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(54) **A METHOD OF PRODUCING BOTTLE CAPS FROM CELLULOSE FIBERS**

(57) This invention relates to a method and a system of producing bottle caps (205) for use with a bottle having a threaded neck (301) opening into the bottle, where the bottle cap is produced from cellulose fibers. Cap-like wet moulded products made from the cellulose fibers are provided and placed into a heated female die comprising plurality of cavities defining the shape of the bottle caps to be produced. Heated elongated structures with the external threads are provided having an outer diameter

being less than the inner diameter of the cavities of the female mould. The elongated structures with the external threads are screwed into the moulded products while the moulded products are in a wet state towards bottom sections of the plurality of cavities up to a pre-defined position, and subsequently un-screwed out front the moulded products, the screwing and the unscrewing of the elongated structure being adapted to produce the thread on inner surface sides of the bottle caps.

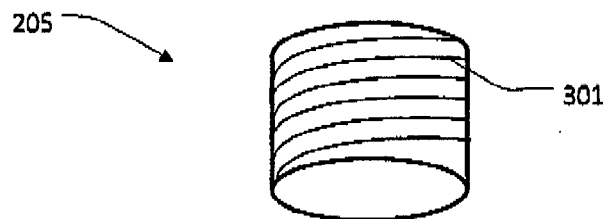


FIG. 3

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method of producing bottle caps for use with a bottle having a threaded neck opening into the bottle.

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] Today's bottle caps are made of plastic material, which after use commonly end up as a waste material.

[0004] The inventor of the present invention has appreciated that there is thus a need for bottle caps that are fully recyclable and a way of producing such recyclable bottle caps and has in consequence devised the present invention.

SUMMARY OF THE INVENTION

[0005] It would be advantageous to be able to produce bottle caps from cellulose fibers in a more efficient and environmentally friendly way at a mass production level.

[0006] In general, the invention preferably seeks to mitigate, alleviate or eliminate one or more of the above mentioned disadvantages singly or in any combination.

[0007] In particular, it may be seen as an object of the present invention to provide a method of producing bottle caps from cellulose fibers that solves the above mentioned problems, or other problems, of the prior art.

[0008] To better address one or more of these concerns, in a first aspect of the invention a method is provided of producing bottle caps for use with a bottle having a threaded neck opening into the bottle, where the bottle cap is produced from cellulose fibers, the method comprising:

- providing cap-like wet moulded products made from the cellulose fibers,
- placing the cap-like wet moulded products into a heated female die comprising plurality of cavities defining the shape of the bottle caps to be produced,
- providing heated elongated structures with external threads having an outer diameter being less than the inner diameter of the cavities of the female mould,
- screwing the elongated structures with the external threads into the moulded products while the moulded products are in a wet state towards bottom sections of the plurality of cavities up to a pre-defined position, and
- un-screwing the elongated structures with the external threads out from the moulded products, the

screwing and the unscrewing of the elongated structure with the external threads being adapted to produce the thread on inner surface sides of the bottle caps.

[0009] Accordingly, a very simple method is provided that is capable of producing recyclable bottle caps in an efficient manner at a mass product level, where the step of providing the cap-like wet moulded products until the bottle caps have been produced takes only several seconds.

[0010] The term cap-like wet moulded products may according to the present invention be understood a product, e.g. cylindrical shaped, that is open in one end and closed in the other end. The inner shape may have a cylindrical shape. The outer shape should not be construed as being limited to a cylindrical shaped, the outer shape can have any kind of shape, e.g. rectangular, triangular etc..

[0011] In one embodiment, the cellulose fibers is a plant based cellulose, where the plant based cellulose may in one embodiment be bagasse produced from sugarcane. Bagasse is 100% biodegradable and compostable and a by-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.

[0012] 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.

[0013] Further, bagasse is annually renewable as opposed to trees that take 7 to 20 years to grow and is biodegradable as trees.

[0014] More importantly, a 100% environmentally friendly product is produced that is 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.

[0015] In one embodiment, the female die is heated to a temperature between 160°C to 220°C.

[0016] In one embodiment, the elongated structure is heated to a temperature between 160°C to 220°C. The elongated structures with the external threads may comprise a cylindrical rod incised with one or more helical or advancing spiral threads, as a lead screw or worm screw.

[0017] When screwing the elongated structures with the external threads into the cap-like wet moulded products inner threads are defined on an inner side of the moulded products, and when un-screwing the elongated structures with the external threads out of the moulded products it is preferred that the elongated structures with the external threads follow these inner threads, i.e. it is preferred that the pulling force that is applied when moving the elongated structures with the external threads out of the moulded products is such that the elongated structures with the external threads follow the same inner

threads as defined when screwing the threads into the moulded products.

[0018] In one embodiment, the method further comprises halting the elongated structures with the external threads upon reaching the pre-defined position for a pre-defined time period. This may be of advantage if the time it takes to screw and un-screw the elongated structures with the external threads is not sufficient to fully dry the cap-like moulded products in the heated female die.

[0019] In one embodiment, the time of screwing and un-screwing the elongated structures with the external threads is selected such that cap-like moulded products are fully dried. As an example, the un-screwing process may be operated at a slower mode than the screwing process, so as to ensure that after completing un-screwing the elongated structures with the external threads out of the moulded products they are fully dry.

[0020] It may also be possible to leave the resulting bottle caps in the heated female die until they are fully dried, e.g. for several seconds or even more, depending among other things on the thickness of the bottle caps.

[0021] In one embodiment, at least one of the elongated structures with the external threads and the plurality of cavities in the female mould comprise plurality of ventilation openings adapted to provide access for the moisture in the wet moulded products. A more efficient drying of the cap-like moulded products is provided.

[0022] In one embodiment, the pre-defined position is a position adjacent to the bottom sections of the plurality of cavities.

[0023] In one embodiment, the step of providing the cap-like wet moulded products made from the cellulose fibers comprises:

- moving a male or female shaped forming mould defining the shape of the wet moulded products into pulp containing the cellulose fibers, and
- supplying vacuum to the forming mould so as to draw pulp through the permeable surface side leaving outwardly facing the cap-like wet moulded products at the permeable surface side.

[0024] Accordingly, an effective process is provided to obtain the plurality of cap-like wet moulded products. The male or female shaped forming mould are typically made of a wire mesh that is commonly used today in processed for producing disposable products.

[0025] In a second aspect of the invention, a bottle cap having an inner thread for use with a bottle having a threaded neck opening into the bottle is provided, where the bottle cap is produced by the above mentioned method steps. Accordingly, a bottle cap is provided that may be used on any type of bottles, preferably any types of recyclable bottles, and that is fully recyclable.

[0026] In a third aspect of the invention, system for producing bottle caps for use with a bottle having a threaded neck opening into the bottle is provided, where the bottle cap is produced from cellulose fibers, the sys-

tem comprising:

- means for providing cap-like wet moulded products made from the cellulose fibers,
- means for placing the cap-like wet moulded products into a heated female die comprising plurality of cavities defining the shape of the bottle caps to be produced,
- plurality of heated elongated structures with external threads having an outer diameter being less than the inner diameter of the cavities of the female mould,
- means for screwing the elongated structures with the external threads into the moulded products while the moulded products are in a wet state towards bottom sections of the plurality of cavities up to a pre-defined position, and
- means for un-screwing the elongated structures with the external threads out from the moulded products, the screwing and the unscrewing of the elongated structure being adapted to produce the thread on inner surface sides of the bottle caps.

[0027] In one embodiment, the means for providing cap-like wet moulded products made from the cellulose fibers comprises a robotic arm and a forming mould mounted to the robotic arm comprising a male or female permeable surface side, where the robotic arm is adapted to:

- move the forming mould into pulp containing the cellulose fibers, and
- supply vacuum to the forming mould so as to draw pulp through the permeable surface side leaving the outwardly facing cap-like wet moulded products at the permeable surface side of the male or female forming mold have.

[0028] In one embodiment, the means for placing the cap-like wet moulded products into the heated female die comprises moving the forming mould towards the heated female and releasing the cap-like wet moulded products into the heated female die.

[0029] In one embodiment, the means for screwing and un-screwing the elongated structures with the external threads comprises a drill system controlled by a control unit. This drill system could as an example comprise plurality of rotatable spouts and where each of the heated elongated structures with the external threads are attached to the spouts, respectively. The heating may in one embodiment originate from a heating source that via the drill pressing system.

[0030] 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

[0031] 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 method according to the present invention of producing bottle caps for use with a bottle having a threaded neck opening into the bottle,

Figure 2 shows a where the cap-like wet moulded products have been placed into heated female die comprising plurality of cavities defining the shape of the bottle caps to be produced,

Figure 3 shows a zoomed up view of a single elongated structure showing in more details the external thread,

Figure 4 shows a front view of the embodiment in figure 2,

Figure 5a-d depict graphically the process producing the bottle caps, starting with the scenario shown in figure 4,

Figure 6 show an example of a produced bottle cap 502 that may be produced in the process depicted in figure 5, and

Figure 7 depicts graphically a system 700 according to the present invention for producing bottle caps for use with a bottle having a threaded neck opening into the bottle, where the bottle cap is produced from cellulose fibers.

DESCRIPTION OF EMBODIMENTS

[0032] Figure 1 shows a flow diagram of method according to the present invention of producing bottle caps for use with a bottle having a threaded neck opening into the bottle, where the bottle cap is produced from cellulose fibers. The cellulose fibers may in one embodiment be plant based cellulose, where the plant based cellulose is bagasse produced from sugarcane.

[0033] In step S1 101, cap-like wet moulded products are provided made from the cellulose fibers.

[0034] The step of providing the cap-like wet moulded products made from the cellulose fibers comprises in one embodiment moving a male or female shaped forming mould defining the shape of the wet moulded products into pulp containing the cellulose fibers, and supplying vacuum to the forming mould so as to draw pulp through the permeable surface side leaving outwardly facing the cap-like wet moulded products at the permeable surface side.

[0035] In step S2 102, the cap-like wet moulded products are placed into a heated female die comprising plurality of cavities defining the shape of the bottle caps to be produced. The temperature of the heated die may in one embodiment be in the range of 160°C to 220°C.

[0036] In step S3 103, heated elongated structures with external threads are provided having an outer diam-

eter being less than the inner diameter of the cavities of the female mould. The temperature of the elongated structure may in one embodiment be in the range 160°C to 220°C.

[0037] In step S4 104, the elongated structures with the external threads are screwed into the moulded products while the moulded products are in a wet state towards bottom sections of the plurality of cavities up to a pre-defined position. The pre-defined position is preferably a position adjacent to the bottom of the heated die.

[0038] In step S5 105, the elongated structures with the external threads are un-screwed out from the moulded products, the screwing and the unscrewing of the elongated structure being adapted to produce the thread on inner surface sides of the bottle caps.

[0039] Figure 2 shows a where the cap-like wet moulded products 203 have been placed into heated female die comprising plurality of cavities 202 defining the shape of the bottle caps to be produced.

[0040] Shown is also plurality of heated elongated structures 205 with the external threads having an outer diameter being less than the inner diameter of the cavities of the female mould. The plurality of heated elongated structures with the external threads 205 are arranged in a matrix corresponding to the arrangement of the plurality of cavities 202 and be operated by a drill system (not shown here) that allows the above mentioned screwing and un-screwing of the elongated structures with the external threads 205.

[0041] The embodiment shown here may also be considered as if a male die 204 is provided comprise the plurality of the elongated structures with the external threads 205.

[0042] The female die 201 and the male die 204 (or the plurality of the elongated structures with the external threads 205) are connected to a heat source (H_S) 206 that operates the temperature of the elongated structures with the external threads 205 and the female die 201.

[0043] Figure 3 shows a zoomed up view of a single elongated structure 205 showing in more details the external thread 301.

[0044] Figure 4 shows a front view of the embodiment in figure 2, showing where the plurality of the elongated structures with the external threads 205 are placed adjacent to the cavities of the female die 202 where each of the elongated structures with the external threads 205 are facing the cap-like wet moulded products 203.

[0045] Figure 5a-d depict graphically the process producing the bottle caps, starting with the scenario shown in figure 4, showing where the elongated structures with the external threads 205 are positioned adjacent to the cap-like wet moulded products 203 (figure 5a), where the elongated structures with the external threads 205 are subsequently screwed into the cap-like wet moulded products (figure 5b) in a rotational direction as indicated by arrows 501 (the direction could just as well be opposite, depending on the external thread).

[0046] Upon reaching a target position, which prefer-

ably is in the proximity to bottom parts of the wet moulded products, the rotation direction of the elongated structures with the external threads is reversed as indicated by arrow 501 and the elongated structures with the external threads are un-screwed and moved in the opposite direction as indicated by arrow 503, but preferably such that the elongated structures with the external threads follow the inner threads defined in the moulded products when during the screwing process.

[0047] The downward movement as indicated by arrow 502 and the upward movement as indicated by arrow 503 may be achieved using a robotic arm and the like, where the speed of the movement may be adapted to the threads of the elongated structures such that the un-screwing follows the inner threads defined during screwing the elongated structures into the wet moulded products 203.

[0048] Figure 6 shows an example of a produced bottle cap 502 that may be produced in the process depicted in figure 5, having an open end 601 and cylindrical outer surface wall 602 and an inner thread 503.

[0049] Figure 7 depicts graphically a system 700 according to the present invention for producing bottle caps for use with a bottle having a threaded neck opening into the bottle, where the bottle cap is produced from cellulose fibers.

[0050] The system comprises means (M1) 701 for providing cap-like wet moulded products made from the cellulose fibers, means (M2) 702 for placing the cap-like wet moulded products into a heated female die comprising plurality of cavities defining the shape of the bottle caps to be produced, plurality of heated elongated structures (E_S) 704 with external threads having an outer diameter being less than the inner diameter of the cavities of the female mould, means (M3) 703 for screwing the elongated structures with the external threads into the moulded products while the moulded products are in a wet state towards bottom sections of the plurality of cavities up to a pre-defined position, and means for un-screwing the elongated structures (M_S_U) 705 with the external threads out from the moulded products, the screwing and the unscrewing of the elongated structure being adapted to produce the thread on inner surface sides of the bottle caps.

[0051] In one embodiment, the means for providing cap-like wet moulded products made from the cellulose fibers comprises a robotic arm and a forming mould mounted to the robotic arm comprising a male or female permeable surface side, where the robotic arm is adapted to:

- move the forming mould into pulp containing the cellulose fibers, and
- supply vacuum to the forming mould so as to draw pulp through the permeable surface side leaving the outwardly facing cap-like wet moulded products at the permeable surface side of the male or female forming mold have.

[0052] In one embodiment, the means for placing the cap-like wet moulded products into the heated female die comprises moving the forming mould towards the heated female and releasing the cap-like wet moulded products into the heated female die.

[0053] In one embodiment, the means for screwing and un-screwing the elongated structures with the external threads comprises a drill system controlled by a control unit.

[0054] 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. 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 bottle caps for use with a bottle having a threaded neck opening into the bottle, where the bottle cap is produced from cellulose fibers, the method comprising:
 - providing (101) cap-like wet moulded products made from the cellulose fibers,
 - placing (102) the cap-like wet moulded products into a heated female die comprising plurality of cavities defining the shape of the bottle caps to be produced,
 - providing (103) heated elongated structures with the external threads having an outer diameter being less than the inner diameter of the cavities of the female mould,
 - screwing (104) the elongated structures with the external threads into the moulded products while the moulded products are in a wet state towards bottom sections of the plurality of cavities up to a pre-defined position, and
 - un-screwing (105) the elongated structures with the external threads out from the moulded products, the screwing and the unscrewing of the elongated structure being adapted to produce the thread on inner surface sides of the bottle caps.
2. The method according to any of the preceding claims, wherein the cellulose fibers is a plant based cellulose.

3. The method according to claim 2, wherein the plant based cellulose is bagasse produced from sugar-cane.
4. The method according to any of the preceding claims, wherein the female die is heated to a temperature between 160°C to 220°C. 5
5. The method according to any of the preceding claims, wherein the elongated structure is heated to a temperature between 160°C to 220°C. 10
6. The method according to any of the preceding claims, further comprising halting the elongated structures with the external threads upon reaching the pre-defined position for a pre-defined time period. 15
7. The method according to any of the preceding claims, wherein the time of screwing and un-screwing the elongated structures with the external threads is selected such that moulded products are fully dried. 20
8. The method according to any of the preceding claims, wherein at least one of the elongated structures with the external threads and the plurality of cavities in the female mould comprise plurality of ventilation openings adapted to provide access for the moisture in the wet moulded products. 25
9. The method according to any of the preceding claims, wherein the pre-defined position is a position adjacent to the bottom sections of the plurality of cavities. 30
10. The method according to any of the preceding claims, wherein the step of providing the cap-like wet moulded products made from the cellulose fibers comprises: 35
 - moving a male or female shaped forming mould defining the shape of the wet moulded products into pulp containing the cellulose fibers, and
 - supplying vacuum to the forming mould so as to draw pulp through the permeable surface side leaving outwardly facing the cap-like wet moulded products at the permeable surface side. 40
11. A bottle cap (502) having an inner thread (503) for use with a bottle having a threaded neck opening into the bottle, where the bottle cap is produced by a method according to any of the claims 1 to 10. 50
12. A system (700) for producing bottle caps (502) for use with a bottle having a threaded neck opening into the bottle, where the bottle cap is produced from cellulose fibers, the system comprises: 55
 - means (701) for providing cap-like wet moulded products (203) made from the cellulose fibers,
 - means (702) for placing the cap-like wet moulded products into a heated female die (201) comprising plurality of cavities (202) defining the shape of the bottle caps to be produced,
 - plurality (704) of heated elongated structures (205) with external threads (301) having an outer diameter being less than the inner diameter of the cavities of the female mould,
 - means (703) for screwing the elongated structures (205) with the external threads (301) into the moulded products while the moulded products are in a wet state towards bottom sections of the plurality of cavities up to a pre-defined position, and
 - means (705) for un-screwing the elongated structures (205) with the external threads out from the moulded products, the screwing and the unscrewing of the elongated structure being adapted to produce the thread on inner surface sides of the bottle caps.
13. The system according to claim 12, where the means for providing cap-like wet moulded products made from the cellulose fibers comprises a robotic arm and a forming mould mounted to the robotic arm comprising a male or female permeable surface side, where the robotic arm is adapted to:
 - move the forming mould into pulp containing the cellulose fibers, and
 - supply vacuum to the forming mould so as to draw pulp through the permeable surface side leaving the outwardly facing cap-like wet moulded products at the permeable surface side of the male or female forming mold have.
14. The system according to claim 13, wherein the means for placing the cap-like wet moulded products into the heated female die comprises moving the forming mould towards the heated female and releasing the cap-like wet moulded products into the heated female die. 45
15. The system according to any of the claims 12-14, where the means for screwing and un-screwing the elongated structures with the external threads comprises a drill system controlled by a control unit.

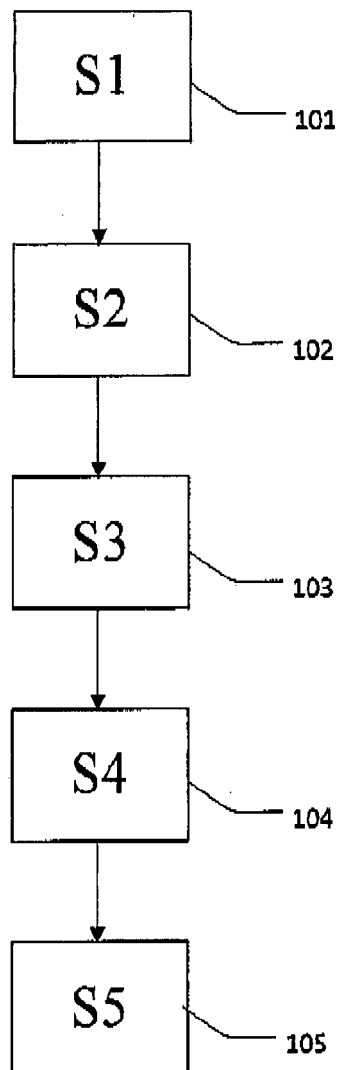


FIG. 1

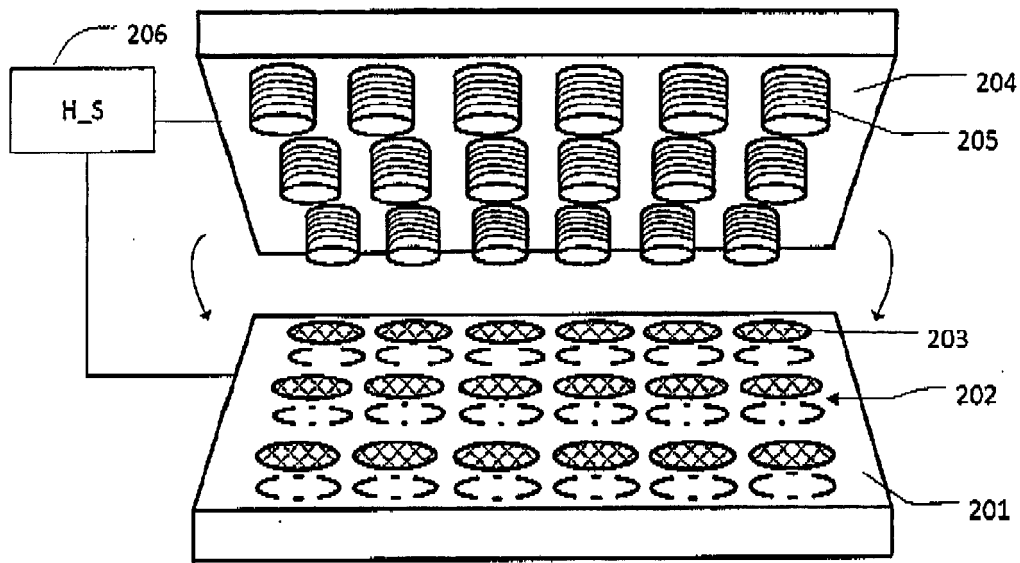


FIG. 2

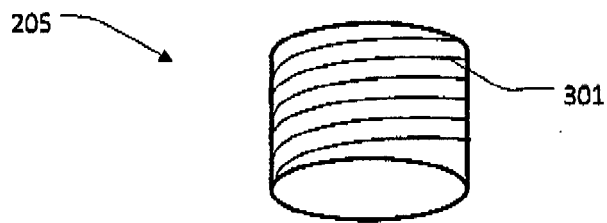


FIG. 3

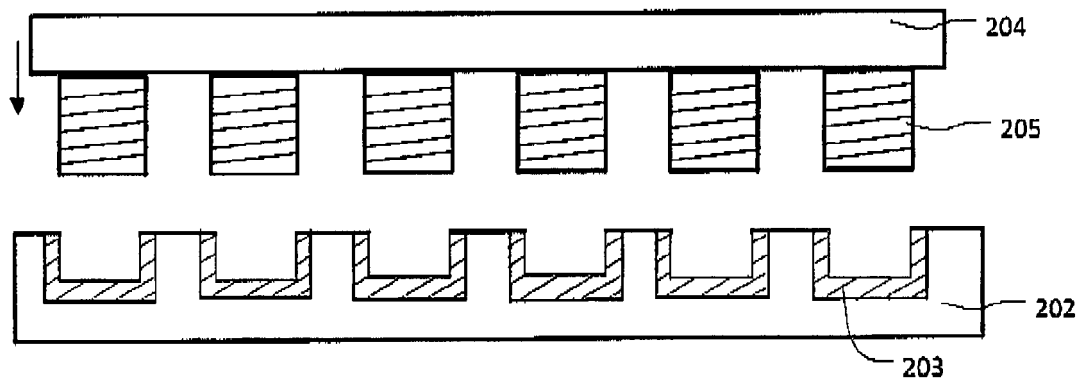


FIG. 4

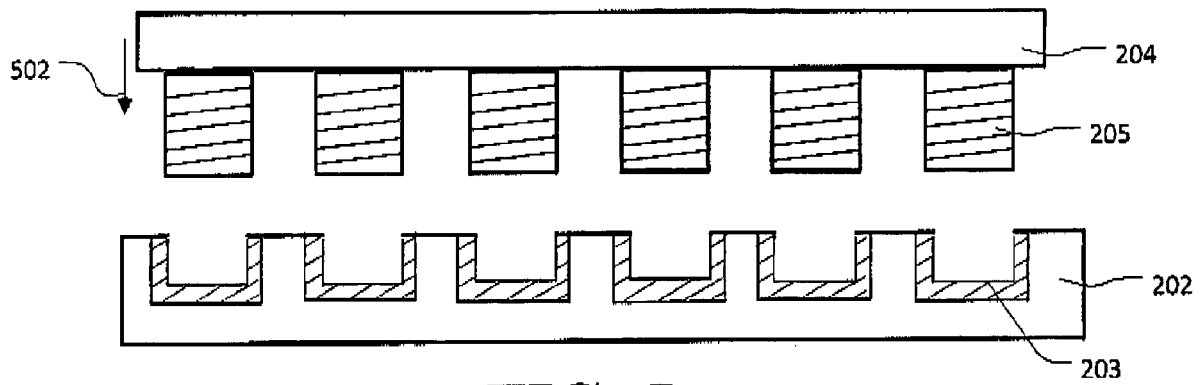


FIG. 5a

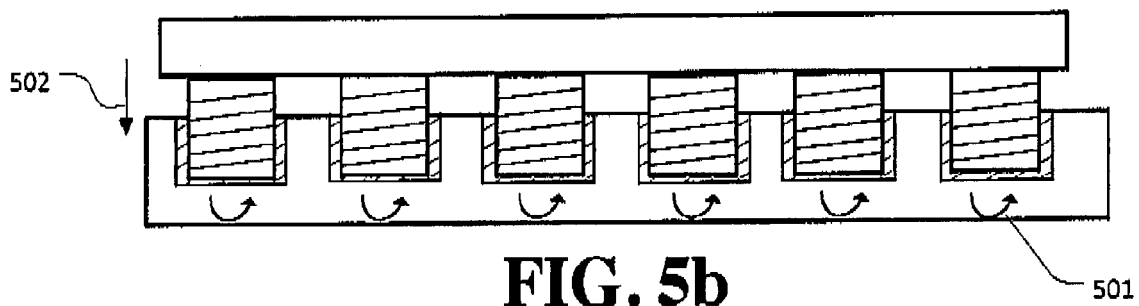


FIG. 5b

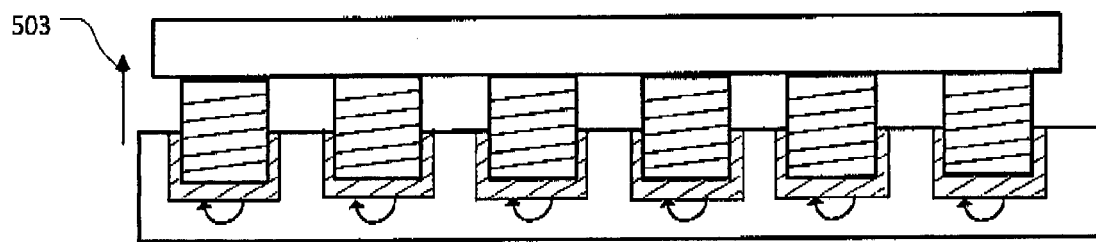


FIG. 5c

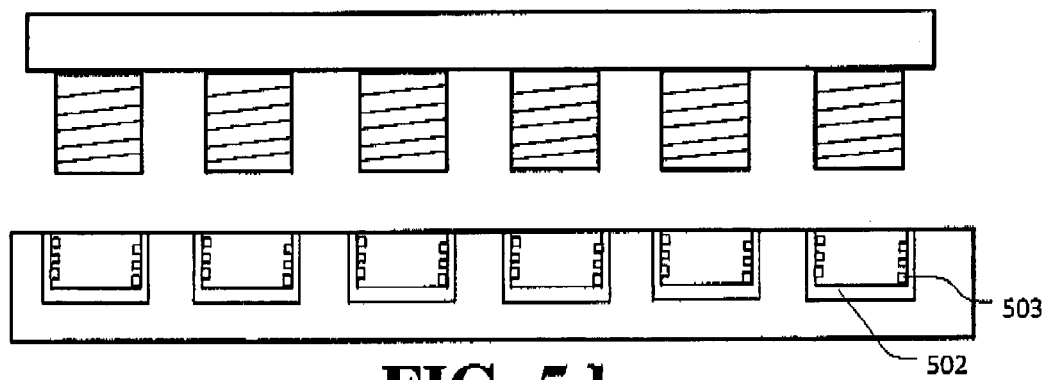


FIG. 5d

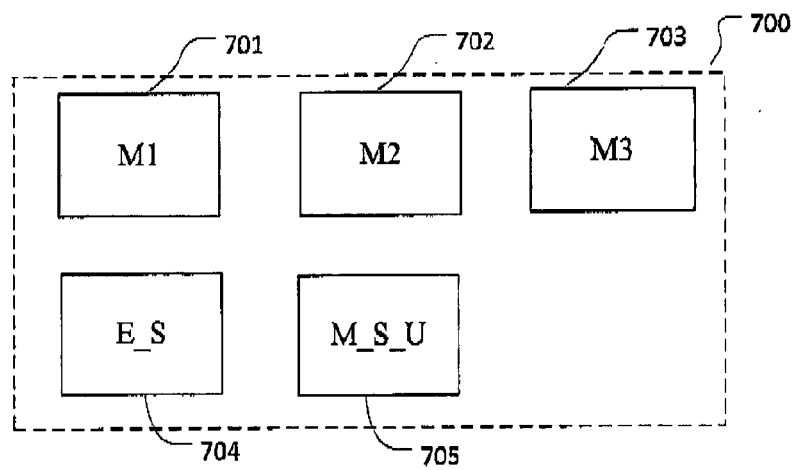
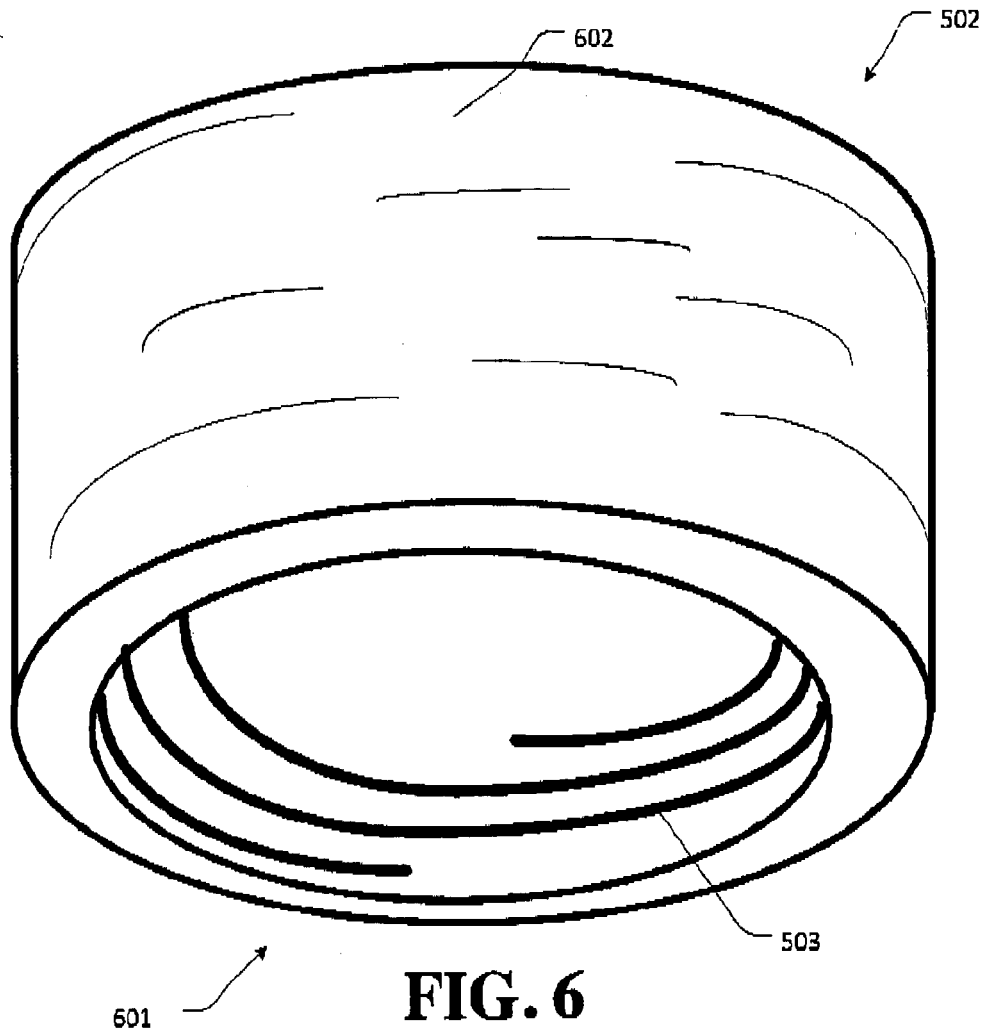


FIG. 7



EUROPEAN SEARCH REPORT

Application Number
EP 15 00 1101

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2009/034344 A2 (NATURAL RESOURCES 2000 LTD [GB]; JOHNSON DAVID BRIAN [GB]) 19 March 2009 (2009-03-19) * page 20, paragraph 2 - page 21, paragraph 3; figures 5A-5D *	11	INV. D21J3/00
A	-----	1-10, 12-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			D21J
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 23 June 2015	Examiner Pregetter, Mario
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EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 00 1101

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