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(54) **A method and an apparatus for producing disposable products from cellulose fibers**

(57) This invention relates a method of producing disposable products from cellulose fibers. Wet moulded products of pre-defined shape are provided and placed into cavities of a blow mould having plurality of ventilation openings, A deformable material is placed adjacent to the cavities of the blow mould, and a pressure is supplied on the deformable material into the shape of the cavities.

The supplied pressure causing simultaneous expansion of the wet moulded products into the shape of the cavities, where the plurality of ventilation openings act as an exit for the moisture in the wet moulded products out of cavities of the blow mould causing drying of the moulded products into the shape of the cavities.

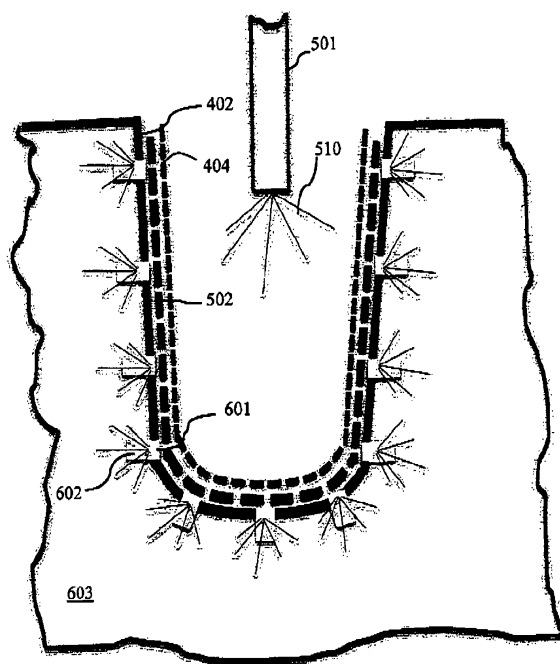


FIG. 6

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method and an apparatus for producing disposable products from cellulose fibers.

BACKGROUND OF THE INVENTION

[0002] US 6,547,931 relates to a method of manufacturing pulp mold formed product such as a container, which is based on two steps.

[0003] In a first step, pulp slurry is injected into a cavity of a split mold composed of a set of slits in such a manner that the cavity is pressurized, where the set of slits are assembled together to form the cavity with a prescribed configuration to form a pulp deposited body. The splits each have a plurality of interconnecting holes, which connect the outer side thereof and the cavity.

[0004] The split mold is evacuated to deposit pulp fibers on the inner wall of the split mold to form a pulp deposited body. An elastic and stretchable pressing member is inserted into the split mold. Subsequently, a fluid is fed into the stretchable pressing member to inflate the pressing member onto the inner wall of the split mold. By doing so fluid is withdrawn from the pulp deposited body. Subsequently, the pulp molded article is removed from the splits.

[0005] In a second step, heat drying of the pulp molded article is carried out. In one embodiment this is done by using a separate pre-heated mould composed of set of slits, where the pulp molded article is put into this separately prepared heating mould and dried under heat. This drying process may be accelerated by inserting another pressing member similar to the one used in the first step where a pressurized fluid is fed into the pressing member to inflate the pressing member.

[0006] This method is however time demanding because it demands the above mentioned two step approach, namely firstly to perform the dewatering process using the above mentioned first pressing member, where subsequently the split mold must be opened and the pulp molded article must be put into the second pre-heated dry mold, where another pressing member is inserted and inflated similar as in the dewatering process.

[0007] Moreover, due to the complexity of this method it is especially unsuitable when manufacturing pulp mold formed product at a mass production level, e.g. several hundreds or thousands of pulp mold formed product within minutes range.

[0008] A typical process of producing disposable products such as paper cups, egg boxes and the like from pulp slurry such as paper pulp starts at a mass production level starts with making moulded products. A pulp mould having a permeable moulding surface side is dipped into the pulp slurry and vacuum pressure is applied to the inner side of the pulp mould to draw pulp slurry through

the permeable surface side leaving an outwardly facing fiber mat on the permeable moulding surface side. Subsequently, the pulp mould is removed from the pulp slurry and subsequently the resulting moulded product is removed from the pulp mould. Typically, one "dipping" given tens or even hundreds of moulded products in wet state, e.g. cup like products, egg boxes and the like. Subsequently, the moulded products in wet state must be dried, but different solutions exist in drying the moulded product.

[0009] Figure 1 depicts graphically the principle of thermopress drying for drying such moulded product in wet state by means of utilizing male and female press dies, but such a thermopress drying is typically required when the recyclable products are to have a smooth and well defined surface such as coffee/tea cups or trays for fresh food products.

[0010] The thermopress drying process starts by placing a moulded product 101, which in this example is a paper cup, into a female die 100. Although this figure shows only a single paper cup die, in praxis tens or even more of such paper cups are typically made simultaneously via tens of female/male dies (not shown). A male die 102 having similar or identical shape as the female die is then slightly pressed onto the moulded product in wet in the female die. The temperature of the male and female die is commonly around 180°C while this is taking place and the time needed to evaporate the moisture in the moulded product until it has a dry shell like structure is between 30- 40 seconds.

[0011] If this shell structure is adapted to be used as a tray for fresh food products such as poultry (e.g. chicken fillets, chicken legs), meat etc., or as a cup for beverages such as coffee or tea a barrier is needed between the food products/liquid and the outer shell. Such a barrier is typically done by means of gluing a Polyethylene film onto the inside of the cup shell, but this film creates the above mentioned barrier.

[0012] The drawback with this process that it is not only an expensive process but also it is very difficult to recycle such trays/cups having such a Polyethelene film on the inside.

[0013] Moreover, the time from where the moulded product in wet state is produced until the Polyethelene film has been glued onto the inner side of the trays/cups can vary from one up to several minutes, but this long time will obviously be reflected in a higher resale price.

[0014] Also, the thermal process described in figure 1 requires a heat source system for supplying the heat for the male/female dies, and a pressing station such as shown in figure 1 (where typically tens of such male dies are used) for supplying the pressure on the moulded product in the female die, but these components are one of the most expensive components in factories that manufacture disposable products such as cups, trays, bottles and the like and are also very space demanding.

[0015] Further, much energy is needed for such a drying process, which is not only very costly but more im-

portantly environmentally unfriendly.

SUMMARY OF THE INVENTION

[0016] It would be advantageous to achieve an improved and environmentally favorable way of manufacturing recyclable products at a mass production level and which are economical favorable and fully recyclable. In general, the invention preferably seeks to mitigate, alleviate or eliminate one or more of the above mentioned disadvantages singly or in any combination.

[0017] In particular, it may be seen as an object of the present invention to provide a method of producing disposable container that solves the above mentioned problems, or other problems, of the prior art.

[0018] To better address one or more of these concerns, in a first aspect of the invention a method is provided of producing disposable products from cellulose fibers, comprising:

- providing a plurality of wet moulded products made from the cellulose fibers, where the wet moulded products have a pre-defined shape,
- providing a blow mould pre-heated to an operating temperature, the blow mould comprising plurality of cavities, each of the plurality of cavities comprising plurality of ventilation openings,
- placing the wet moulded products into the cavities of the blow mould,
- placing a deformable material adjacent to the plurality of cavities of the blow mould, and
- supplying a pressure on the deformable material at the plurality of cavities of the blow mould, the supplied pressure causing a simultaneous inflation of the deformable material into the shape of the plurality of cavities thereby pressing the wet moulded products into the shape of the cavities, the plurality of ventilation openings acting as an exit for the moisture in the wet moulded products out of the cavities.

[0019] Surprisingly, a method is provided that replaces the standard male/femal pressing method where there is no need to undergo a drying process for the wet moulded product, which is relative time demanding and takes at least 40 seconds or more. More importantly, an environmentally friendly way is provided where only a fraction of the energy is needed, compared to the conventional male/femal pressing method, to achieve the above mentioned drying of the wet moulded product.

[0020] Supplying pressure on the deformable material into the shape of the cavities of the blow mould, while the moulded products are in wet state, increases the thermal contact between the moulded products in wet state and the cavities. This increases the energy transfer from the cavities into the moulded product in wet state leading to an almost instant evaporation of the moisture from the moulded product through the ventilation openings of the cavities of the blow mould, turning it into a shell like struc-

ture defining the shape of the disposable product.

[0021] Due to the flexibility of the deformable film and the high kinetic energy that will be produced in the film due to the supplied pressure via e.g. air or hydraulic pressure, the deformable material will impact on the inner side of the cavities of the blow mould with such a pressure that the deformable material will touch all the surface and surface spots/areas on the inner side of the blow mould such as all types of protrusions, boundaries etc., that are otherwise impossible to reach with a standard male/female pressing die. Thus, disposable products having different shapes/structures on the outside, e.g. any types of outwardly protruding parts, or areas, can be produced almost instantly. The deformable material may be at a room temperature during this, i.e. there may be no need to heat it up to a higher temperature during the production of the disposable containers. The deformable material may also be pre-heated to a given operating temperature during this process.

[0022] Moreover, a single drying and shaping step is provided to produce the disposable products at a mass production level within few seconds time, but tens or hundreds of moulded products of pre-defined shape in a wet state may be produced simultaneously within a second or several seconds time, where the shaping and the drying of the moulded products into a final shell like structure defining the shape of the disposable products is performed simultaneously in the cavities of the blow mould.

[0023] The deformable material may be made of any type of material that preferably has high elasticity such as, but not limited to, latex, rubber, or any type of deformable plastic material having sufficient elasticity. The thickness of the deformable material may also be adapted to the type of products being produced, and may e.g. vary from being a millimeter or even less thick up to few millimeters thick.

[0024] In one embodiment, the deformable material has a pre-defined shape essential following the shape of the plurality of cavities of the blow mould and where the deformable material is a single piece material. This may reduce the stretch load on the deformable material since the deformable material is typically adapted to be used multiple of times, and thus its lifetime is increased. This is also of particular relevance when the products have shapes that deviate much from a "surface" reference level, such as coffee/tea cups. For products such as trays that do not have much depth, a flat or substantial flat deformable material may be implemented. Also, the fact that the deformable material is a single piece material simplifies the drying and final shaping process significantly since, when placing the deformable material adjacent to the plurality of cavities of the blow mould, the deformable material may cover tens or hundreds of cavities at the same time thus allowing production of tens or hundreds of disposable products simultaneously.

[0025] In one embodiment, the wet moulded products have geometry essentially following the geometry of the plurality of cavities of the blow mould. The step of placing

the moulded product when it is in a wet state into the mould may be a manual process, or it may be semi or fully automatized process where e.g. robot arms or the like places the moulded product into the cavities of the blow mould.

[0026] The step of placing the moulded product in wet state into the cavities of the blow mould typically occur directly after dipping a cellulose fiber mould having a permeable moulding surface side into the cellulose fibers, where the moulded product in wet state produced are subsequently transferred direct from the cellulose fiber mould into the blow mould.

[0027] In one embodiment, the disposable products are cups, the wet moulded products comprising plurality of cup like products in a wet state, and where the plurality of cavities have cup like shape. The deformable material may in one embodiment comprises plurality of cup like portions, the step of placing a deformable material adjacent to the plurality of cavities of the blow mould includes placing the plurality of cup like portions of the deformable material at least partly into the plurality of cavities having the cup like shape, where supplying a pressure on the deformable material into the shape of the plurality of cavities comprises supplying a pressure on the plurality of the cup like portions of the deformable material causing a simultaneous inflation of the cup like portions of the deformable material into the plurality of cup like cavities of the blow mould. Accordingly, tens or hundreds of cups, such as tea or coffee cups, or cups for any types of beverages may be produced within few seconds time.

[0028] In one embodiment, the disposable products are trays, the wet moulded products comprising plurality of trays like products in a wet state, and where the plurality of cavities have trays like shape. The deformable material may in one embodiment comprises plurality of trays like portions, the step of placing a deformable material adjacent to the plurality of cavities of the blow mould includes placing the plurality of trays like portions of the deformable material at least partly into the plurality of cavities having the trays like shape, where supplying a pressure on the deformable material into the shape of the plurality of cavities comprises supplying a pressure on the plurality of the trays like portions of the deformable material of the deformable material causing a simultaneous inflation of the trays like portions of the deformable material into the plurality of trays like cavities of the blow mould. The term "trays" may include as an example trays having a flat bottom and upwardly extending sites for e.g. food products such as meat slices, or the term tray may include egg boxes and the like.

[0029] As already addressed, having substantially similar shape as the blow mould will increase the lifetime of the deformable material. Also, it is ensure that upon supplying a pressure on the deformable material into the shape of the mould, the deformable material will fill into all corners and/or all types of protrusions of the cavities of the blow mould and thus ensure that the resulting shell like structure of the moulded products will have an iden-

tical shape as the inner side of the blow mould, but such corners and/or cavities by play a key role in defining the outer shape of the disposable products.

[0030] In one embodiment, when supplying a pressure on the deformable material into the shape of the cavities of the blow mould the operating temperature of the blow mould in the range of 150-250°C, preferably in the range of 180-220°C.

[0031] In one embodiment, the pressure supplied on the deformable material is in the range of 20-80bar, preferably between 30-70bar, more preferably between 40-60bar, most preferably around 50bar.

[0032] In one embodiment, the method further comprises depositing a film on an inner surface of the dried moulded product having a shell like structure defining the shape of the disposable product, where the film comprises an aluminium oxide film, or a silicon oxynitride film or a silicon oxide film. Such films, e.g. a silicon oxide film, provide a kind of a "nano-glass" films, which provides an environmentally favorable barrier needed for e.g. all types of paper cups such as coffee/tea paper cups between the beverages and the outer shell structure. Thus, the commonly used Polyethelene films that are glued onto the inside of product shells to provide such a barrier are no longer needed, but such Polyethelene films are very difficult to recycle. Thus, utilizing this type of a coating on the inner side of the product shells (e.g. paper cup shell) ensures that the disposable product is fully sustainable and low cost to entry.

[0033] Also, the dominant factor that reduces a shelf life of beverages such as sodas in bottles is the fact that CO₂ leaves the bottles and O₂ enters the beverages/soda in the bottle. Such a "nano-glass" film however creates a CO₂ and O₂ barrier between beverages such as sodas and the outer shell of a bottle. Thus, by coating the disposable product with such a "nano-glass" film the shelf life of the beverages in the disposable product will be significantly increased.

[0034] In one embodiment, the cellulose fibers comprise a mix including Polylactic acid (PLA) and/or citrus peel fibers. Surprisingly, the mixing of the cellulose fibers such as paper pulp slurry or paper pulp with PLA has shown that the shell like structure has higher strength.

[0035] In one embodiment, the wet moulded product of the pre-defined shape is provided by means of:

- dipping a cellulose fiber mould having a permeable moulding surface side into the cellulose fibers,
- applying a vacuum to the cellulose fiber mould to draw cellulose fibers through the permeable surface side leaving an outwardly or inwardly facing fiber mat on the permeable moulding surface side, and
- removing the cellulose fiber mould from the cellulose fibers and subsequently removing the resulting moulded product of the pre-defined shape from the cellulose fiber mould.

[0036] The resulting moulded product of the pre-de-

finer shape of the cellulose fiber mould may subsequently be placed directly into the plurality of the cavities of the blow mould. The shape of the cellulose fiber mould is preferably substantially the same as the shape of the blow mould, such that the moulded products in wet form fit directly into the cavities of the blow mould. This means that the cellulose fiber mould also has a plurality of cellulose fiber mould cavities having substantially the same geometrical shape as the cavities of the blow mould. As an example, if the blow mould comprises 40 cavities where there is e.g. 5cm between adjacent cavities in the blow mould, the cellulose fiber mould preferably also has 40 cellulose fiber mould cavities where the distance between adjacent cellulose fiber mould cavities is 5cm. It is thus possible to move the cellulose fiber mould, subsequent to removing the cellulose fiber mould from the cellulose fibers, towards and adjacent to the blow mould and release the moulded products in wet form directly into the cavities of the blow mould.

[0037] In one embodiment, the cellulose fibers comprises a paper pulp. For example, the paper pulp may be formed from waste newspapers. In this case, the material of the moulded product is both recycled and biodegradable. The permeable surface of the cellulose fiber mould may e.g. comprise a wire mesh.

[0038] In one embodiment, the inner side of the cavities of the blow mould comprises plurality of impressions so as to produce a disposable product comprising plurality of protrusions. Accordingly, it is possible to produce products such as a paper cup and the like having plurality of protrusions resulting from the plurality of impressions of the blow mould, having predefined shapes and that protrude outwardly from the shell like structure defining the shape of the disposable product. The plurality of protrusions may have all types of shapes, e.g. conical or dot-like like shapes, which may have a dimension negligible compared to the surface area of the disposable product such that they form a kind of a dot like structures protruding outwardly from the outer surface of the shell like structure. The advantage of producing disposable products comprising such plurality of protrusions is to provide a kind of a heat-shield above the "primary" outer surface of the disposable products, in case the disposable products are cups for hot beverages such as coffee or tea. The dimensions of these impressions is selected such that the heat transfer from the inner side of the cups towards the outer side will more or less occur at the "primary surface" of the cups, i.e. the surface between these plurality of protrusions. In that way, there is no need to provide an extra isolation layer around the cups, which is commonly the case so as to prevent a customer from burning his/her hand when drinking the hot beverage because his/her fingers will not come into contact with this primary surface. A typical dimension of these impressions may within the millimeter range, where e.g. the largest width of the impressions at the primary surface of the cavities of the blow mould may e.g. be between 0.5-2mm, whereas the distal end of the impressions is only a frac-

tion of a millimeter, e.g. around 0.1mm-0.5mm. These dimensions should of course not be construed to be limited to these numbers. As already stated, the dimensions and/or shape of these impressions is selected such that the heat of the beverage in e.g. the cup will be accumulated between the plurality of protrusions of the disposable product.

[0039] Also, the overall surface of the disposable product may be covered with such plurality of protrusions, or they may be localized to a typical holding area of the disposable product, e.g. in case the disposable product is a cup around the center of the cup so that they circumferentially surround the center of the cup.

[0040] In one embodiment, the method further comprises means for providing a moisture resistant covering on the outer surface of the disposable product. This may be particularly beneficial where the disposable product may be left in a wet or damp environment in which the shell like structure of the disposable product could be destroyed by moisture. For example, where the disposable product is intended to hold a product that must be kept at a low temperature, there is the risk of condensation forming on the outside of the disposable product if the disposable product is moved into a warm environment. In this case, the condensation could damage the disposable product, and in particular its structural rigidity, if the outer surface were not moisture resistant.

[0041] According to a second aspect, the present invention relates to a disposable product produced by the above mentioned method steps. As already addressed, the disposable product may be selected from, but is not limited to, a cup for any types of beverages such as hot beverages, a tray or any tray like structure, a egg box etc.

[0042] According to a third aspect, the present invention relates to an apparatus for producing disposable products from cellulose fibers, comprising:

- a moulding mechanism for providing a plurality of wet moulded products made from the cellulose fibers, where the wet moulded products have a predefined shape,
- means for placing the wet moulded products into plurality of cavities of a blow mould, the blow mould being pre-heated to an operating temperature, each of the plurality of cavities of the blow mould comprising plurality of ventilation openings,
- means for placing a deformable material adjacent to the plurality of cavities of the blow mould,
- a pressure mechanism for supplying a pressure on the deformable material at the plurality of cavities of the blow mould, the pressure causing a simultaneous inflation of the deformable material into the shape of the plurality of cavities thereby pressing the wet moulded product into the shape of the cavities, the plurality of ventilation openings acting as an exit for the moisture in the wet moulded products out of the cavities.

[0043] The pressure mechanism comprises in one embodiment at least one nozzle or nozzle like part such as at least one thin steel rod or the like that is connected to high pressure gas source such as high pressurized air.

[0044] The at least one nozzle like part may be associated to a moving mechanism that places the nozzle like part automatically inside or above the deformable material distantly away from the blow mould. The pressure mechanism and the flexible material may also be internally fixed in relation the each other within a housing, where the deformable material defines of side of the housing and another side of the housing may be a fixed material such as a steel plate, and where the pressure source may be comprised there between.

[0045] The at least one nozzle like part may be operated such that it blows e.g. highly pressurized gas into or onto the deformable material resulting in the simultaneous expansion of the wet moulded product into the shape of the blow mould.

[0046] In case the deformable material has a pre-defined shape essential following the shape of the plurality of cavities of the blow mould, one or more nozzles may be associated to each of the pre-defined shapes of the deformable material, such that plurality of localized pressures are supplied. If e.g. the deformable material has a plurality of cup like portions, or tray like portions, and the like, the one or more nozzles are associated to each of these cup/tray like portions.

[0047] In another embodiment, the pressure source comprises a hydraulic pressure source where any type of liquid may be used as a pressure source for supplying a pressure on the deformable material into the shape of the blow mould.

[0048] In general the various aspects of the invention may be combined and coupled in any way possible within the scope of the invention. These and other aspects, features and/or advantages of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] Embodiments of the invention will be described, by way of example only, with reference to the drawings, in which

Figure 1 depicts graphically the principle of prior art thermopress drying for drying such moulded product in wet state by means of utilizing male and female press dies,

Figure 2 shows a flow diagram of a method according to the present invention for producing disposable products from cellulose fibers,

Figure 3 shows a flowchart of one embodiment of providing the wet moulded product,

Figure 3 depict graphically production step for manufacturing a container according to the present invention,

Figure 4 depicts graphically one embodiment of the present invention of producing disposable products, Figures 5a-d depicts a cross sectional view of figure 4 while producing disposable products,

Figure 6 shows a zoomed up view of one of the cup like moulds in figure 5 when the pressure is supplied via the nozzle,

Figure 7 shown one embodiment of a disposable product utilized as a cup for hot beverages such as coffee or tea and the like,

Figure 8 shows the zoomed up area from figure 7, depicting in an exaggerated way, plurality of protrusions, and

Figure 9 shows an apparatus for producing disposable products from cellulose fibers.

DESCRIPTION OF EMBODIMENTS

[0050] Figure 2 shows a flow diagram of a method according to the present invention for producing disposable container from cellulose fibers. The cellulose fibers may comprise pulp slurry such as paper pulp. The cellulose fibers may also comprise a mix of Polylactic acid (PLA) and/or any type of citrus peel fibers, and/or a paper pulp formed from e.g. waste newspapers.

[0051] In a first step (S1) 201, a wet moulded products is provided from the cellulose fibers having a pre-defined shape. It is not an essence of the present invention how the wet moulded products are provided, but as will be discussed in more details in relation to figures 2, this may be done using vacuum forming techniques well known in the art, e.g. similar to those used for the formation of e.g. egg boxes.

[0052] In a second step (S2) 203, the wet moulded products are placed into cavities of a blow mould, where the cavities have plurality of ventilation openings. This step may in one embodiment be a fully manual or semi manual process where on operator places the moulded products in wet state into the mould, or this may be a fully automatic process where e.g. a robotic arm and the like puts the moulded products in wet state it into the cavities of the blow mould. The ventilation openings may have all kinds of geometry, having a hole like structure, slits, etc.

[0053] In one embodiment, the wet moulded products have a geometrical shape essentially following the geometrical shape of the cavities of the blow mould. As an example, if the disposable container is a coffee/tea cup the wet moulded product would have a cup like shape of the same/similar geometry as of the cavities of the blow mould and thus the end product.

[0054] In a third step (S3) 205, a deformable material is placed adjacent to or into the cavities of the blow mould containing the wet moulded products. The deformable material may be a substantially flat film material or, as will be discussed in more details later, have a shape that substantially matches the shape of the cavities of the blow mould. The deformable material implemented may

be any type of material having preferably high elasticity, e.g. a solid material that returns to its original shape and size after the forces deforming them, i.e. in this case the pressure, have been removed. An example of such material is Latex, and any type of plastic materials, rubber and the like.

[0055] In a fourth step (S4) 207, a pressure is supplied on the deformable material resulting in an inflation of the deformable material into the shape of the cavities of the blow mould. The supplied pressure may in one embodiment be in the range of 20-80bar, preferably between 30-70bar, more preferably between 40-60bar, most preferably around 50bar.

[0056] This causes a simultaneous formation of the wet moulded product into the shape of the cavities of the blow mould, where the plurality of ventilation openings act as an exit for the moisture in the wet moulded products out of the blow mould causing almost instantly drying of the moulded products into a shell like structure having identical shape as the inner side of the cavities of the blow mould. The temperature of the blow mould may during this process be adjusted to an operating temperature in the range of 150-250°C, preferably in the range of 180-220°C.

[0057] Supplying such a high pressure on the deformable material will ensure that the deformable material, and thus the wet moulded products, will reach into every corner, niche and intrusions of the blow mould. This allows shaping the wet moulded product precisely into the shape of the cavities of the mould such that the resulting shell structure has a nice and smooth shape looking similar or identical to a texture of a plastic or glass product.

[0058] More importantly, this drying process takes only around second (or even less), which is only a fraction of the time needed to produce a shell-like product from a wet moulded product using traditional male/female dies.

[0059] In one embodiment, the method according to the present invention may further comprise step (S5) 209 of depositing a film on an inner surface of the moulded products, where the film may comprise an aluminium oxide film, or a silicon oxynitride film or a silicon oxide film. Such a film acts as a "nano-glass" film, which provides an environmentally favorable barrier and/or isolation needed for e.g. all types of disposable products such as coffee/tea paper cups and also increases the shell life time of the products/beverages in the disposable products (e.g. bottles, milk bottles/containers and the like).

[0060] Figure 3 shows a flowchart of one embodiment of providing the wet moulded product.

[0061] In a first step (S1') 301, a cellulose fibers mould having a permeable moulding surface side is dipped into cellulose fibers, e.g. a paper pulp.

[0062] In a second step (S2') 303, a vacuum is applied to the inner side of the cellulose fibers mould to draw cellulose fibers through the permeable surface side leaving an outwardly or inwardly facing fiber mat on the permeable moulding surface side.

[0063] In a third step (S3') 305, the cellulose fibers

mould is removed from the cellulose fibers and subsequently the resulting wet moulded products are removed from the cellulose fibers mould. This may e.g. be done by removing and placing the wet moulded products directly into the cavities of the blow mould. As an example, the cellulose fibers mould may be carried by a robotic arm that may e.g. place the cellulose fibers mould adjacent to the blow mould while keeping an under pressure of the blow mould preventing that the wet moulded products fall out of the cellulose fibers mould. By positioning the cellulose fibers mould directly above the blow mould, the pressure of the cellulose fibers mould may be released causing the wet moulded products to fall directly into the cavities.

[0064] The above mentioned steps S1'-S3' may be identical to the method steps that are used for the formation of egg boxes, which is well known in the art.

[0065] Figure 4 depicts graphically one embodiment of the present invention of producing disposable products, which in this embodiment comprise cups for beverages for e.g. hot drinks such as coffee or tea.

[0066] A female blow mould 401 is provided comprising plurality of cup like cavities 402. The female blow mould is typically, during use, preheated to an operating temperature such as, but not limited to, 180-220°C where the plurality of cup like cavities 402 have ventilation openings (not shown here).

[0067] As discussed in relation to figure 2, moulded products in wet state are provided, in this case having cup like shape, and arranged in the cup like cavities 402. This may be done manually, semi manually or fully automatically as discussed previously, where e.g. the moulded products in wet state may be released from a cellulose fibers mould (not shown) discussed in relation to figure 3 directly into the cavities 402 of the blow mould 401.

[0068] A deformable material 403 is provided comprising plurality of cup like portions 404 having a shape essentially matching the shape of the cup like or pocket like cavities 402. Shown is also an upper coverage 405, but the deformable material 403 and this upper coverage may be a single unit. As will be discussed later, plurality of pressure means such as plurality of nozzles may be provided within an interior between the deformable material 403 and this upper coverage 405.

[0069] The movement of the deformable material 404 having the cup like portions 404 and the upper coverage may be operated by a robotic arm or system.

[0070] Figures 5a-d depicts a cross sectional view of figure 4, showing where the deformable material 403 and the coverage 405, which may e.g. be a steel coverage or a coverage of high strength material, is moved towards the cavities of the blow mould 401 (see figure 5a). In this embodiment, the pressure that is supplied to the deformable material 403 is a gas pressure, e.g. air pressure, where multiple of nozzles 501 are coupled to a gas source (not shown). The deformable material 403 comprises, as already discussed, plurality of cup or pocket-like portions

404 that may essentially or partly follow the shape of the cup like cavities 402 of the blow mould 401. As depicted here, the shape of the pocket-like portions 404 does not necessarily need to be very similar or identical to the shape of the cavities 402. The wet moulded product 502 is also shown in the plurality of the cup like cavities 402.

[0071] Figure 5b shows where the deformable material 403 has been placed adjacent to the blow mold 401, such that the pocket-like portions 404 of the deformable material are within the cavities 402 of the blow mould 401, where in this embodiment one (or more) nozzle is associated with each of the pocket-like portions 404 of the deformable material 403. The supplied pressure, in this case the air pressure 510, causes a simultaneous inflation of the pocket-like portions 404 into the shape of the cup like moulds 402. As already discussed, this pressure may be in the range of 20-80bar, preferably between 30-70bar, more preferably between 40-60bar, most preferably around 50bar.

[0072] Figure 5c shows where the impact of the pocket like of the deformable material 403 onto the wet moulded products 502 in the cup like cavities 402 causes an almost immediate evaporation of the moisture in the moulded products 502 via ventilation opening in the cavities of the blow mould (not shown here), resulting in the that the wet moulded products 502 will dry within a second and form shell like products 503 having identical shape as the interior of the cup like cavities 402.

[0073] Figure 5d shows one embodiment of releasing the shell like products 503 out of the cavities 402 of the blow mould 401 where the blow mould 401 is rotated 180°. The temperature of the blow mould may e.g. be adjusted from the operation temperature discussed in relation to figure 2 and may be rapidly cooled down such that the shell like products 503 simply fall down via gravity.

[0074] Figure 6 shows a zoomed up view of one of the cup like cavities 402 in figure 5 when the pressure 510 is supplied via the nozzle 501, showing clearly how a pocket-like portion 404 of the deformable material presses the wet moulded product 502 towards the inner wall of the cup like moulds 402. Shown is also the plurality of ventilation openings 601 distributed along the cup like cavities 402 of the blow mould so as to provide an exit for the moisture 602 in the wet moulded product 502. The shape of the ventilation openings may contain all kinds of shapes, e.g. be circular like, have slits-like shape etc. Also, the number of such ventilation openings may be adapted to the size and/or shape of the blow mould. In this side view, the number of ventilation openings may be, instead of being 11, be tens, hundreds or even more. The number is preferably selected so as to provide a sufficient exit for the moisture in the web moulded product.

[0075] The space 603 between the plurality of cup like cavities is preferably an empty cavity so as to provide an exit for the moisture 602 from the wet moulded products 502.

[0076] Figure 7 shows one embodiment of a disposable product 503 which is a cup for e.g. hot beverages such as coffee, tea, soup and the like. This may e.g. be cup resulting from the production illustrated in figures 4-6.

[0077] In this embodiment, the inner side of the cup like moulds 402 from figure 4 would comprise plurality of impressions (not shown) so as to produce cups 503 as shown here comprising plurality of protrusions 701 that preferably have a dimension that is negligible compared to the overall areal of the cup 503 (see figure 5). The aim of producing the cups with such a shape, preferably at a gripping area of the cup (i.e. where a user holds the cup), is to create "cold-spots" for the user, because such protrusions 701 result in that the heat from the beverage will more or less be accumulated in the primary area of the cup between these protrusions 701, i.e. not where the users/fingers hold the cup. The whole out surface area of the cup 700 may also comprise such protrusions.

[0078] Figure 8 shows the zoomed up area 702 from figure 7, depicting in an exaggerated way, the plurality of protrusions, where temperature $T_1 \ll T_2$, where T_1 is the temperature at the distal end of the protrusions and T_2 is the temperature at the primary area between the protrusions. Accordingly, the cup 503 shown here does not need any extra layer of paper or any type of isolation so as to prevent a user from burning his/her hand/fingers.

[0079] These plurality of protrusions may have all types of shapes, e.g. conical or dot-like like shapes.

[0080] Figure 9 shows an apparatus 900 for producing disposable products from cellulose fibers, comprising a moulding mechanism (M_M) 901 for providing plurality of wet moulded products of a pre-defined shape. The moulding mechanism may e.g. comprise a robotic arm attached/mounted to a cellulose fibers mould (not shown) discussed in relation to figure 3 and figure 4. The apparatus 900 further comprises means for placing (M_P) 902, which may be the above mentioned robotic arm, the wet moulded products into plurality of cavities (see e.g. 402 in figure 4) of a blow mould (e.g. 401 in figure 4), where the blow mould is pre-heated to an operating temperature as e.g. discussed in relation to figure 2-4, each of the plurality of cavities of the blow mould comprising plurality of ventilation openings (see e.g. 601 in figure 6). The apparatus further comprises means for placing (M_P') 903 a deformable material adjacent to the plurality of cavities of the blow mould, but this may e.g. be done by the above mentioned robotic arm, and a pressure mechanism (P_M) 904 for supplying a pressure on the deformable material at the plurality of cavities of the blow mould. The pressure causes a simultaneous inflation of the deformable material into the shape of the plurality of cavities thereby pressing the wet moulded product into the shape of the cavities, the plurality of ventilation openings acting as an exit for the moisture in the wet moulded products out of the cavities. The pressure means may as an example be the one discussed in relation to figure 4-6.

[0081] While the invention has been illustrated and de-

scribed in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

Claims

1. A method of producing disposable products (503) from cellulose fibers, comprising:
 - providing (201) plurality of wet moulded products (502) made from the cellulose fibers, where the wet moulded products have a pre-defined shape,
 - providing a blow mould (401) pre-heated to an operating temperature, the blow mould comprising plurality of cavities (402), each of the plurality of cavities comprising plurality of ventilation openings (601),
 - placing (203) the wet moulded products into the cavities (402) of the blow mould (401),
 - placing a deformable material (403) adjacent to the plurality of cavities (402) of the blow mould (205), and
 - supplying a pressure on the deformable material at the plurality of cavities (402) of the blow mould (401), the supplied pressure causing a simultaneous inflation of the deformable material (403) into the shape of the plurality of cavities (402) thereby pressing the wet moulded products into the shape of the cavities (402), the plurality of ventilation openings acting as an exit for the moisture (602) in the wet moulded products out of the cavities (402).
2. A method according to claim 1, wherein the deformable material has a pre-defined shape (404) essential following the shape of the plurality of cavities (402) of the blow mould and where the deformable material is a single piece material.
3. A method according to claim 1 or 2, wherein the wet moulded products have geometry essentially following the geometry of the interior of the plurality of cavities (402) of the blow mould.
4. A method according to any of the preceding claims,

wherein the disposable products are cups (503), the wet moulded products comprising plurality of cup like products in a wet state, and where the plurality of cavities (402) have cup like shape.

5. A method according to claim 4, wherein the deformable material comprises plurality of cup like portions (404), the step of placing a deformable material (403) adjacent to the plurality of cavities (402) of the blow mould (205) includes placing the plurality of cup like portions of the deformable material at least partly into the plurality of cavities (402) having the cup like shape, where supplying a pressure on the deformable material into the shape of the plurality of cavities comprises supplying a pressure on the plurality of the cup like portions of the deformable material causing a simultaneous inflation of the cup like portions of the deformable material into the plurality of cup like cavities (402) of the blow mould.
6. A method according to claim 1, where the disposable products are trays, the wet moulded products comprising plurality of trays like products in a wet state, and where the plurality of cavities (402) have trays like shape.
7. A method according to claim 6, wherein the deformable material comprises plurality of trays like portions, the step of placing a deformable material (403) adjacent to the plurality of cavities (402) of the blow mould (205) includes placing the plurality of trays like portions of the deformable material at least partly into the plurality of cavities (402) having the trays like shape, where supplying a pressure on the deformable material into the shape of the plurality of cavities comprises supplying a pressure on the plurality of the trays like portions of the deformable material of the deformable material causing a simultaneous inflation of the trays like portions of the deformable material into the plurality of trays like cavities (402) of the blow mould.
8. A method according to any of the preceding claims, wherein when supplying a pressure on the deformable material into the shape of the cavities of the blow mould the operating temperature of the blow mould is in the range of 150-250°C, preferably in the range of 180-220°C.
9. A method according to any of the preceding claims, wherein the pressure supplied on the deformable material is in the range of 20-80bar, preferably between 30-70bar, more preferably between 40-60bar, most preferably around 50bar.
10. A method according to any of the preceding claims, further comprising depositing a film on an inner surface of the dried moulded product having a shell like

structure defining the shape of the disposable product, where the film comprises an aluminium oxide film, a silicon oxynitride film or a silicon oxide film (209).

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11. A method according to any of the preceding claims, wherein the cellulose fibers comprise a mix including Polylactic acid (PLA) and/or citrus peel fibers.

12. A method according to any of the preceding claims, wherein the wet moulded products of the pre-defined shape is provided by means of:

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- dipping a cellulose fiber mould having a permeable moulding surface side into the cellulose fibers (301), 15
- applying a vacuum to the cellulose fiber mould to draw cellulose fibers through the permeable surface side leaving an outwardly or inwardly facing fiber mat on the permeable moulding surface side (303), and 20
- removing the cellulose fiber mould from the cellulose fibers and subsequently removing the resulting moulded product of the pre-defined shape from the cellulose fiber mould (305). 25

13. A method according to any of the preceding claims, wherein the inner side of cavities of the blow mould comprises plurality of impressions so as to produce a disposable product (503) comprising plurality of protrusions (701). 30

14. A disposable product produced by the method according to any of the claims 1-13.

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15. An apparatus (900) for producing disposable products from cellulose fibers, comprising:

- a moulding mechanism (M_M) 901 for providing plurality of wet moulded products made from the cellulose fibers, where the wet moulded products have a pre-defined shape, 40
- means for placing (M_P) 902 the wet moulded products into plurality of cavities (402) of a blow mould, the blow mould being pre-heated to an operating temperature, each of the plurality of cavities (402) of the blow mould comprising plurality of ventilation openings, 45
- means for placing (M_P') 903 a deformable material adjacent to the plurality of cavities (402) of the blow mould, 50
- a pressure mechanism (P_M) 904 (501) for supplying a pressure on the deformable material at the plurality of cavities (402) of the blow mould (401), the pressure causing a simultaneous inflation of the deformable material (403) into the shape of the plurality of cavities (402) thereby pressing the wet moulded product into the shape 55

of the cavities (402), the plurality of ventilation openings acting as an exit for the moisture in the wet moulded products out of the cavities (402).

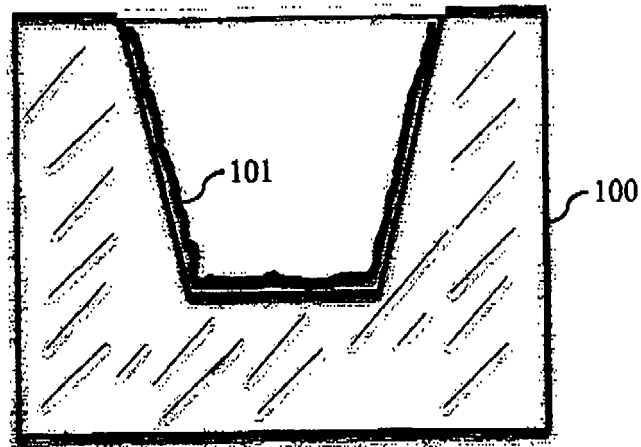


FIG. 1a (PRIOR ART)

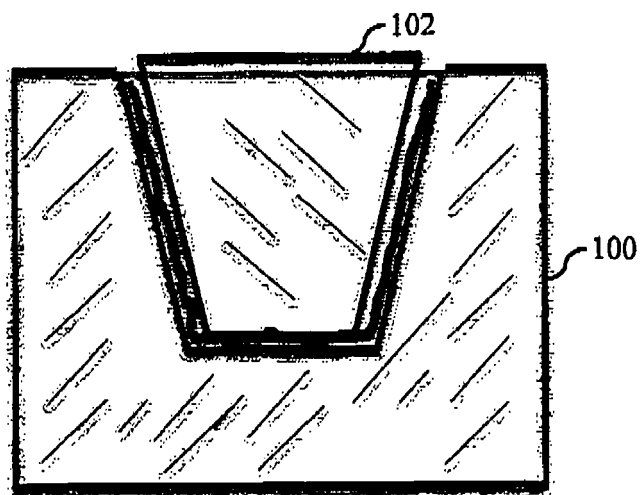


FIG. 1b (PRIOR ART)

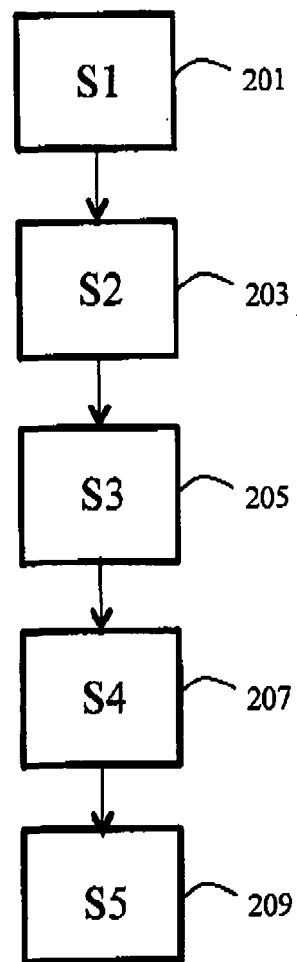


FIG. 2

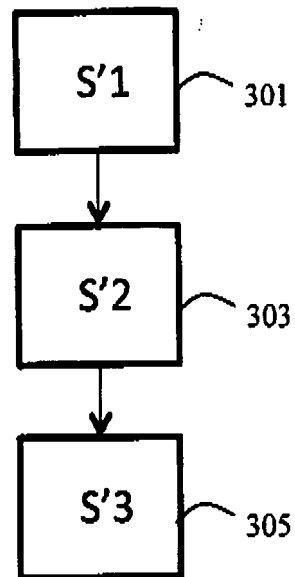


FIG. 3

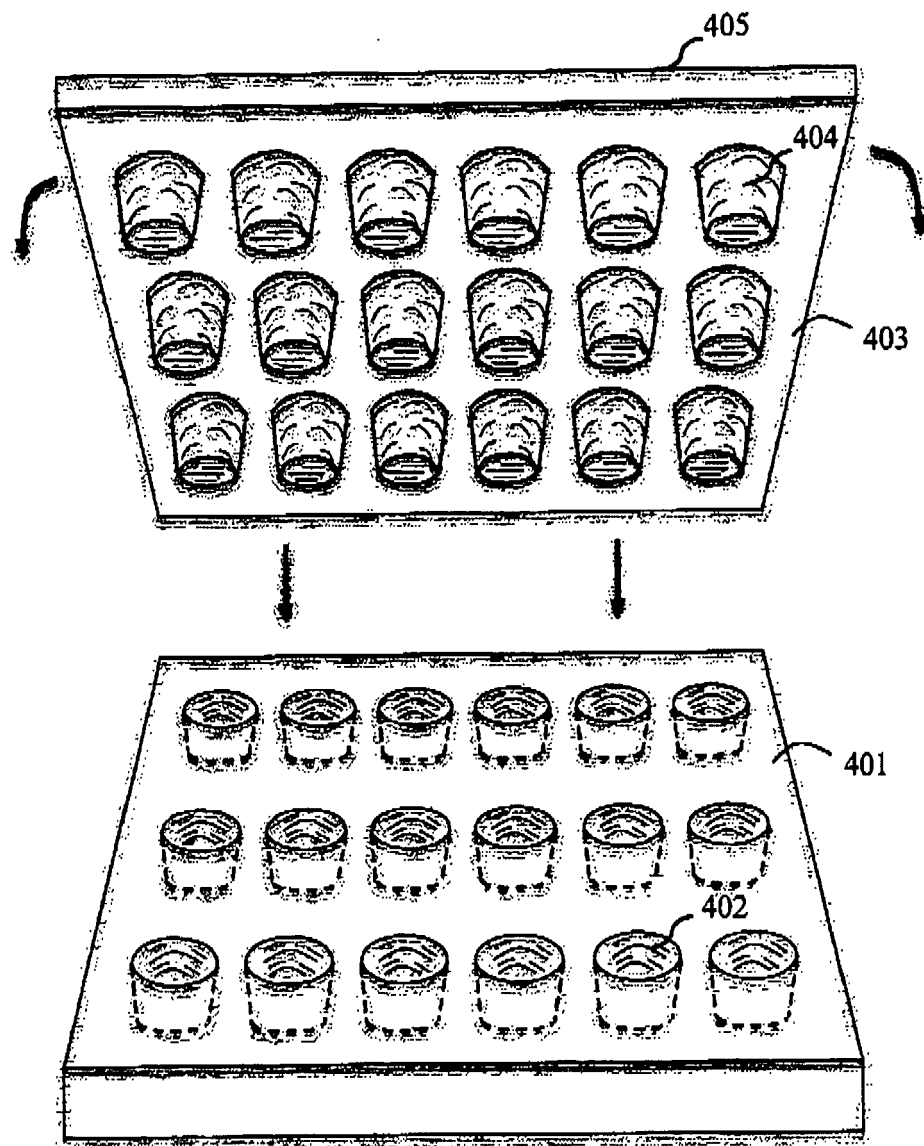


FIG. 4

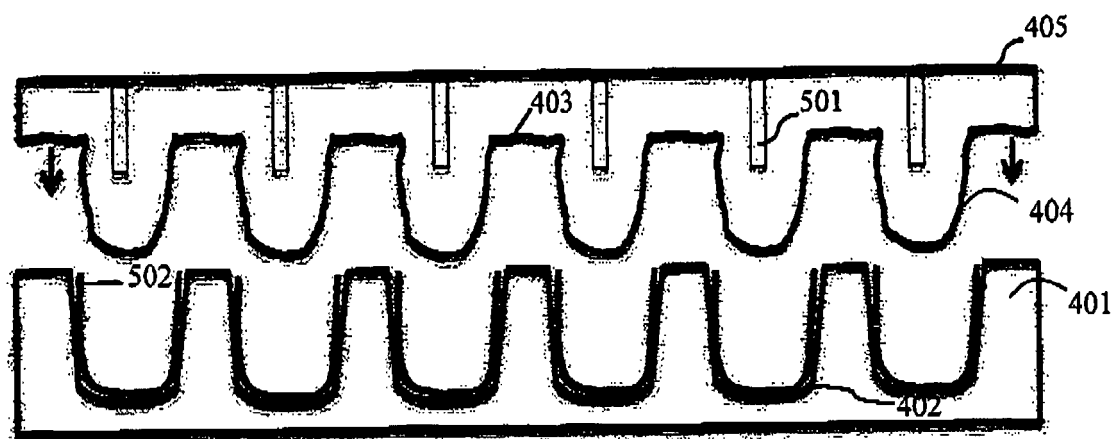


FIG. 5a

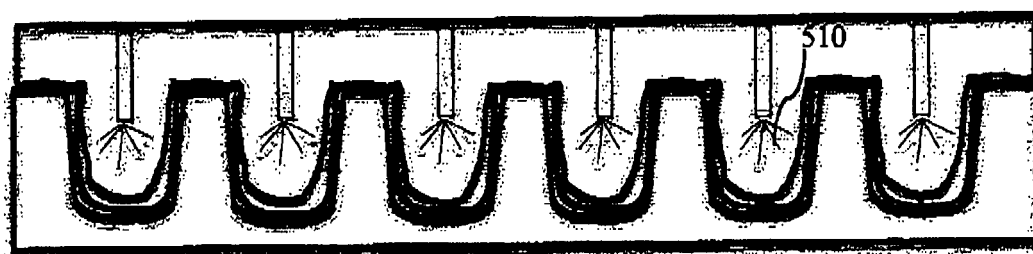


FIG. 5b



FIG. 5c

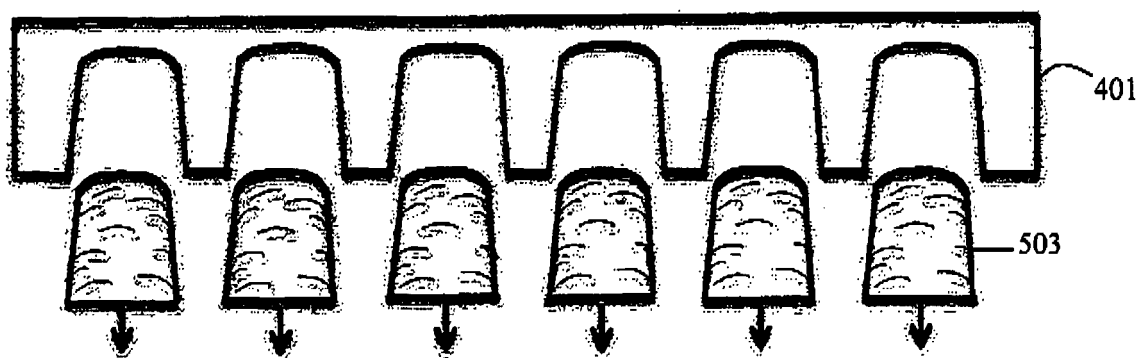


FIG. 5d

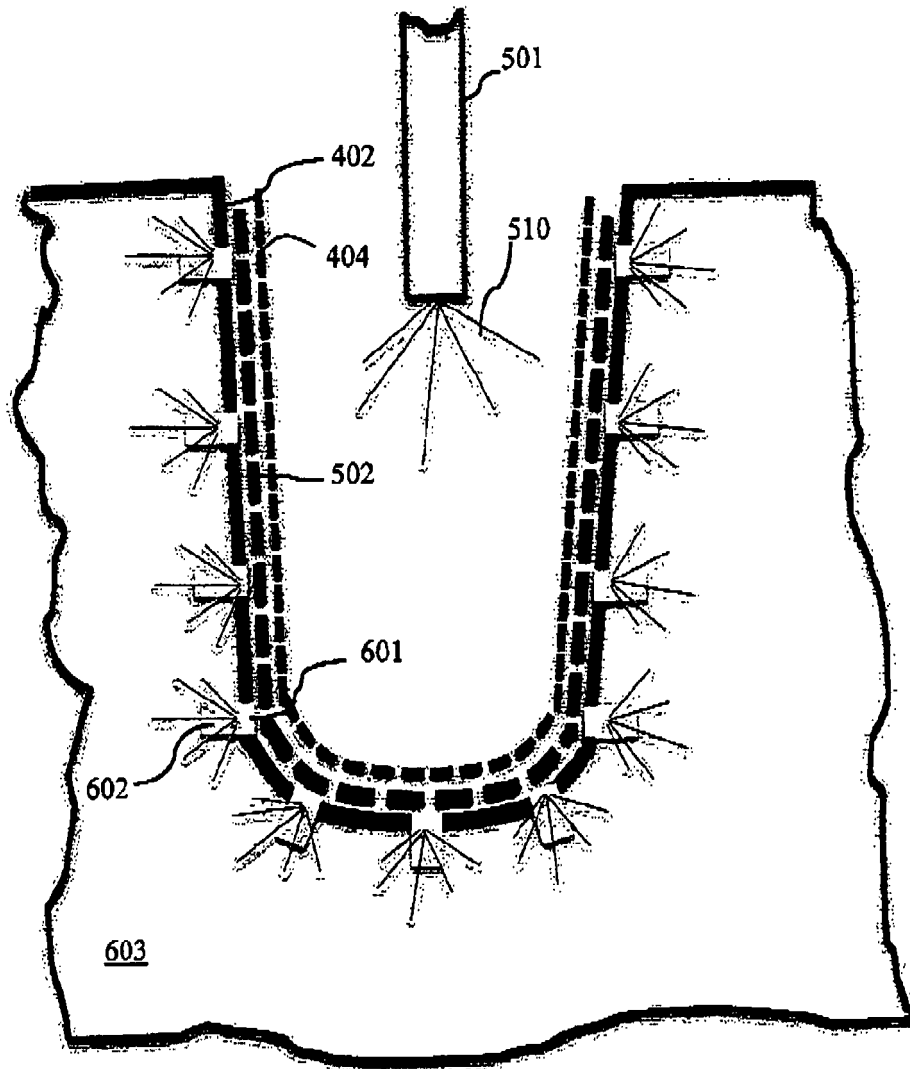


FIG. 6

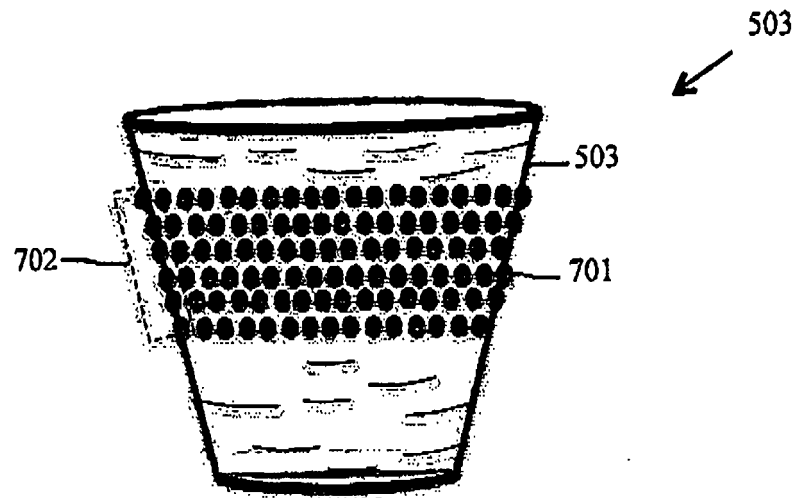


FIG. 7

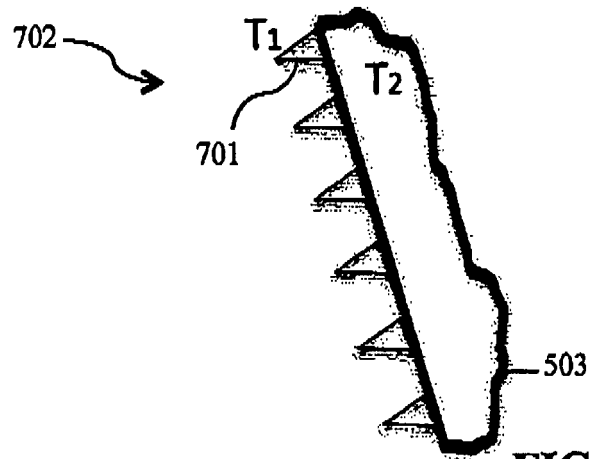


FIG. 8

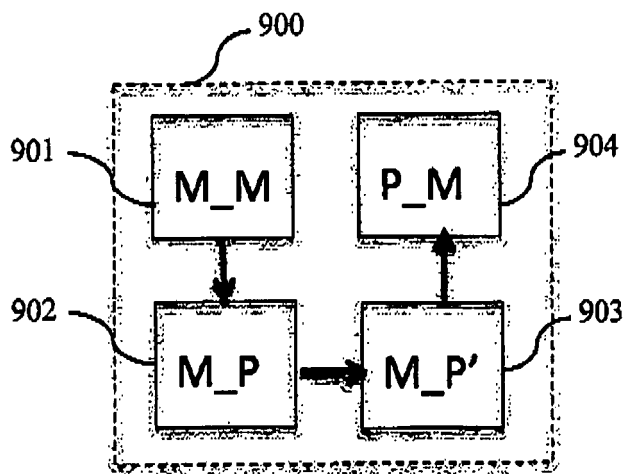


FIG. 9



EUROPEAN SEARCH REPORT

Application Number
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			D21J
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 September 2014	Examiner Pregetter, Mario
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