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(54) **A METHOD AND AN APPARATUS FOR PRODUCING PRODUCTS FROM CELLULOSE FIBERS**

(57) This invention relates a method of producing products from cellulose fibers. A forming mould is provided having a male or female permeable surface side. Plurality of outwardly facing wet moulded products is provided made from the cellulose fibers at the permeable surface side of the male or female forming mold, where the plurality of wet moulded products have a shape substantially following the shape of the products to be produced. A heated female or male die is provided having a shape essentially following the shape of the male or female permeable surface side. A wet-pressing is performed on the wet moulded products by means pressing the female or male die and the male or female permeable surface side together, where the pressure is maintained until the plurality of outwardly facing wet moulded products are partly dried. A further drying is performed on the partly dried moulded products. A heated male and female after-press die set is provided having a shape defining the shape of the products to be produced, where at least one of the male or female after-press die set comprise plurality of ventilation openings. The partly dried moulded products are placed, after undergoing the further drying step, into the male or female die of the after-press die set and pressing the female and male die of the after-press die set together, where the pressure is maintained until the partly dried moulded products are fully dried, the plurality of ventilation openings acting as access channels for the remaining moisture in the partly dried moulded products.

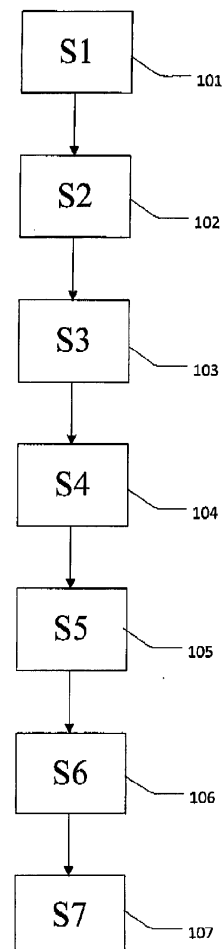


FIG. 1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method and a system for producing products, such as plates, from cellulose fibers.

BACKGROUND OF THE INVENTION

[0002] There is a general environmental desire to reduce the amount of waste generated, and to re-use or recycle waste materials where possible. Some development has in the past years been taking place in producing environmental products such as containers and plates.

[0003] Conventional technique to produce e.g. plates is based on dipping a forming mould having a male or female permeable surface side into a paper pulp, where the shape of the male or female permeable surface side substantially defines the shape of the plates to be produced. A vacuum pressure is supplied to the forming mould to draw the paper pulp through the permeable surface side leaving an outwardly facing fiber mat, i.e. a plurality of pre-shaped wet moulded products, on the permeable moulding outer surface side. In this case, the wet moulded products have a plate-like shape.

[0004] Finally, the wet moulded products are placed into an after-press die set where heated male and female dies are pressed together for an approximately 40-50 seconds, or until the plate structures have dried.

[0005] This problem with this process is how slow it is, and is energy demanding because of e.g. the heating required during pressing the male and female dies together.

[0006] The inventor of the present invention has appreciated that there is thus a need for faster and more energy friendly process to produce such products and has in consequence devised the present invention.

SUMMARY OF THE INVENTION

[0007] It would be advantageous to be able to produce products such as plates from cellulose fibers in a more efficient and environmentally friendly way at a mass production level.

[0008] In general, the invention preferably seeks to mitigate, alleviate or eliminate one or more of the above mentioned disadvantages singly or in any combination. In particular, it may be seen as an object of the present invention to provide a method of producing products from cellulose fibers, such as any type of plates, that solves the above mentioned problems, or other problems, of the prior art.

[0009] To better address one or more of these concerns, in a first aspect of the invention a method is provided of producing products from cellulose fibers, comprising:

- providing a forming mould comprising a male or female permeable surface side,
- obtaining plurality of outwardly facing wet moulded products made from the cellulose fibers at the permeable surface side of the male or female forming mold, where the plurality of wet moulded products have a shape substantially following the shape of the products to be produced,
- providing a heated female or male die having a shape essentially following the shape of the male or female permeable surface side,
- performing a wet-pressing on the wet moulded products by means pressing the female or male die and the male or female permeable surface side together, where the pressure is maintained until the plurality of outwardly facing wet moulded products are partly dried,
- performing a further drying on the partly dried moulded products,
- providing a heated male and female after-press die set having a shape defining the shape of the products to be produced, where at least one of the male or female after-press die set comprise plurality of ventilation openings,
- placing the partly dried moulded products, after undergoing the further drying step, into the male or female die of the after-press die set and pressing the female and male die of the after-press die set together, where the pressure is maintained until the partly dried moulded products are fully dried, the plurality of ventilation openings acting as access channels for the remaining moisture in the partly dried moulded products.

[0010] Surprisingly, by applying the intermediate wet-press drying and the further drying steps before the moulded products are placed into the after-press die set, the total time needed to produce the products may be decreased dramatically, or from 40-50 second down to 5-20 seconds. This reduction in time is obviously reflected in less energy use which makes the process more energetically friendly.

[0011] The male or female shapes of the permeable side of the forming mould may be made of a wire mesh that is commonly used today.

[0012] The term ventilation openings may be understood as any type of access channels, access slits, or drainage channels for the moisture and/or the liquid in the wet moulded products, that may have any type of cross sectional shape, e.g. cylindrical, rectangular, elliptical etc. that interconnect the inside and the outside of the male/female moulds. As an example, the diameter of these ventilation openings may have a dimension ranging from, but is not limited to, 1mm to micrometer range such as 50 μ m.

[0013] The product may be, but is not limited to, any type of plate, a container, a convex/concave shaped structure.

[0014] In one embodiment, the further drying step comprises placing the partly dried products into a microwave drier. Such microwave drier use only a fraction of the energy compared to the conventional convection drier which makes the process more energetically favorable.

[0015] In one embodiment, the cellulose fibers is a plant based cellulose. The plant based cellulose may in one embodiment, be bagasse produced from sugarcane. Bagasse is 100% biodegradable and compostable and a bi product of sugar cane fiber which is left after the juice has been extracted from the sugar cane, but hundred thousands of tons of bagasse remains to be used yearly.

[0016] Also, due to new processing methods bagasse has become an inexpensive product and thus the value of bagasse may be increased significantly and therefore a favorable option is provided for producing lids for containers using bagasse.

[0017] Further, bagasse is annually renewable as opposed to trees that take 7 to 20 years to grow and is biodegradable as trees.

[0018] More importantly, a 100% environmentally friendly product is produced that fully recyclable. Also, due to the property of bagasse, the sturdiness in the products will be increased compared to conventional products made from paper pulp.

[0019] In one embodiment, the pressure between the female or male die and the male or female permeable surface side during the wet-pressing is in the range of 5N/cm² to 50N/cm².

[0020] In one embodiment, the heated female or male die and/or the female or male of the after-press die set is/are heated to a temperature in the range of 160°C and 210°C.

[0021] In one embodiment, the pressure between female and male die of the after-press die set is in the range of 125N/cm² and 1250N/cm².

[0022] In one embodiment, the further drying step is adjusted such that after undergoing the further drying step the partly dried moulded products are 80° to 90° solid and have moisture in the range between 20° to 10°. Thus, most of the moisture (liquid) has been removed but at the same time there is sufficient moisture remaining in the products to allow the final shaping step. Also, the fact that most of the moisture has been removed the pressing time of the male or female after-press die set is very low, such as between 1 and 4 seconds, whereas in conventional techniques at least 40 seconds pressing time is required which obviously requires much more energy.

[0023] In one embodiment, the step of obtaining plurality of outwardly facing wet moulded products made from the cellulose fibers comprises:

- moving the forming mould into pulp containing cellulose fibers, and
- supplying vacuum to the forming mould so as to draw liquid through the permeable surface side leaving the outwardly facing wet moulded products at the

permeable surface side of the male or female forming mold.

[0024] Accordingly, an effective process is provided to obtain the plurality of outwardly facing wet moulded products and subsequently perform the wet-drying in one and the same movement where the wet moulded products do not need to be removed from the forming mould in such a wet state.

[0025] In a second aspect of the invention, A system is provided for producing products from cellulose fibers, comprising:

- a forming mould comprising a male or female permeable surface side,
- means for obtaining plurality of outwardly facing wet moulded products made from the cellulose fibers at the permeable surface side of the male or female forming mold, where the plurality of wet moulded products have a shape substantially following the shape of the products to be produced,
- a heated female or male die having a shape essentially following the shape of the male or female permeable surface side,
- means for performing a wet-pressing on the wet moulded products by pressing the female or male die and the male or female permeable surface side together, where the pressure is maintained until the plurality of outwardly facing wet moulded products are partly dried,
- a drying station for performing a further drying on the partly dried moulded products,
- a heated male or female after-press die set having a shape defining the shape of the products to be produced, where at least one of the male or female after-press die set comprise plurality of ventilation openings,
- means for placing the partly dried moulded products, after undergoing the further drying step, into the male or female die of the after-press die set and pressing the female and male die of the after-press die set together, where the pressure is maintained until the partly dried moulded products are fully dried, the plurality of ventilation openings acting as access channels for the remaining moisture in the partly dried moulded products.

[0026] Accordingly, A system is provided that is capable of producing products such as plates, bowls, and the like, from cellulose fibers, in only a fraction of the time that is needed by conventional apparatuses. Also, due to the additional wet-pressing and the subsequent further drying, the time needed to compress the male and female dies of the after-press die set is greatly reduced and therefor the energy costs is reduced.

[0027] In one embodiment, the drying station comprises microwave drier. The drying time may be one second or more, where the drying time is selected such that after

the drying there is preferably 10-20° moisture in the products. The drying station may further comprise a conveyor means where the products, subsequent to the wet-pressing, are placed onto the conveyor and where they are conveyed through the microwave drier.

[0028] Any means may be used to move the partly dried moulded products from the forming mould to the drying station, e.g. suction mechanism may be provided to suck the partly dried moulded products from the forming mould and/or the forming mould may also supply an air pressure to facilitate the releasing of the partly dried moulded products from the forming mould.

[0029] In one embodiment, the means for obtaining plurality of outwardly facing wet moulded products comprises a computer controlled robotic arm and where the forming mould is attached to the robotic arm, and where the robotic arm and/or the forming mould is connected to a vacuum source, the robotic arm being adapted:

- move the forming mould into a liquid containing the cellulose fibers,
- supply vacuum to the forming mould so as to draw liquid through the permeable surface side leaving the outwardly facing wet moulded products at the permeable surface side of the male or female forming mold,
- perform the wet-pressing by means of moving the forming mould containing outwardly facing wet moulded products at the permeable surface side of the male or female forming mold and compress the permeable surface side the heated female or male die against each other.

[0030] Accordingly, in a simple movement the robotic arm may move the forming mould from the pulp with the wet moulded products and in the same movement or cycle, perform the wet-pressing.

[0031] In one embodiment, there may be two or more, e.g. four forming molds, operated at the same time in a cyclic way where the wet-pressing is an intermediate step meaning that the productivity may be increased greatly.

[0032] As an example, the robotic arm may comprise two or more sub-arms where two or more forming moulds are mounted to the respective one of the two or more sub-arm, such that while one sub-arm is dipping the forming mould mounted to the sub-arm into pulp containing the cellulose fibers, another sub-arm may be performing the wet-pressing, another sub-arm may have completed the wet-pressing and is at another position for released the partly dried products to the drying station, another sub-arm may be positioned at a halting position after obtaining the wet-moulded products, be before undergoing the wet pressing.

[0033] As an example, the robotic arm may contain four such sub-arms arranged in a cross-like manner and that move in a cyclic movement, where each movement is a 90° degree movement between different operations steps.

[0034] 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

[0035] Embodiments of the invention will be described, by way of example only, with reference to the drawings, in which

Figure 1 shows a flow diagram of a method according to the present invention of producing products from cellulose fibers,

Figure 2 shows graphically the wet-pressing step discussed in relation to figure 1,

Figure 3 shows a drying station 300 where the partly dried products 301 (the plates) have been removed from the forming mould in figure 2

Figure 4 shows where the further partly dried plates 301 have been placed into heated female die 401 from an after-press die set,

Figure 5a-c depict graphically the final drying step where the partly dry products (in this example the plates) are dried in the after-press die set, and

Figure 6 shows a zoomed up view of the female die in figure 5 depicting in more details the plurality of ventilation openings, and

Figure 7 shows an embodiment of system according to the present invention for producing products from cellulose fibers.

DESCRIPTION OF EMBODIMENTS

[0036] Figure 1 shows a flow diagram of a method according to the present invention of producing products from cellulose fibers, where the products may as an example be any type of plates.

[0037] The cellulose fibers may in one embodiment be plant based cellulose, where the plant based cellulose is bagasse produced from sugarcane.

[0038] In step S1 (101), a forming mould is provided comprising a male or female permeable surface side.

[0039] In step S2 (102), plurality of outwardly facing wet moulded products is obtained made from the cellulose fibers at the permeable surface side of the male or female forming mold, where the plurality of wet moulded products have a shape substantially following the shape of the products to be produced.

[0040] In one embodiment, the step of obtaining plurality of outwardly facing wet moulded products made from the cellulose fibers comprises moving the forming mould into pulp containing cellulose fibers, and supplying vacuum to the forming mould so as to draw liquid through the permeable surface side leaving the outwardly facing wet moulded products at the permeable surface side of

the male or female forming mold.

[0041] In step S3 (103), a heated female or male die is provided having a shape essentially following the shape of the male or female permeable surface side.

[0042] In step S4 (104), a wet-pressing is performed on the wet moulded products by means pressing the female or male die and the male or female permeable surface side together, where the pressure is maintained until the plurality of outwardly facing wet moulded products are partly dried.

[0043] The pressure between the female or male die and the male or female permeable surface side during the wet-pressing may be in the range of 5N/cm² to 50N/cm² and the female or male die may in one embodiment be heated to a temperature in the range of 160°C and 210°C. The time of maintaining the pressure depends on the temperature and or the pressure, and may in one embodiment be between 1-10 seconds.

[0044] In step S5 (105), a further drying on the partly dried moulded products is performed. In one embodiment, this further drying step comprises removing the partly dried products from the forming mould and placing them into a microwave drier where they may be moved or conveyed through the microwave drier. After completing this further drying step the products may be 80-90° solid/dried and contain 20-10° water.

[0045] The step of placing the partly dried products from the forming mould and into the microwave drier may be done in several ways, e.g. via gravity and/or via air pressure at the forming mould where the semi dried products are blown away from the forming mould, and/or by means of removing the semi dried products from the forming mould via similarly shaped mould via a suction. Other solutions well known to a person skilled in the art are also possible to implement.

[0046] In step S6 (106), a heated male and female after-press die set is provided having a shape defining the shape of the products to be produced, where at least one of the male or female after-press die set comprise plurality of ventilation openings.

[0047] In step S7 (107), the partly dried products are, after undergoing the further drying step, placed into the male or female die of the after-press die set where the female and male die of the after-press die set are pressed together. This pressure is maintained until the partly dried moulded products are fully dried, which may e.g. be in the range of 1-4 seconds. The plurality of ventilation openings act as access channels for the remaining moisture in the partly dried moulded products.

[0048] The pressure between the female and male die of the after-press die set may in one embodiment be in the range of 125N/cm² and 1250N/cm² and the temperature of at least one of the female and male die, preferably both of the female and male die, may be in the range of 160°C and 210°C.

[0049] Figure 2 shows graphically the wet-pressing step discussed in relation to figure 1, showing where a forming mould 201 comprising a female permeable sur-

face side 202 has been dipped into a pulp containing cellulose fibers leaving an outwardly facing fiber mats 203 on the permeable surface side.

[0050] Shown is also a heated male die 204 that may be heated to a temperature in the range of 150°C to 210°C. This heated male die may be stationary, e.g. fixed to a frame structure or to a wall or ceiling, and has a shape essentially following the shape of the female permeable surface side 202. In this case, the products to be produced are plates meaning that the female permeable surface side and the male die 204 have a plate like shapes.

[0051] Subsequent to obtaining the outwardly facing fiber mats 203 the forming mould may be moved towards the heated male die 204 where the forming mould and the heated die are pressed together, as discussed in relation to figure 1, leaving partly dried products, in this case partly dried plates.

[0052] Subsequently, the forming mould may be moved from the heated die 204 to an area (not shown) where the semi dried plates are removed, e.g. via suction as discussed in relation

[0053] The forming mould may be mounted to a robotic arm (not shown) that moves the forming mould 201 smoothly from the pulp directly towards the heated die 204 where the wet-pressing takes place, where subsequently the robotic arm moves the forming mould towards the removing area.

[0054] Figure 3 shows a drying station 300, e.g. a microwave drier, where the partly dried products 301 (the plates) have been removed from the forming mould in figure 2 and been into the drying station 300 where a further drying takes place, preferably until the plates are 80-90° dry.

[0055] As depicted here, a conveyor 302 may extend through the drying station 300 and convey the partly dried plates through the drying station. The speed and/or the drying station may be adapted to how dried the products are to be when leaving the drying station, but as already mentioned, subsequent to undergoing the drying the products still contain some remaining moisture.

[0056] Figure 4 shows where the further partly dried plates 301 have been placed into heated female die 401 from an after-press die set where subsequently a corresponding heated male die 402 from the after-press die are compressed together as discussed in relation to figure 1. The shape of the female and the male die of the after-press die define the final shape of the product, i.e. in this case the plate.

[0057] The number of products that may be produced simultaneously by be tens or even hundreds, and not only six as shown here.

[0058] Figure 5a-c depict graphically the final drying step where the partly dry products (in this example the plates) are dried in the after-press die set.

[0059] Figure 5a depicts where the partly dried plates 301a have been placed into the female die 401 of the after-press die, and figure 5b depicts where the male die

402 and female die 401 are compressed together causing the remaining moisture/liquid in the products to leave via the ventilation openings 403, and where the pressure is maintained until the products are fully dried, and figure 5c depicts where the male die 402 is released from the female die.

[0060] Figure 6 shows a zoomed up view 406 of the female die 401 in figure 5 depicting in more details the plurality of ventilation openings 404 (the same may apply for the male die) and a plate structure 301 b after undergoing the further drying step in figure 5.

[0061] Figure 7 shows an embodiment of system 700 according to the present invention for producing products from cellulose fibers, where in this embodiment four forming moulds 201a-201d comprising a female permeable surface side (could just as well be a male permeable surface side) attached to a robotic arm 701, which is preferably computer controlled, and where the robotic arm 701 comprises four sub-arms 702a-702d. The four forming moulds 201a-201d are mounted to these four sub-arms 702a-702d arranged in a cross like manner, respectively.

[0062] The operation of steps S1 - S5 discussed in relation to figure 1, may be based on a cyclic movement as indicated by arrows 711a-711d of a robotic system that operates the robotic arm 701.

[0063] One (or more) tub 712 is provided containing pulp 712 having the cellulose fibers, e.g. bagasse as discussed in relation to the previous figures.

[0064] The operation steps may in one embodiment be following. A forming mould 201c is dipped into the pulp 703 via a moving mechanism 704, which may be a hydraulic operating system, where subsequently a suction pressure 709 is provided for drawing the pulp through the permeable surface side leaving outwardly facing wet moulded products on the permeable surface side 713. During this, a forming mould 201a at the opposite side that has already undergoing this process is performing a wet-pressing by moving the forming mould 201a towards the heated die 204 as indicated by an arrow 706 and presses it against the heated die 204. Also, during this, a forming mould 201d may be held at a holding position 714 and a forming mould 201b that has already undergone the wet-pressing is delivering the partly dried products to a take-away means 708, which may e.g. be a robotic arm that applies suction pressure 710 to such the partly dried products from the forming mould 201b.

[0065] The take-away means 708 delivers the partly dried products to the drying station 300 discussed in relation to figure 3, and the drying station delivers the further dried products to the after-press die set 401, 402 where the final drying and shaping takes place as shown in figure 5.

[0066] The number of forming moulds should of course not be construed as being limited to four forming moulds, the number could just as well be more than four forming moulds or less than four forming moulds.

[0067] It should be noted that this apparatus could im-

plement only a single forming mould, two forming moulds, three forming moulds, or four forming moulds as shown here, or even more.

[0068] While the invention has been illustrated and described 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.

[0069] 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 products from cellulose fibers, comprising:

- providing a forming mould comprising a male or female permeable surface side,
- obtaining plurality of outwardly facing wet moulded products made from the cellulose fibers at the permeable surface side of the male or female forming mold, where the plurality of wet moulded products have a shape substantially following the shape of the products to be produced,
- providing a heated female or male die having a shape essentially following the shape of the male or female permeable surface side,
- performing a wet-pressing on the wet moulded products by means pressing the female or male die and the male or female permeable surface side together, where the pressure is maintained until the plurality of outwardly facing wet moulded products are partly dried,
- performing a further drying on the partly dried moulded products,
- providing a heated male and female after-press die set having a shape defining the shape of the products to be produced, where at least one of the male or female after-press die set comprise plurality of ventilation openings,
- placing the partly dried moulded products, after undergoing the further drying step, into the male or female die of the after-press die set and pressing the female and male die of the after-press die set together, where the pressure is maintained until the partly dried moulded products are fully dried, the plurality of ventilation openings acting as access channels for the remaining

- moisture in the partly dried moulded products.
2. The method according to claim 1, wherein the further drying step comprises placing the partly dried products into a microwave drier. 5
 3. The method according to claim 1 or 2, wherein the cellulose fibers is a plant based cellulose.
 4. The method according to any of the preceding claims, wherein the plant based cellulose is bagasse produced from sugarcane. 10
 5. The method according to any of the preceding claims, wherein the disposable is a plate. 15
 6. The method according to any of the preceding claims, wherein the pressure between the female or male die and the male or female permeable surface side during the wet-pressing is in the range of 5N/cm² to 50N/cm². 20
 7. The method according to any of the preceding claims, wherein the heated female or male die and/or the female or male of the after-press die set is/are heated to a temperature in the range of 160°C and 210°C. 25
 8. The method according to any of the preceding claims, wherein the pressure between female and male die of the after-press die set is in the range of 125N/cm² and 1250N/cm². 30
 9. The method according to any of the preceding claims, wherein the further drying step is adjusted such that after undergoing the further drying step the partly dried moulded products are 80° to 90° solid and have moisture in the range between 20° to 10°. 35
 10. The method according to any of the preceding claims, wherein the step of obtaining plurality of outwardly facing wet moulded products made from the cellulose fibers comprises: 40
 - moving the forming mould into pulp containing cellulose fibers, and 45
 - supplying vacuum to the forming mould so as to draw liquid through the permeable surface side leaving the outwardly facing wet moulded products at the permeable surface side of the male or female forming mold. 50
 11. A system for producing products from cellulose fibers, comprising: 55
 - a forming mould comprising a male or female permeable surface side,
 - means for obtaining plurality of outwardly fac-

ing wet moulded products made from the cellulose fibers at the permeable surface side of the male or female forming mold, where the plurality of wet moulded products have a shape substantially following the shape of the products to be produced,

- a heated female or male die having a shape essentially following the shape of the male or female permeable surface side,
- means for performing a wet-pressing on the wet moulded products by pressing the female or male die and the male or female permeable surface side together, where the pressure is maintained until the plurality of outwardly facing wet moulded products are partly dried,
- a drying station for performing a further drying on the partly dried moulded products,
- a heated male or female after-press die set having a shape defining the shape of the products to be produced, where at least one of the male or female after-press die set comprise plurality of ventilation openings,
- means for placing the partly dried moulded products, after undergoing the further drying step, into the male or female die of the after-press die set and pressing the female and male die of the after-press die set together, where the pressure is maintained until the partly dried moulded products are fully dried, the plurality of ventilation openings acting as access channels for the remaining moisture in the partly dried moulded products.

12. The apparatus according to claim 11, wherein the means for obtaining plurality of outwardly facing wet moulded products comprises a computer controlled robotic arm and where the forming mould is attached to the robotic arm, and where the robotic arm and/or the forming mould is connected to a vacuum source, the robotic arm being adapted:
 - move the forming mould into a liquid containing the cellulose fibers,
 - supply vacuum to the forming mould so as to draw liquid through the permeable surface side leaving the outwardly facing wet moulded products at the permeable surface side of the male or female forming mold,
 - perform the wet-pressing by means of moving the forming mould containing outwardly facing wet moulded products at the permeable surface side of the male or female forming mold and compress the permeable surface side against the heated female or male die.
13. The apparatus according to claim 11 or 12, wherein the drying station comprises microwave drier.

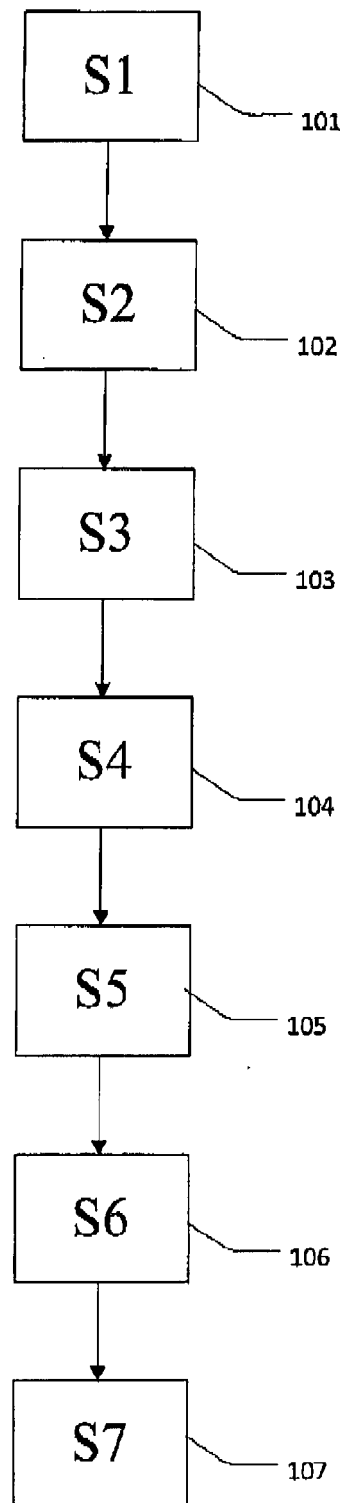


FIG. 1

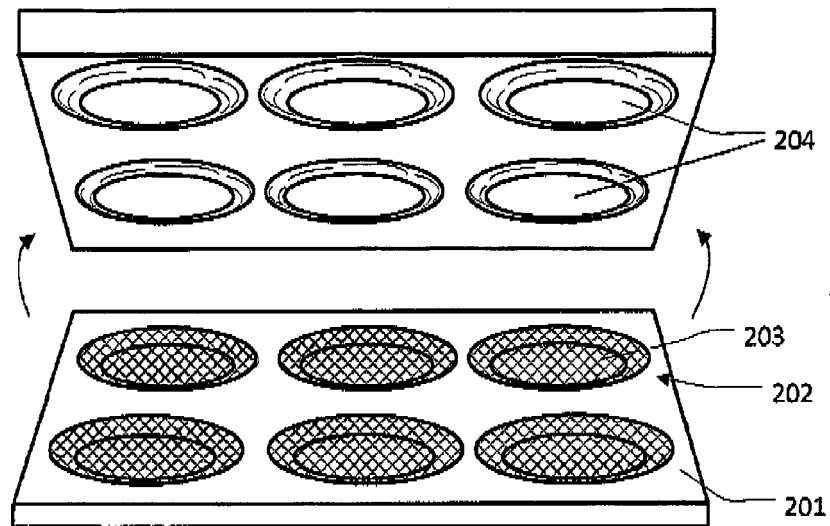


FIG. 2

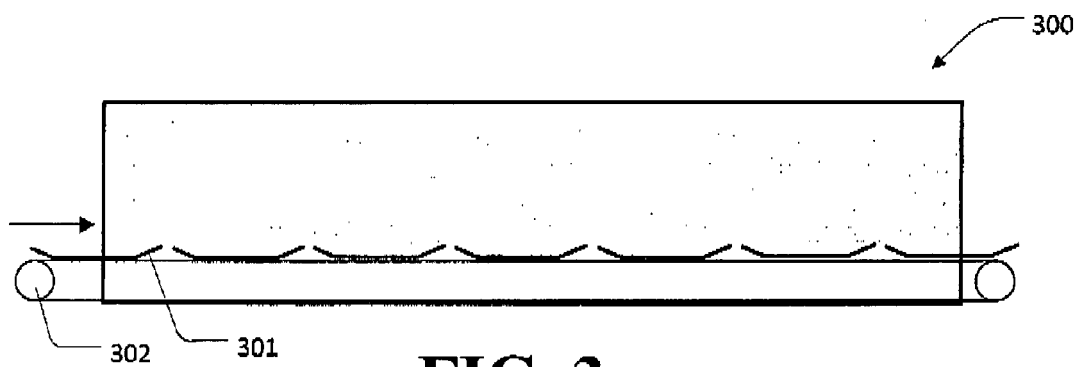


FIG. 3

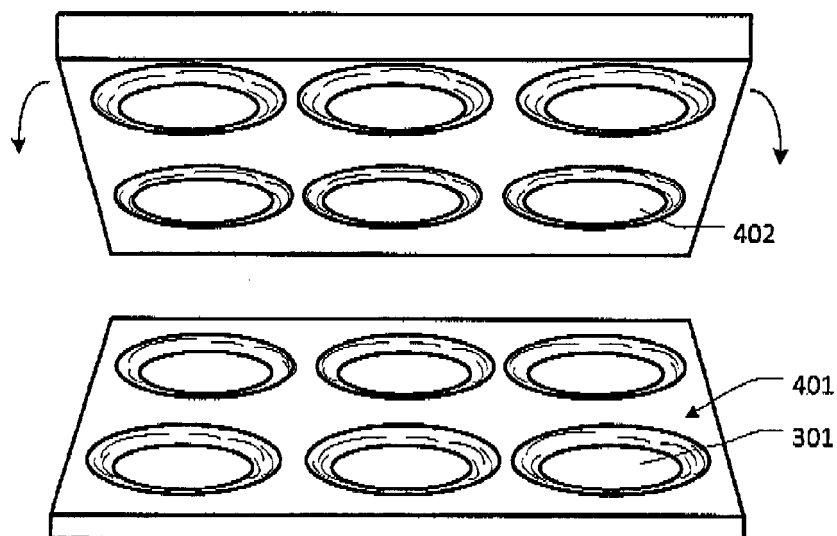


FIG. 4

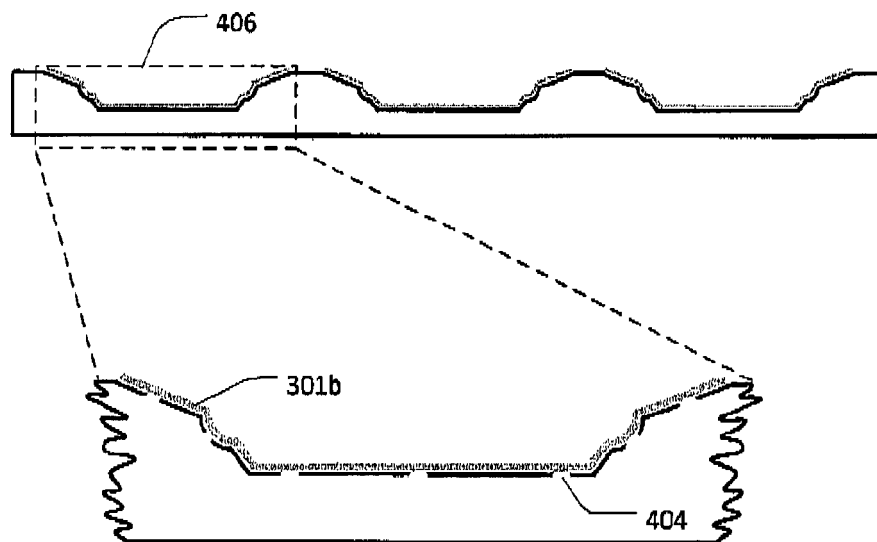
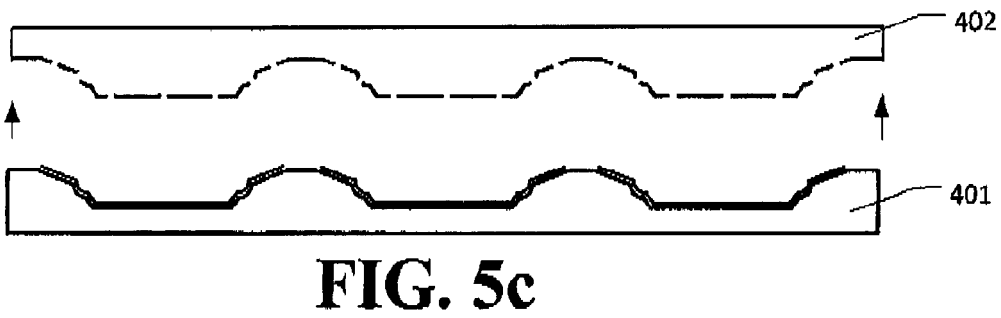
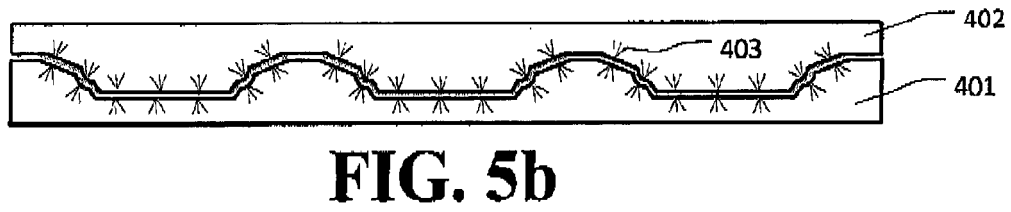
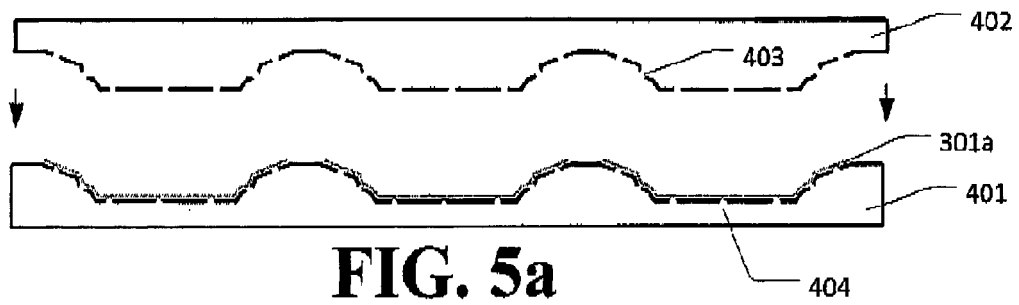


FIG. 6

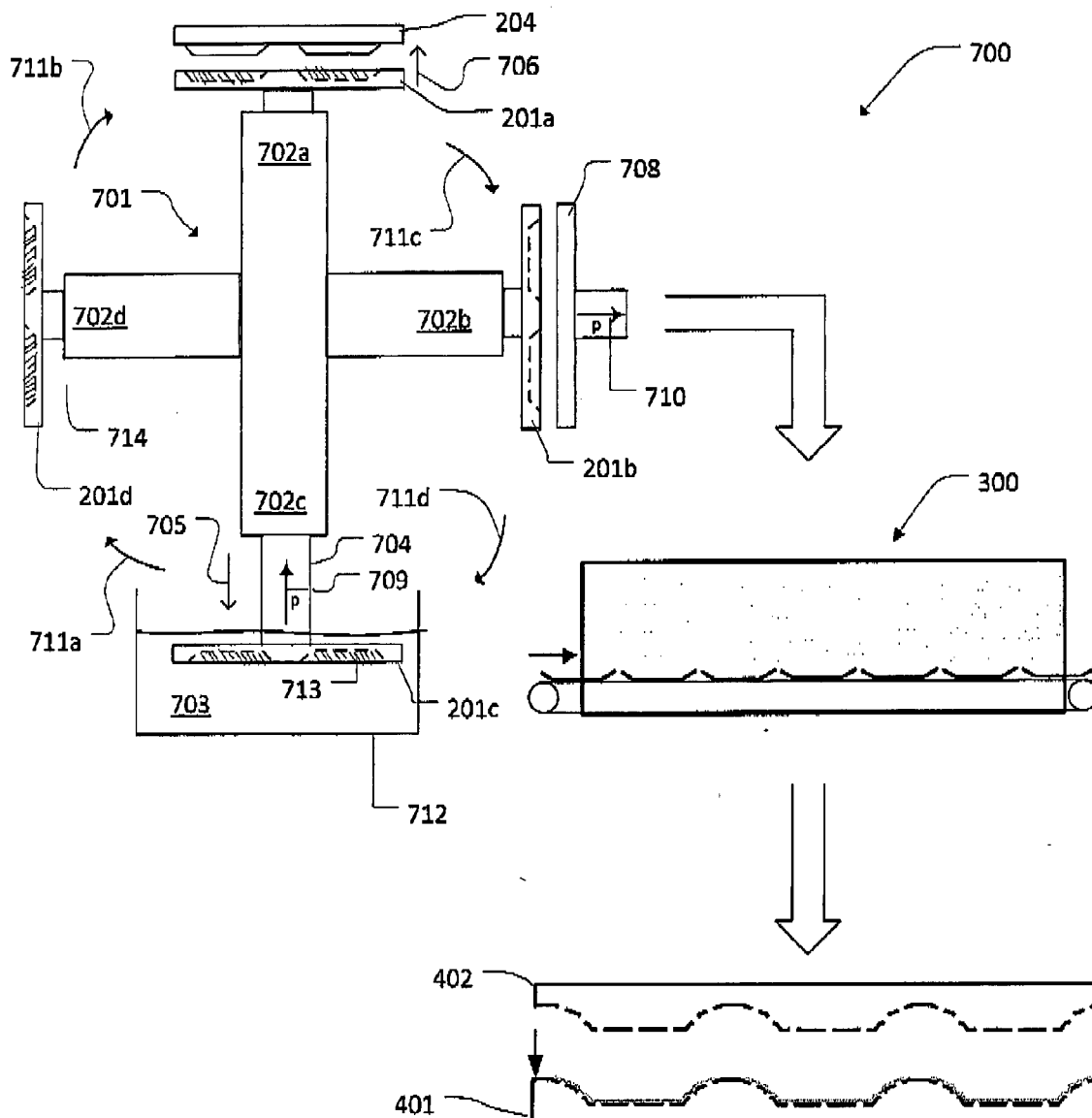


FIG. 7



EUROPEAN SEARCH REPORT

Application Number
EP 15 00 1102

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 24 June 2015	Examiner Pregetter, Mario
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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