COMMONWEALTH OF AUSTRALIA

Patents Act 1952

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT

In support of the Application made by BRODRENE HARTMANN A/S for a patent for an invention entitled "Method for the Manufacture of Contour-Stable Objects".

I, Kaj Fauerskov Sørensen, Havrevænget 3 , DK-3660 Stenløse

do solemnly and sincerely declare as follows:-

1. I am authorized by BRODRENE HARTMANN A/S the applicant for the patent to make this declaration on its behalf.

2. The basic application as defined by Section 141 of the Act was made in Denmark on the 25th day of October, 1988 by BRODRENE HARTMANN A/S.

3. TORBEN RASMUSSEN, of Christoffersalle 63, DK-2800 Lyngby, Denmark, is the actual inventor of the invention referred to in the basic application and the facts upon which the said applicant is entitled to make the application are as follows:-

   The applicant is the Assignee from the Actual Inventor, TORBEN RASMUSSEN.

4. The basic application referred to in paragraph 2 of this Declaration was the first application made in a Convention country in respect of the invention the subject of the application.

Declared at Lyngby this Friday 11 day of october 1991.

Kaj Fauerskov Sørensen
Finance Director

To the Commissioner of Patents,
Commonwealth of Australia.

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**METHOD FOR THE MANUFACTURE OF CONTOUR-STABLE OBJECTS**

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(56) Prior Art Documents
**GB 1589077**
**US 3325345**

(57) Claim

1. Method for the manufacture of form stable objects by depositing of a fluidized fibre raw material on a form-giving foundation by means of suction of a pulp of fibre raw material on the foundation, in which method a pulp is prepared from said fluidized raw material which by means of the use of a long-fibred starting material provides improved drainability and the pulp is applied to said foundation, the pulp being applied in such quantity, and the suction action being carried out and controlled in such a way that there is deposited a fibre raw material layer with such thickness that the object so obtained has the desired contour stability.

CORRECTED VERSION * **PCT**

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(54) Title: METHOD FOR THE MANUFACTURE OF CONTOUR-STABLE OBJECTS

(57) Abstract

By means of a procedure for the manufacture of contour stable objects a fluidized fibre raw material is deposited on a moulding foundation through suction of a pulp of the fibre raw material on that foundation. For this purpose the foundation is applied with an easily drainable pulp created from the fluidized fibre raw material layer in such an amount and the suction is carried out controlled in such a way that on the foundation through suction a fibre raw material layer is deposited having such wall thickness that it substantially provides the desired contour stability of the object.

The present invention concerns a method for the manufacture of contour-stable objects by the depositing of a fluidized fibre raw material on a moulding foundation by suction of a pulp of the fibre raw material on this foundation.

A fluidized fibre raw material means a starting material, which may be in wet form, of a fibrous nature and suited for the manufacture of the desired objects. Such starting material may for instance be a fibre pulp material as used for instance for trays and cartons for packaging of fragile and sensitive objects such as fruit, flowers, eggs and objects of for instance glass. The pulp material usually consists of a suspended, fibrous cellulose.

It is well known for this purpose to use a production technique by which the starting material in the form of a pulp is by a depositing process placed against the outline forming outside of a mould which is permeable to let a gaseous working medium, through a suction effect, affect the material through the material of the mould and thus mould the contour of the material on the mould through suction.

The object of the invention is to indicate how this in itself suitable production technique may be used not only to manufacture relatively small and light objects but also to manufacture large, rather heavy objects with extremely high load capacity characterized by a contour stability which is substantially based on a corresponding thickness of the material layer deposited on the moulding foundation. In comparison with this the wall thickness of the said small and light objects is rather thin and the rigidity necessary in practice is usually obtained by deliberately moulding the wall panels which for instance support the said objects as the walls produce a rather rigid total object by mutually supporting each other.

According to the invention the stated objective is achieved by applying to the foundation a pulp formed by the fluidized fibre raw material and easily to be drained in such quantity and by controlling the suction in such a way that on the foundation is deposited a fibre raw material layer of such thickness that the object so obtained has the desired contour-stability.

More particularly, in one form the invention resides in a method for the manufacture of form-stable objects by depositing of a fluidized fibre raw material on a form-giving foundation by means of suction of a pulp of fibre raw material on the foundation, in which method a pulp is prepared from said fluidized raw material which by means of the use of a long-fibred starting material provides improved drainability and the pulp is applied to said foundation, the pulp being applied in such quantity, and the suction action being carried out and controlled in such a way that there is deposited a fibre raw material layer with such thickness that the object so obtained has the desired contour stability.

This will by using the above production technique also enable the manufacture of elements with high load capacity such as pallets and building elements which may, contrary to the said packaging examples, display rather even and smooth outer surface and which in itself displays a high degree of contour stability. The depositing of a fibre raw material layer of the defined thickness that the negative pressure used for suction may procure a material density in the fibre raw material layer directed towards the mould surface and which will have a reinforcing effect as it is placed at a distance from the through-going centre plan of the deposited object.

By using the layer thickness of the object thus manufactured the contour stability of this object may according to the invention also be increased by procuring

in the fibre raw material layer and distributed over this one or more variations in the layer thickness by means of the suction effect being correspondingly varied locally in a common suction process for the fibre pulp volume necessary for the manufacture of the whole object. In this way it will be possible in one and the same working process, i.e. the depositing of the fibre raw material on the moulding foundation, to mould both the final outside desired for the object and, by using the thickness of the material layer, a contour stability increasing moulded structure in the actual material object forming the object. The fibre raw material may be deposited with a thickness corresponding to the desired contour stability, there being formed connected regions that have a larger wall thickness in comparison with the other regions of the object.

For suction of an easily drainable pulp of the fibre raw material in the desired thickness, a mould may be used which has a mould surface that is permeable to a gaseous active working medium at negative pressure, the thickness of which mould surface is selected according to the thickness of the fibre raw material layer to be deposited by suction of the pulp on this surface.

In this way it is possible to achieve such interaction between the draining ability of the pulp and the suction capability of the mould surface that also elements having thick fibre layer thickness owing to the desired load capacity may be manufactured rationally.

In order to achieve local variations in the layer thickness of the fibre raw material layer of the object, a mould having a mould surface with a permeability varying in accordance with the desired variation of the wall thickness or, respectively, with the desired configuration of connected regions of the easily drainable fibre pulp layer deposited on the mould surface by the suction.

This means that the depositing of fibre raw material on the mould surface will vary according to the permeability of this surface which results in local variations in the suction effect which, in areas with poor mould surface permeability, causes reduced depositing of fibre raw material in the mould surface whereas the depositing will be high in areas with high mould surface permeability.

In one embodiment of the method according to the invention there is used for the suction of the easily drainable pulp of the fibre raw material in the desired thickness a mould which at negative pressure is permeable by a gaseous active working medium, of which mould at least a contour-forming part of the mould is manufactured from a particle composite material the particles of which are fixed together for the formation of a contour-stable mould surface at the same time as they together limit passages open to the working medium, which passages extend through the composite material to the outside surface of the mould, and that the thickness of at least the composite material layer forming the mould surface is selected according to the thickness of the fibre raw material layer to be deposited by suction of the pulp to the mould surface.

Such a mould may be manufactured on the basis of a cheap, inorganic raw material such as sand as well as by means of a production technique which is simple, of short duration and thus also cheap. The total production costs of the mould may be kept at a low level and this embodiment will consequently be suitable for the production of a small number of products.

In order to achieve local variations in the layer thickness of the object's fibre raw material layer a mould may, according to the latter procedure, be used in which the composite material formed by the mould surface has a thickness that varies in accordance with the desired

variation of the layer thickness or, respectively, with the desired configuration of connected regions of the easily drainable fibre pulp layer deposited on the mould surface by suction.

The permeable mould surface of the mould may be composed of particles with varying particle size, the particle size being small in the part providing the mould surface of the mould and larger in an underlying supporting layer for this part. In this way it is possible to procure good passage for air and at the same time procure for the object to be manufactured a rather smooth mould outside which will result in the object obtaining an even surface.

The mould strength necessary for the carrying through of a production process may be achieved in a simple way by mixing the mould particles with suitable binding agents. The binding agent may contain an adhesion-improving agent. The binding agent may be thermo-setting. The mould manufactured by mixing the particles with suitable binding agents may be hardened for instance by heat treatment. The particles may have a rounded contour. Also wedging between the particles may be used to give the mould strength.

Furthermore, according to the invention it is possible to use a mould having at the bottom a base in which the composite particles are fused together, while the particles in the rest of the mould are linked together by a hardening conglutinating compound. Such a mould is characterized by good strength which will also enable it to resist considerable working pressure.

a particle composite material as mentioned above by binding the material particles together for the creation of an open, stable structure with air passages extending to the outside of the mould and by connecting with a source for a suction provoking vacuum.

The transfer mould is producible directly on the basis of an object produced on the casting mould as on this object a first auxiliary mould (negative) of for instance gypsum is produced corresponding to the side of the object pointing away from the casting mould and on this first auxiliary mould (negative) a second auxiliary mould (positive) is produced for instance also from gypsum and the transfer mould (negative) is then formed directly on this second auxiliary mould.

The permeable mould surface may be kept clean by, prior to the start of the depositing process or the transfer process, exposing for cleaning purposes the mould surface to an air current passing through the mould passages for a gaseous medium.

A mould used in accordance with the invention and constructed by a particle composite material may be manufactured in such a way that it may after use or in case of wear be regenerated as the particle-shaped building material of the mould may be recycled.

For the manufacture of a pulp which is to be easily drained it is possible, according to the invention, as fibre raw material at least partly to use a starting material containing long fibres which is processed to a pulp partly by means of a shake-out in a pulper, partly by a preceding, separate, controlled dry grinding by which the starting material is divided into dosage amounts and divided into its fibres whereupon the object is manufactured from the pulp thus created.

The use of a pulper as an essential step in the processing of the fibre raw materials for the creation of a pulp from which the desired objects are to be manufactured takes place among other things in cases where the fibre raw materials are received in the form of dry substances in bales,

for instance as paper waste.

Heavy whirl formation is produced in the pulper by which the single parts of the material rub against each other and is thereby pulverized and the raw materials divided into fibres.

Especially in case of heterogeneous material such as waste or recycled paper it has to be anticipated that this separation is carried out successively so that the fibres released first are exposed to a higher degree of additional substantial processing than the fibres released later. In other words the processing in the pulper will in its proceedings thus be uncontrolled and thus heterogeneous. The said additional processing results in an increase in both the degree of grinding (°SR-Schopper-Riegler) and thus the formation of mucus in the pulper, which negatively affects the subsequent draining of the object manufactured from the pulp and increases the shrinkage of the object during draining and drying of its material.

The method according to the invention achieves that to the pulper is at least partly added a fibre raw material the fibres of which are already to a substantial degree separated into single fibres why they are more instant and at the same time susceptible to the self-grinding effect and mixing effect obtained in the pulper. As the pulper processes a more uniform raw material also the grinding degree obtained in the pulper through self-grinding may be adjusted to be more uniform and the above-mentioned binding of water in the pulp leaving the pulper will thus be more controllable.

The same procedure will, however, also result in other advantages which are especially valuable in case of recycling of paper waste.

Recycled paper waste exists in many different qualities and gradings. If this material prior to the shake-out in the pulper is exposed to a separate, controlled dry grinding, it is often possible to use a poorer and thus cheaper material quality, than if the division process was only carried out as a shake-out in the pulper.

the preceding separate dry grinding as mentioned above as a multiple-stage process whereby it is possible to separate the starting material in dosage amounts in a special efficient manner.

In this particular way also e.g. waste paper material containing plastic, water resistant paper, plastic laminated cartons and paper, to the degree desired can be separated into fibres and other particles. Separated constituents not being paper can be screened off before entering the pulper, or it is possible to let these constituents since they exist in pulverized form enter into the following production process.

At a performance of the method a long fibre starting material having been subjected to a separate controlled dry grinding be added to an already in the pulper formed pulp and be subjected to a joint time-limited shake-out with this.

In this manner an object can be manufactured whose fibre material is partly mainly bound by hydrogen fibre bindings partly have been mixed with air suspended fibre material for whose binding glue is normally used. It has turned out that in this way it is possible to abandon a traditional complete hydrogen binding of the whole pulp, which means that the drain and thereby the production time for the object can be substantially reduced. Furthermore the method makes it possible to obtain a strict control of the desired object strength characteristics as it will be possible to have strict control of these by the addition of glue.

These advantages are of major importance for a rational and thus economic industrial manufacture also of large, form stable objects by the application of the suction technique described.

It will e.g. be possible to carry out a multiple-stage dry grinding by the application of a tearing machine also called a shredder followed by a treatment in a hammer mill which thus can receive the material from the shredder in dosage amounts and which exposes the material to a further grinding process before it if required also in special do-

sage amounts is added to the pulper for the actual shake-out processing.

The separate, controlled dry grinding suggested according to the invention of the fibre raw materials prior to their shake-out in the pulper also provides the possibility for the co-application of recycling waste paper in cases where the objects to be manufactured must be shrink proof and measure proof. A starting material with a high content of wooden fibre causes less shrinkage that if the fibre were cellulose fibre. It has turned out that by applying the method according to the invention it is even possible to add to a wooden paper raw material a substantial amount of cheap recycling paper including carton waste which not necessarily is wooden since it is possible to manufacture due to the preceding separate controlled dry grinding of the raw material a pulp which causes no undesired shrinkage of the objects manufactured.

It is a well known principle for the manufacture of objects of a fluidized fibre raw material to utilize auxiliary materials such as filling material and chemicals and binding agents. The auxiliary materials decide whether the objects manufactured shall be more or less strong, hard or transparent, or weak, soft and absorbing. The present invention is also advantageous in connection with the application of such auxiliary materials.

The division of the manufacturing process in multiple-stages actually increases the possibility of adding the auxiliary materials at different stages of the total manufacturing process. The achieved open structure of the final pulp, obtained as a result of this particular invention, even facilitates a better access for auxiliary materials so that e.g. a binding material may be applied more or less integrating on the surface of the objects in order to increase the strenght of the wall. The addition of auxiliary material under the preceding separate, controlled dry grinding will in a especially good manner be able to further a particular uniform distribution of the auxiliary materials in the ma-

nufactured fibre mass. It is of course also still possible to add the auxiliary materials to the pulper.

Furthermore, it lies within the scope of the invention that the shake-out in the pulper is carried out as a manufacturing process dependent on the preceding separate, controlled grinding. In other words the obtained degree of self-grinding in the pulper can be adjusted in accordance with the degree of the grinding which according to the circumstances has been carried out at the preceding dry grinding stage(s). As an example, a paper pulp which in the pulper is separated into a normal, at self grinding obtained grinding degree of 60° SR (Schopper-Riegler), be added dry grounded fibre material whereafter the mixture is processed in the pulper for 5 minutes more. Objects manufactured from such a mixture pulp may be provided with a special heavy thickness, porosity and permeability. That means that the products can have good drainage qualities and therefore also can be manufactured with large wall thickness.

An easily drainable pulp manufactured according to the invention facilitates unproblematically a uniform addition of the fibre suspension over the mould even in cases of manufacturing objects with large wall thickness.

Waste paper, also called return paper, may be very composite, and contain fibre with a large variety of fibre lengths. However, it has actually turned out that the average fibre length is so large that the above mentioned advantages especially as regards drainage and structure may be obtained when this paper material forms part of the manufacturing process.

The method according to the invention will also be available for the processing of so-called virgin material.

PATENT CLAIM

1. Method for the manufacture of form stable objects by depositing of a fluidized fibre raw material on a form-giving foundation by means of suction of a pulp of fibre raw material on the foundation, in which method a pulp is prepared from said fluidized raw material which by means of the use of a long-fibred starting material provides improved drainability and the pulp is applied to said foundation, the pulp being applied in such quantity, and the suction action being carried out and controlled in such a way that there is deposited a fibre raw material layer with such thickness that the object so obtained has the desired contour stability.

2. Method in accordance with claim 1 wherein one or more variations in the wall thickness are procured in the fibre raw material layer, distributed over the layer, by means of the suction effect being correspondingly varied locally in a common suction process for the fibre pulp quantity necessary for the manufacture of the whole object.

3. Method in accordance with claim 2 the fibre raw material is deposited with a thickness corresponding to the desired form stability, there being formed connected regions that have a larger wall thickness in comparison with the other regions.

4. Method in accordance with any one of the claims 1 to 3 wherein for suction of an easily drainable pulp of the fibre raw material in the desired wall thickness, a mould is used which has a mould surface that is permeable to a working medium at negative pressure, the thickness of which mould surface is selected according to the thickness of the fibre raw material layer to be deposited by suction of the pulp on the surface.

5. Method in accordance with claim 4, for the carrying out of the method in accordance with claims 2 or 3

wherein a mould is used whose mould surface has a permeability which varies in accordance with the desired variation of the wall thickness or, respectively, with the desired configuration of connected regions of the easily drainable fibre pulp layer deposited by suction on the mould surface.

6. Method in accordance with claim 4, the mould surface is permeable by a gaseous active working medium at negative pressure and wherein at least a contour-forming part of the mould is manufactured from a particle composite material whose particles are fixed together for the creation of a contour stable mould surface and at the same time defining open passages for the working medium extending through the composite material to the mould outside surface and that the thickness in at least the composite material layer forming the mould surface is selected according to the thickness of the fibre raw material layer which is to be deposited by suction of the pulp on the mould surface.

7. Method in accordance with claim 5 wherein a mould is used in which the layer of composite material forming the mould surface is manufactured with a thickness varying in accordance with the wall thickness of the fibre pulp layer or the desired configuration of connected regions of the easily drainable fibre pulp layer deposited by suction on the mould surface.

8. Method in accordance with any one of the claims 4 to 7, wherein a mould is used whose permeable mould surface is composed of particles of different particle sizes, the particle size being small in a part providing the mould surface and bigger in an underlying supporting layer for the first-mentioned part.

9. Method in accordance with claim 8 wherein a mould is used whose particles are clad with a layer formed by a bonding agent.

10. Method in accordance with claim 9 wherein a mould is used whose binding agent is thermo-setting.

11. Method in accordance with claim 9 wherein a mould is used whose binding agent consists of adhesion-improved agent.

12. Method in accordance with claim 8 wherein a mould is used in which the particles have a rounded contour.

13. Method in accordance with claim 8 wherein the particles of the mould are in a wedging compound with each other.

14. Method in accordance with claims 5 or 6 wherein a mould is used having at the bottom a base part in which the composite particles are connected with each other through a real fusion connection while the particles of the rest of the mould are linked to each other through a hardening conglutination connection.

15. Method in accordance with any one of the claims 4 to 14 wherein a mould is used whose mould surface is provided with such a strength that the mould can be used for finishing pressing of an object.

16. Method in accordance with any one of the preceding claims wherein as fibre raw material at least partly a starting material containing long fibres is used which is processed into a pulp partly by the application of a shake-out in a pulper, partly by a preceding, separate, controlled dry grinding, whereby the starting material is separated into portions and divided into its fibres whereafter the object is manufactured from the pulp thus created.

17. Method in accordance with claim 16 wherein the preceding separate dry grinding controlled manufacturing process is carried out as a multiple-stage process.

18. Method in accordance with claim 16 or 17 wherein the shake-out is carried out as controlled manufacturing process dependent on the separate dry grinding.

19. Method in accordance with any one of the claims 16 to 18 wherein a long fibre starting material that has been subjected to a separate, controlled dry grinding is added in portions to a pulp already created in the pulper and is subjected with said pulp to a shake-out of limited duration.

20. Method in accordance with any one of the claims 16 to 19 wherein auxiliary material is added to the fibre material in the separate dry grinding step.

21. Method in accordance with any one of the claims 16 to 20 wherein auxiliary material is added after the pulp has been made.

22. Method in accordance with any one of the claims 16 to 21 wherein a pulp is manufactured as stated in claim 16, and portions of the pulp so obtained are combined with added another already manufactured pulp, and the object is manufactured from the mixture thus created.

23. Method for the manufacture of form-stable objects, substantially as herein described.

# INTERNATIONAL SEARCH REPORT

International Application No PCT/DK 89/00250

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: D 21 J 7/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

| Classification System | Classification Symbols |
|---|---|
| IPC5 | D 21 J |

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

| Category * | Citation of Document, [11] with indication, where appropriate, of the relevant passages [12] | Relevant to Claim No. [13] |
|---|---|---|
| X | GB, B, 1589077 (SOCIETE EUROPEENNE DES PRODUITS REFRACTAIRES (S.E.P.R.)) 7 May 1981, see the whole document -- | 1-22 |
| X | SE, B, 324498 (HARTMAN FIBRE LTD) 1 June 1970, see the whole document -- | 1-22 |
| X | US, A, 3325349 (RICHARD F. REIFERS) 13 June 1967, see the whole document -- | 1-22 |

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* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

| Date of the Actual Completion of the International Search | Date of Mailing of this International Search Report |
|---|---|
| 26th January 1990 | 1990 -01- 31 |
| **International Searching Authority** | **Signature of Authorized Officer** |
| SWEDISH PATENT OFFICE | Olov Jensén |

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. PCT/DK 89/00250

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| GB-B- 1589077 | 07/05/81 | BE-A- 856206 | 17/10/77 |
| | | NL-A- 7707246 | 02/01/78 |
| | | FR-A- 2356488 | 27/01/78 |
| | | DE-A- 2729197 | 12/01/78 |
| | | CH-A- 614884 | 28/12/79 |
| SE-B- 324498 | 01/06/70 | NONE | |
| US-A- 3325349 | 13/06/67 | NONE | |