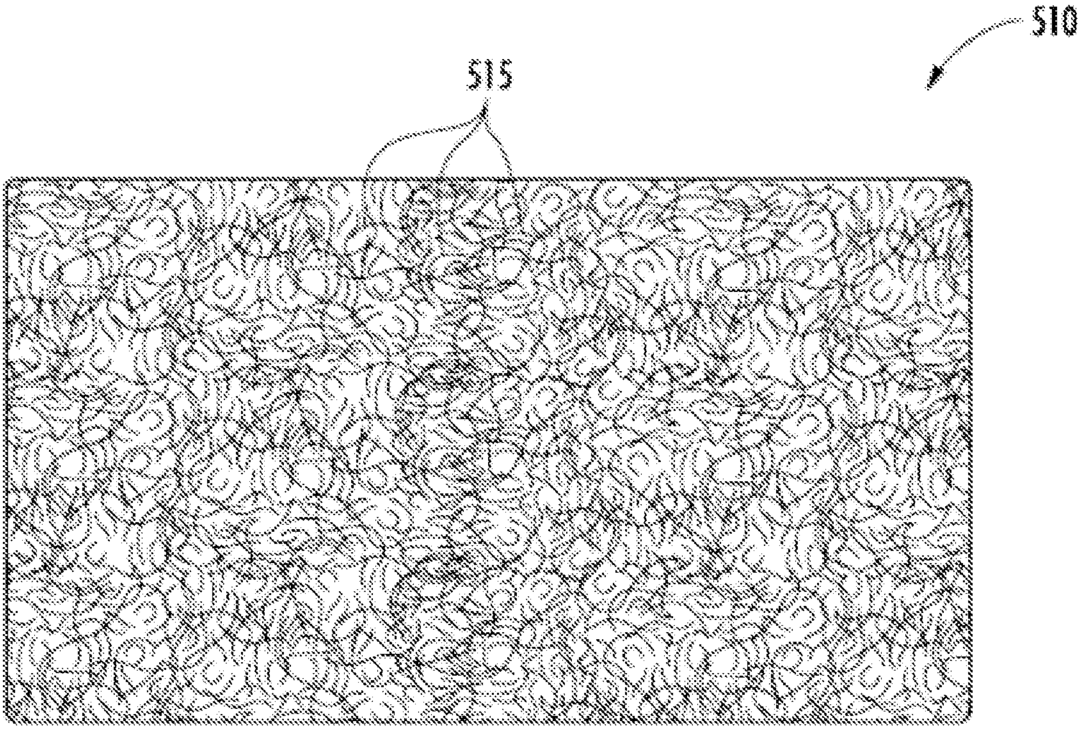


FIG. 11

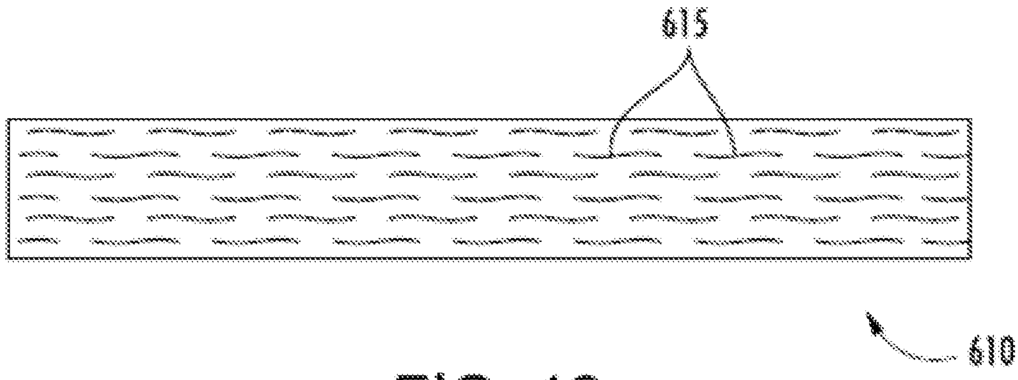


FIG. 12

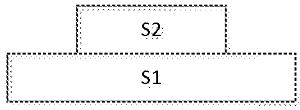


FIG. 13B

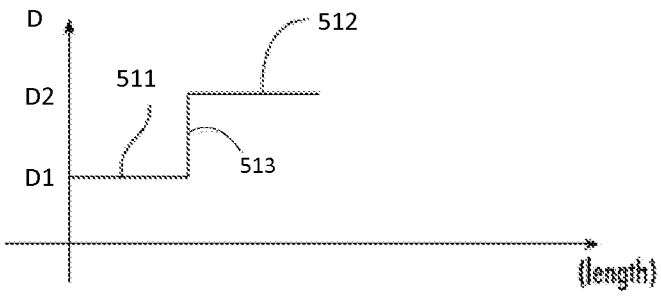


FIG. 13

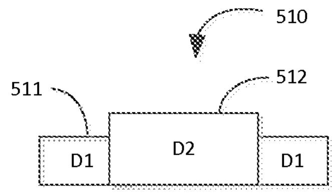


FIG. 13C

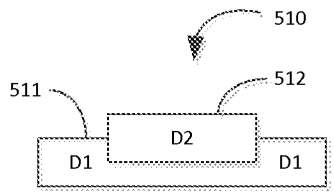


FIG. 13D

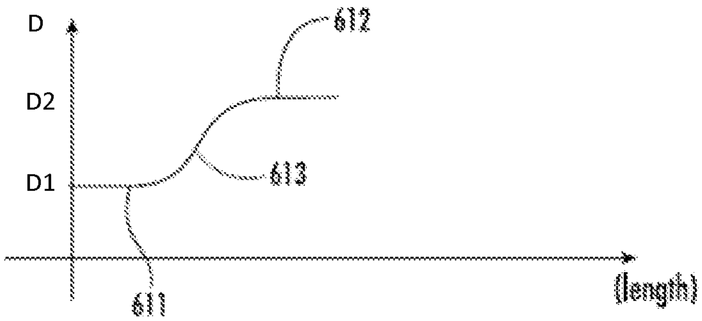


FIG. 14

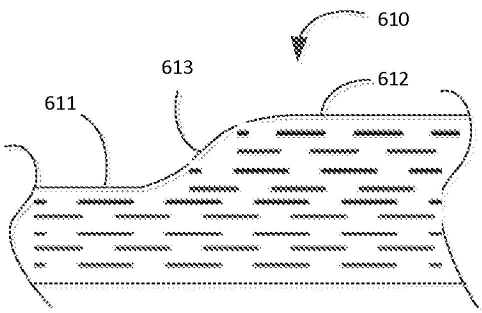


FIG. 14B

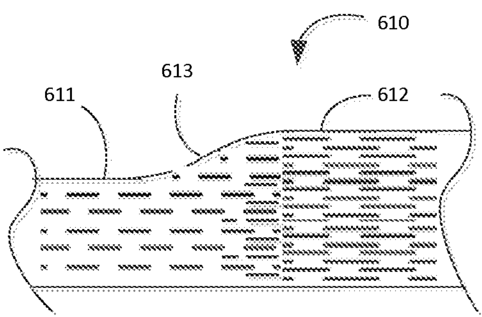


FIG. 14C