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ESCOBAR - URIBE ASOCIADOS

A B O G A D O S

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2320/P

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISIÓN DE NUEVAS CREACIONES
E. S. D.

Re: Expediente No. 00016913
Solicitud de Patente en nombre de
HUMATRO CORPORATION

Yo, JIMENA ESCOBAR URIBE, identificada como aparece al pie de mi firma, domiciliada en Santafé de Bogotá, en la Carrera 11 A No. 94-76 Of. 305, obrando como apoderada de la sociedad HUMATRO CORPORATION solicitante de la patente de la referencia, anexo al presente memorial el siguiente documento:

Copia certificada de la solicitud de Patente Número 09/264,401 presentada en los Estados Unidos de América el día 8 de marzo de 1999, con la debida traducción de lo pertinente, incluyendo el capítulo reivindicatorio.

Señor Superintendente,

JIMENA ESCOBAR URIBE
C.C.39.779.452 de usaquén
T.P. 68228
Cód. 5376

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ESTADOS UNIDOS DE AMERICA
A TODOS AQUELLOS A QUIENES EL PRESENTE LLEGUE:

DEPARTAMENTO DE COMERCIO DE LOS ESTADOS UNIDOS
Oficina de Patentes y Marcas de los Estados Unidos

Marzo 28, 2000

La presente es para certificar que el anexo es una copia fiel de los registros de la Oficina de Patentes y Marcas de los Estados Unidos, de los documentos de la solicitud de patente identificada más adelante, que cumplieron con los equerimientos para concederse una fecha de presentación de acuerdo con 35 USC 111.

Número de Solicitud: 09/264/401

Fecha de Presentación: Marzo 08,1999

Por la autoridad del
Comisionado de Patentes y Marcas

(fdo) P. SWAIN
Oficial Certificador
Sello oficial de la Oficina de Patentes y Marcas de los Estados Unidos de América.

Reivindicaciones:

1. Una estructura flexible absorbente que comprende fibras de almidón pseudo-termoplásticas.

2. La estructura de la reivindicación 1, en donde la estructura tiene una densidad aparente que va desde aproximadamente 0.02 gr/cm³ hasta aproximadamente 0.20 gr/cm³ .

3. La estructura de la reivindicación 2, en donde la estructura tiene una densidad aparente que va desde aproximadamente 0.04 gr/cm³ hasta aproximadamente 0.15 gr/cm³ .

4. La estructura de la reivindicación 3, en donde la estructura tiene una densidad aparente que va desde aproximadamente 0.04 gr/cm³ hasta aproximadamente 0.12 gr/cm³ .

5. La estructura de la reivindicación 1, en donde las fibras de almidón tienen un tamaño que va desde aproximadamente 0.01 dtex hasta aproximadamente 135 dtex.

6. La estructura de la reivindicación 5, en donde las fibras de almidón tienen un tamaño que va desde aproximadamente 0.02 dtex hasta aproximadamente 30 dtex.

7. La estructura de la reivindicación 6, en donde las fibras de almidón tienen un tamaño que va desde aproximadamente 0.02 dtex hasta aproximadamente 5 dtex.

8. La estructura de la reivindicación 1, en donde la estructura tiene una resistencia a la tracción seca media geométrica que va desde aproximadamente 10 gr/cm hasta aproximadamente 1200 gr/cm.

9. La estructura de la reivindicación 8, en donde la estructura tiene una resistencia a la tracción seca media geométrica que va desde aproximadamente 30 gr/cm hasta aproximadamente 600 gr/cm.

10. La estructura de la reivindicación 9, en donde la estructura tiene una resistencia a la tracción seca media geométrica que va desde aproximadamente 40 gr/cm hasta aproximadamente 475 gr/cm.

11. La estructura de la reivindicación 1, en donde la estructura tiene una resistencia a la tracción húmeda media geométrica inicial que va desde aproximadamente 2 gr/cm hasta aproximadamente 400 gr/cm.

12. La estructura de la reivindicación 11, en donde la estructura tiene una resistencia a la tracción húmeda media geométrica inicial que va desde aproximadamente 2 gr/cm hasta aproximadamente 200 gr/cm.

13. La estructura de la reivindicación 1, en donde la estructura tiene una resistencia a la tracción seca media geométrica por peso básico básico unitario la cual va desde aproximadamente 200 mt hasta aproximadamente 2500 mt.

14. La estructura de la reivindicación 13, en donde la estructura tiene una resistencia a la tracción seca media geométrica por peso básico unitario la cual va desde aproximadamente 200 mt hasta aproximadamente 1500 mt.

15. La estructura de la reivindicación 14, en donde la estructura tiene una resistencia a la tracción seca media geométrica por peso básico unitario la cual va desde aproximadamente 200 mt hasta aproximadamente 1200 mt.

16. La estructura de la reivindicación 1, en donde la estructura tiene una resistencia a la tracción húmeda media geométrica por peso básico unitario la cual va desde aproximadamente 10 mt hasta aproximadamente 1500 mt.

17. La estructura de la reivindicación 16, en donde la estructura tiene una resistencia a la tracción húmeda media geo-

métrica por peso básico unitario la cual va desde aproximadamente 10 mt hasta aproximadamente 1000 mt.

18. La estructura de la reivindicación 17, en donde la estructura tiene una resistencia a tracción húmeda media geométrica por peso básico unitario la cual va desde aproximadamente 10 mt hasta aproximadamente 500 mt.

19. La estructura de la reivindicación 1, en donde la estructura tiene una resistencia a la tracción húmeda decaída media geométrica que va desde aproximadamente 0 gr/cm hasta aproximadamente 20 gr/cm.

20. La estructura de la reivindicación 19, en donde la estructura tiene una resistencia a la tracción húmeda decaída media geométrica que va desde aproximadamente 0 gr/cm hasta aproximadamente 10 gr/cm.

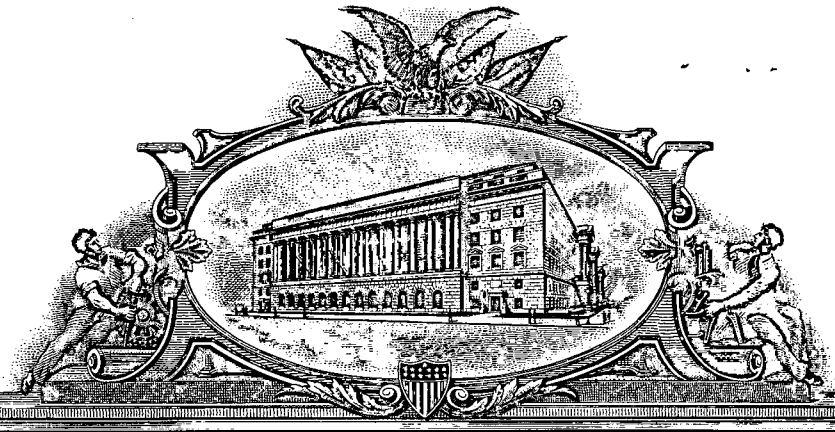
21. La estructura de la reivindicación 1, en donde la estructura tiene un peso básico que va desde aproximadamente 10 gr/mt^2 hasta aproximadamente 450 gr/mt^2.

22. La estructura de la reivindicación 21, en donde la estructura tiene un peso básico que va desde aproximadamente 12 gr/mt^2 hasta aproximadamente 150 gr/mt^2.

23. La estructura de la reivindicación 1, la cual comprende además un plastificante seleccionado entre el grupo constituido por sorbitol, monosacáridos, disacáridos, glicerol, polivinilo alcohol y polietileno glicol.

24. La estructura de la reivindicación 23, en donde dicho plastificante comprende desde aproximadamente 5% de peso hasta aproximadamente 70% de peso con respecto al peso total de la estructura.

25. La estructura de la reivindicación 24, en donde el mencionado plastificante comprende desde aproximadamente 15% de



PA 227568

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March 28, 2000

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: ***09/264,401***
FILING DATE: ***March 08, 1999***

By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS

P. SWAIN
Certifying Officer

Please type a plus sign (+) inside this box → [+]

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03/08/99 JC88 U.S. PTO

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	7456
First Inventor or Application Identifier	Larry Neil Mackey
Title	Absorbent, Flexible, Structure Comprising Starch Fibers
Express Mail Label No.	EE829903065US

03/08/99 09/264401 jc635 U.S. PTO

APPLICATION ELEMENTS

See MPEP Chapter 600 concerning utility patent application contents.

ADDRESS TO: **Assistant Commissioner for Patents**
Box Patent Application
Washington, D.C. 20231

1. [X] * Fee Transmittal Form (e.g., PTO/SB/17)
(Submit an original, and a duplicate for fee processing)
2. [X] Specification Total Pages [32]
(preferred arrangement set forth below)
- Descriptive Title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R&D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. [X] Drawing(s) (35 USC 113) Total Sheets [5]
4. Oath or Declaration Total pages [3]
a. [X] Newly executed (original or copy)
b. [] Copy from a prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 16 completed)
i. [] DELETION OF INVENTORS
Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR §§1.63(d)(2) and 1.33(b).

NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37. C.F.R. §1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R.§1.28).

5. [] Microfiche Computer Program (Appendix)
6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. [] Computer Readable copy
b. [] Paper Copy *(identical to computer copy)*
c. [] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [] Assignment Papers (cover sheet & document(s))
8. [] 37 CFR 3.73(b) Statement [] Power of Attorney
(when there is an assignee)
9. [] English Translation Document *(if applicable)*
10. [] Information Disclosure Statement (IDS)/PTO-1449 [] Copies of IDS Citations
11. [] Preliminary Amendment
12. [X] Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
13. [] *Small Entity Statement(s) [] Statement filed in prior application Status still proper and desired
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(if foreign priority is claimed)
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16. **If a CONTINUING APPLICATION**, check appropriate box and supply the requisite information below and in the preliminary amendment:
[] Continuation [] Divisional [] Continuation-in-part (CIP) of prior application No. /
Prior application information: Examiner: _____ Group/Art Unit: _____
For CONTINUATION or DIVISIONAL only: The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

[ ] Customer Number or Bar Code Label	(Insert Customer No. or Attach bar code label here)	or [X] Correspondence address below

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COUNTRY	U.S.A.	TELEPHONE	513/634-1151	FAX	513/634-3612

Name (Print/Type)	Jay A. Krebs	Registration No. (Attorney/Agent)	41,914
Signature		Date 3-8-99	March 8, 1999

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, D.C. 20231.

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FEE TRANSMITTAL FORM

CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16 (c))	45 - 20	25	x $18.00 =	$450.00
	INDEPENDENT CLAIMS (37 CFR 1.16 (c))	3 - 3	0	x $78.00 =	$-0-
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			+ $270.00 =	$
				BASIC FEE (37 CFR 1.16(a))	$760.00
				Total of above Calculations -=	$1210.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				
				TOTAL =	$1210.00

19. The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 16-2480. A duplicate copy of this sheet is enclosed.

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20. The Commissioner is hereby authorized to charge payment of the following fees during the pendency of this application or credit any overpayment to Deposit Account No. 16-2480. A duplicate copy of this sheet is enclosed.

    a. [X] Any patent application processing fees under 37 CFR 1.17.
    b. [ ] The issue fee set in 37 CFR 1.18 at or before mailing of the Notice of Allowance, pursuent to 37 CFR 1.311(b).
    c. [X] Any filing fees under 37 CFR 1.16 for presentation of extra claims.

21. The total number of duplicate copies enclosed is 5. The Commissioner is hereby authorized to make any additional copies of this sheet needed to accomplish the purposes provided for herein and to charge any fee for such copies to Deposit Account No. 16-2480.

11. SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED	
NAME	Jay A. Krebs
SIGNATURE	
DATE	March 8, 1999

"Express Mail" mailing label number EE829903065US

Date of Deposit March 8, 1999

I hereby certify that this paper/fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to Assistant Commissioner for Patents, Washington, D C 20231

Jay A. Krebs — 41,914
Attorney/Agent mailing application — Reg No.

Signature of Attorney/Agent mailing application

Case 7456

ABSORBENT, FLEXIBLE, STRUCTURE COMPRISING STARCH FIBERS

Larry Neil Mackey
James Daniel Miller II
Mark Ryan Richards
John Gerhard Michael
David William Cabell
Valerie Ann Bailey

FIELD OF THE INVENTION

The present invention relates to pseudo-thermoplastic starch extruded in the form of fibers. Starch may be extruded and either meltblown or spunbonded to form fibrous low density structures.

BACKGROUND OF THE INVENTION

Cellulosic fibrous webs such as paper are well known in the art. Low density fibrous webs are in common use today for paper towels, toilet tissue, facial tissue, napkins, wet wipes, and the like. The large demand for such paper products has created a demand for improved versions of the products and the methods of their manufacture. In order to meet such demands, papermaking manufacturers must balance the costs of machinery and resources with the total cost of delivering the products to the consumer.

For conventional papermaking operations wood cellulosic fibers are repulped, beaten or refined to achieve a level of fiber hydration in order to form an aqueous pulp slurry. Processes for the making of paper products for use in tissue,

toweling, and sanitary products generally involve the preparation of the aqueous slurry and then subsequently removing the water from the slurry while contemporaneously rearranging the fibers therein to form a paper web. Subsequent to dewatering, the web is processed into a dry roll or sheet form and eventually converted into a consumer package. Various types of machinery must be employed to assist in the dewatering process and converting operations requiring a significant investment in capital.

Another aspect of the conventional papermaking operation involves the incorporation of additives into the pulp in order to achieve specific end properties. For instance, additives such as strength resins, debonding surfactants, softening agents, pigments, lattices, synthetic microspheres, fire-retardants, dyes, perfumes, etc., are often employed in the manufacture of paper. The efficient retention of these additives at the wet end of a papermaking process presents difficulty to the manufacturer since that portion which is not retained creates not only an economic loss but also significant pollution problems if it becomes part of a plant effluent. Additives can also be added to the paper web subsequent to dewatering via coating or saturation processes commonly known in the art. These processes usually require that excess heating energy be consumed to redry the paper after coating. Moreover, in some instances, the coating systems are required to be solvent based which increases capital costs and requires recovery of volatile materials to meet regulatory requirements.

Various natural fibers other than cellulose as well as a variety of synthetic fibers have been employed in making paper, however, all these replacements have failed to provide a commercially acceptable substitute for cellulose due to their high cost, poor bonding properties, chemical incompatibilities, and handling difficulties in papermaking systems. Starch fibers have been suggested as a substitute for cellulose in various aspects of the papermaking process, however, commercial attempts to use such fibers have been unsuccessful. As a result, paper products are still being manufactured almost exclusively from wood base cellulosic ingredients.

Extrusion is a mature technology for production of non-woven webs and films from synthetic thermoplastic polymers. U.S. Pat. Nos. 3,802,817 issued to

Matsuki et al. 1974 and 4,064,605 issued to Akiyama, et al. Dec 27, 1977 provide examples of extrusion and spinbonding techniques used in the formation of non-woven fabrics. Synthetic thermoplastic polymers are not suitable materials for tissue, towel, facial products because they are expensive and most are neither biodegradable, flushable, nor absorbent. However, naturally occurring starch is a relatively inexpensive biodegradable polymer which can be made to be thermoplastic in the presence of a solvent such as water.

In the foods industry, starch is extruded in a thermoplastic form to make cereals and snack foods. Also, starch extrusion has been used in the packaging industry to produce low-density, foam starch structures to compete with non-biodegradable polystyrene packaging materials.

U.S. Patent No. 5,316,578 issued to Buehler et al. May 31, 1994 discloses a process for extruding a chemically modified starch in combination with synthetic thermoplastic polymers to produce a thermoplastic melt which can be pressed either into an injection mold or extruded into the open where it can be optionally further shaped. U.S. Patent No. 5,516,815 issued to Buehler et al. May 14, 1996 discloses melt spun fibers comprising chemically modified starch and synthetic thermoplastic polymers. Although U.S. Patent No. 5,516,815 suggests that the melt spun fibers can be used for biodegradable fabrics and nonwovens, such fabrics and nonwovens made of fibers which include synthetic thermoplastic polymers are not flushable. In addition, U.S. Patent No. 5,516,815 does not disclose how to produce low density, flexible and absorbent structures composed of starch fibers. Furthermore, the costs associated with the chemically modified starch and the synthetic thermoplastic polymers limits the economic benefit desired.

The present invention provides a low density flexible structure comprising starch fibers utilizing extrusion and fiber spinning techniques. Particularly, the present invention provides a low density flexible structure comprising starch fibers, wherein the structure has improved tensile strength, softness, and absorbency properties relative to cellulosic pulp fiber structures while maintaining biodegradability and flushability.

SUMMARY OF THE INVENTION

The present invention provides an absorbent flexible structure comprising starch fibers. Naturally occurring starch in the presence of water, plasticizers and other additives is melt extruded and spun into fibers to form an absorbent flexible structure having an apparent density ranging from 0.02 g/cm^3 to 0.20 g/cm^3 and a basis weight ranging from 10 g/m^2 to 450 g/m^2.

The starch fibers making up the structure can have a size ranging from about 0.01 decitex to about 135 decitex. In a preferred embodiment the fibers can have a size ranging from about 0.02 decitex to about 30 decitex, and most preferably ranging from about 0.02 to about 5 decitex. In addition, fibers making up the structure of the present invention can have a glass transition temperature ranging from about -30 °C to about 150 °C, more preferably from about -30 °C to about 100 °C, and most preferably from about -30 °C to about 25 °C.

Exemplary physical properties of the flexible structure of the present invention include dry tensile strength and wet tensile strength. The dry tensile strength of the structure, which is measured as a geometric mean tensile strength, can range from about 10 g/cm to about 1200 g/cm, more preferably from about 30 g/cm to about 600 g/cm, and most preferably from about 40 g/cm to about 475 g/cm. The wet tensile strength of the structure, which is also measured as a geometric mean tensile strength, can range from about 2 g/cm to about 400 g/cm, and more preferably from about 2 g/cm to about 200 g/cm.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

Figure 1a illustrates a torque rheometer assembly used to produce starch fibers.

Figure 1b illustrates the twin screw elements attached to the drive unit and disposed within the barrel of the torque rheometer assembly illustrated in Figure 1a.

Figure 2a illustrates a vented twin screw extruder assembly.

Figure 2b illustrates the screw and mixing element configuration for the extrusion assembly depicted in Figure 2a.

Figure 3a illustrates a non-vented twin screw extruder assembly.

Figure 3b illustrates the screw and mixing element configuration for the extrusion assembly depicted in Figure 3a.

Figure 4 illustrates a spinneret and a drawing unit used for pseudo-thermoplastic starch melt fiber spinning.

Figure 5 illustrates the sample rack and cover used for determining absorbency of the starch fiber structures.

Figure 6 illustrates the cross section of the frames for the sample rack and cover illustrated in Figure 5.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

As used herein, the following terms have the following meanings:

Pseudo-thermoplastic composition is intended to denote materials which by the influence of elevated temperatures may be softened to such a degree that they can be brought into a flowable state, and in this condition may be shaped as desired. Pseudo-thermoplastic materials may be formed under simultaneous influence of heat and pressure. Pseudo-thermoplastic compositions differ from thermoplastic compositions in that the softening or liquefying of the pseudo-thermoplastic is caused by softeners or solvents present without which it would be impossible to bring them by any temperature or pressure into a soft or flowable condition necessary for shaping since pseudo thermoplastics do not melt as such. The influence of water content on the glass transition temperature and melting temperature of starch can be measured by differential scanning calorimetery as described by Zeleznak and Hoseny "Cereal Chemistry", Vol. 64, No. 2, pp. 121-124, 1987.

Pseudo-thermoplastic melt is a pseudo-thermoplastic material in a flowable state.

Glass transition temperature, T_g, is the temperature at which the material changes from a viscous or rubbery condition to a hard and relatively brittle condition.

Basis weight is the weight (in grams) per unit area (in square meters) of a sample reported in grams per square meter.

Caliper is the macroscopic thickness of a sample measured as described below.

Apparent density is the basis weight of the sample divided by the caliper with appropriate unit conversions incorporated therein. Apparent density used herein has the units of grams / centimeters cubed (g/cm^3).

Machine direction, designated MD, is the direction parallel to the flow of the starch fiber structure through the product manufacturing equipment.

Cross machine direction, designated CD, is the direction perpendicular to the machine direction in the same plane of the starch fiber structure.

Geometric Mean Dry Tensile Strength (GMDT) is the square root of the product of the machine and cross-machine dry tensile strengths (in grams/cm). The value of GMDT is reported in grams/cm.

Geometric mean wet tensile strength (GMWT) is the square root of the product of the machine and cross-machine wet tensile strengths (in grams/cm). The value of GMWT is reported in grams/cm.

Structure is an arrangement of one or more parts forming a substance or body.

Absorbency is the ability of a material to take up fluids by various means including capillary, osmotic, solvent or chemical action and retain such fluids.

Flexibility indicates the capability of being deformed under a given load without being broken and with or without returning of itself to its former shape.

A fiber is a slender object having a major axis which is very long compared to the two orthogonal axes and having an aspect ratio of at least 4/1, preferably at least 10/1.

Decitex ,dtex, is a unit of measure for a fiber expressed in $\frac{\text{grams}}{10{,}000 \text{ meters}}$

Flushability is determined by the geometric mean decayed wet tensile strength (GMDWT) (defined below). A flushable structure has a geometric mean decayed wet tensile of less than about 20 g/cm and more preferably less than about 10 g/cm.

The specification contains a detailed description of (1) exemplary materials of the present invention, (2) exemplary processes for producing the present invention, (3) material properties of the present invention, and (4) analytical procedures for measuring properties of the present invention

(1) Exemplary Materials

For the present invention a starch polymer is mixed with water, plasticizers and other additives and melt extruded to produce fibers . Standard meltblowing or spunbonding techniques are used to produce starch fiber structures. Such structures may be absorbent and flexible. These structures may be used as substitutes for paper products such as paper towels, napkins, toilet tissues, facial tissues, place mats and wet wipes.

The starch fibers of the present invention may be useful for forming fibrous structures and also forming absorbent materials, as described above. The absorbent structures/fibrous materials comprising the starch fibers of the present invention may have from a trace amount to one hundred percent (100%) starch fibers, or a blend of starch fibers and other suitable fibers. Other suitable fibers for the blend include cellulose fibers, synthetic fibers, and a combination thereof.

Starch polymers can include any naturally occurring starch, physically modified starch or chemically modified starch. Suitable naturally occurring starches can include, but are not limited to, corn starch, potato starch, sweet potato starch, wheat starch, sago palm starch, tapioca starch, rice starch, soybean starch, arrow root starch, bracken starch, lotus starch, waxy maize starch, high amylose corn starch, and commercial amylose powder. Naturally occurring starches particularly, corn starch and wheat starch, are the preferred starch polymers of choice due to their economy and availability.

Physically modified starch is formed by changing the dimensional structure. Physically modified starch can include α starch, fractionated starch, moisture and heat treated starch.

Chemically modified starch may be formed by reaction of its OH groups with alkylene oxides, and other ether-, ester-, urethane-, carbamate-, or isocyanate-forming substances. Hydroxyalkyl, acetyl, or carbamate starches or mixtures thereof are preferred chemically modified starches. The degree of substitution of the chemically modified starch is 0.05 to 3.0, preferably 0.05 to 0.2.

The starch desirably has a native water content of about 5% to 16% by weight. A water content of 8% to 12% is particularly preferred. The amylose content of the starch is 0% to 80%, preferably 20% to 30%.

A plasticizer is typically added to the starch polymer in order to lower the glass transition temperature of the starch fibers thereby enhancing the flexibility of the fibers. In addition, the presence of the plasticizer lowers the melt viscosity which in turn facilitates the melt extrusion process. The plasticizer is advantageously an organic compound having at least one hydroxyl group, preferably a polyol. Sorbitol, mannitol, D-glucose, polyvinyl alcohol, ethylene glycol, polyethylene glycol, propylene glycol, polypropylene glycol, sucrose, fructose, glycerol and mixtures thereof have been found especially suitable. For the present invention, the preferred plasticizers include sorbitol, sucrose, and fructose in quantities ranging from about 5% by weight to about 70% by weight, more preferably from about 15% by weight to about 60% by weight, most preferably from about 30% by weight to about 40% by weight.

Other additives are typically included with the starch polymer as a processing aid and to modify physical properties such as elasticity, dry tensile strength, and wet strength of the extruded fibers. Additives are typically present in quantities ranging from 0.1% to 70% by weight on a non-volatiles basis. Preferred additives are urea, urea derivatives, cross-linking agents, emulsifiers, surfactants, lubricants, proteins and their alkali salts, biodegradable synthetic polymers, waxes, low melting synthetic thermoplastic polymers, tackifying resins, extenders, and mixtures thereof. Preferred biodegradable synthetic polymers include

polycaprolactone, polyhydroxybutyrates, polyhydroxyvalerates, polylactides, and mixtures thereof. Other preferred additives and associated properties include optical brighteners, antioxidants, flame retardants, dyes, pigments, and fillers. For the present invention, a preferred additive is urea in quantities ranging from 20% to 60% by weight.

Suitable extenders for use herein include gelatin, vegetable proteins such as sunflower protein, soybean proteins, cotton seed proteins, and water soluble polysaccharides; such as alginates, carrageenans, guar gum, agar, gum arabic and related gums, pectin, water soluble derivatives of cellulose, such as alkylcelluloses, hydroxyalkylcelluloses, carboxymethylcellulose, etc. Also, water soluble synthetic polymers, such as polyacrylic acids, polyacrylic acid esters, polyvinylacetates, polyvinylalcohols, polyvinylpyrrolidone, etc., may be used.

Lubricant compounds may further be added to improve the flow properties of the starch material during the processes used for producing the present invention. The lubricant compounds can include animal or vegetable fats, preferably in their hydrogenated form, especially those which are solid at room temperature. Additional lubricant materials include mono-glycerides and di-glycerides and phosphatides, especially lecithin. For the present invention, a preferred lubricant compound includes the mono-glyceride, glycerol mono-stearate.

Further additives including inorganic fillers such as the oxides of magnesium, aluminum, silicon, and titanium may be added as inexpensive fillers or processing aides. Additionally, inorganic salts, including alkali metal salts, alkaline earth metal salts, phosphate salts, etc., may be used as processing aides.

Other additives may be desirable depending upon the particular end use of the product contemplated. For example, in products such as toilet tissue, disposable towels, facial tissues and other similar products, wet strength is a desirable attribute. Thus, it is often desirable to add to the starch polymer cross-linking agents known in the art as "wet strength" resins.

A general dissertation on the types of wet strength resins utilized in the paper art can be found in TAPPI monograph series No. 29, Wet Strength in Paper and Paperboard, Technical Association of the Pulp and Paper Industry (New York, 1965).

The most useful wet strength resins have generally been cationic in character. Polyamide-epichlorohydrin resins are cationic polyamide amine-epichlorohydrin wet strength resins which have been found to be of particular utility. Suitable types of such resins are described in U.S. Patent Nos. 3,700,623, issued on October 24, 1972, and 3,772,076, issued on November 13, 1973, both issued to Keim and both being hereby incorporated by reference. One commercial source of a useful polyamide-epichlorohydrin resin is Hercules, Inc. of Wilmington, Delaware, which markets such resins under the mark Kymene™.

Glyoxylated polyacrylamide resins have also been found to be of utility as wet strength resins. These resins are described in U.S. Patent Nos. 3,556,932, issued on January 19, 1971, to Coscia, et al. and 3,556,933, issued on January 19, 1971, to Williams et al., both patents being incorporated herein by reference. One commercial source of glyoxylated polyacrylamide resins is Cytec Co. of Stanford, Connecticut, which markets one such resin under the mark Parez™ 631 NC.

Still other water-soluble cationic resins finding utility in this invention are urea formaldehyde and melamine formaldehyde resins. The more common functional groups of these polyfunctional resins are nitrogen containing groups such as amino groups and methylol groups attached to nitrogen. Polyethylenimine type resins may also find utility in the present invention. In addition, temporary wet strength resins such as Caldas 10 (manufactured by Japan Carlit) and CoBond 1000 (manufactured by National Starch and Chemical Company) may be used in the present invention.

For the present invention, the preferred cross-linking agent is the wet strength resin Kymene , in quantities ranging from about 0.1% by weight to about 10% by weight, more preferably from about 0.1% by weight to about 3% by weight.

(2) Exemplary Processes

Extruder Apparatus

The apparatus for carrying out the process of the invention consists of an extruder having

a. first inlet chamber containing at least one conveying element,

b. a heated receiving chamber downstream of said first chamber and containing at least one conveying element;

c. a heated destructurization chamber, downstream of said second chamber, containing kneading and retaining elements;

d. a heated degassing chamber under reduced pressure downstream of said destructurization chamber and said degassing chamber containing at least one conveying element, and

e. a heated extrusion chamber downstream of said degassing chamber being under elevated pressure and having at least one conveying element.

Furthermore, the extruder preferably has at least one delivery device for solids for process step a, a liquid metering device for process step b, a degassing fitting for process step d, and a die for process step e. A twin screw extruder having closely meshing screws which run in the same direction is preferred.

For the present invention, the starch material can have a total water content, i.e. water of hydration plus added water, in the range of about 5 to about 40%; preferably in the range of about 10 to about 20%. The starch material is heated to elevated temperatures sufficient to form a pseudo-thermoplastic melt. Such temperature is typically higher than the glass transition and/or melting temperature of the formed material. For the present invention, the glass transition temperatures are at least about minus -30°C, preferably in the range of about -30°C to about 150°C, more preferably in the range of about -30°C to about 100°C, and most preferably in the range of about -30°C to about 25°C. The melting temperature is preferably in the range of about 100°C to about 180°C. The pseudo-thermoplastic melts of the invention are polymeric fluids having a shear rate dependent viscosity, as known in the art. The viscosity decreases with increasing shear rate as well as with increasing temperature.

The starch material is heated preferably in a closed volume in the presence of a low concentration of water to convert the starch material to a pseudo-thermoplastic melt. A closed volume can be a closed vessel or the volume created by the sealing action of the feed material as happens in the screw of extrusion equipment. Pressures created in a closed vessel will include pressures due to the vapor pressure

of water as well as pressures generated due to compression of materials in the screw-barrel of the extruder.

A chain scission catalyst, which reduces the molecular weight by splitting the glycosidic bonds in the starch macromolecules resulting in a reduction of the average molecular weight of the starch, may be used to reduce the viscosity of the pseudo-thermoplastic melt. Suitable catalysts include inorganic and organic acids. Suitable inorganic acids include hydrochloric acid, sulfuric acid, nitric acid, phosphoric acid, and boric acid as well as the partial salts of polybasic acids, e.g. $NaHSO_4$ or NaH_2PO_4 etc. Suitable organic acids include formic acid, acetic acid, propionic acid, butyric acid, lactic acid, glycolic acid, oxalic acid, citric acid, tartaric acid, itaconic acid, succinic acid, and other organic acids known in the art, including partial salts of the polybasic acids. For the present invention, the preferred catalysts are hydrochloric acid, sulfuric acid, and citric acid, including mixtures thereof.

The reduction of the molecular weight of the non-modified starch used is by a factor of 2 to 5000, preferably by a factor of 4 to 4000. The concentration of catalysts is in the range of 10^{-6} to 10^{-2} mole of catalyst per mole of anhydro-glucose unit, preferably between $0.1x10^{-3}$ to $5x10^{-3}$ mole of catalyst per mole of anhydro-glucose unit of starch.

The following examples illustrate the type of extrusion equipment and operating parameters for producing starch fibers.

Example 1

The purpose of this example is to illustrate starch fibers extruded at a particular cross section and subsequently drawn to a reduced cross section. Drawn pseudo-thermoplastic starch fibers were produced using a torque rheometer assembly 100 illustrated in Figure 1a. The torque rheometer assembly 100 includes a drive unit 110 (manufactured by Haake GmbH, model Rheocord 90), a barrel 120 partitioned into four temperature zones 122, 124, 126 and 128, a feed port 121, a single capillary die assembly 130, and a simple mandrel winder 140. Twin screw elements 160 (model TW100, from Haake GmbH), depicted in Figure 1b, are

attached to the drive unit 110 and disposed within the barrel 120. A capillary die was made to fit the die assembly 130, with an orifice diameter of 0.5 mm and a length of 5.6 mm. The mandrel rewinder 140 comprises a 3 inch core mounted to a simple DC driven 3 inch diameter shaft. The 3 inch core can achieve surface speeds from 150 to 2000 fpm.

Raw materials utilized included the following:

45% by weight Durabond A Corn Starch from National Starch
25% by weight Water
15% by weight Urea available from Aldrich Chemicals
15% by weight Sorbitol available from Aldrich Chemicals

All raw materials were mixed off-line until a slurry was formed. The slurry was then manually fed into the feed port 121 of the torque rheometer assembly 100.

The settings on the torque rheometer were as follows:

RPM	50
Barrel Temperature	110 °C
Die Temperature	105 °C
Feed Rate	1.7 grams/minute

After running the rheometer for approximately 20 minutes, the process stabilized and a single pseudo-thermoplastic starch fiber 150 exited the die 130. The single fiber 150 was manually wound around the mandrel winder 140. The winder 140 was then slowly sped up to 900 feet/minute surface speed in order to draw the fiber 150 increasing the fiber length and decreasing the cross sectional area. The diameter of the wound fiber 150 was between 70 and 90 microns.

Example 2

The purpose of this example is to illustrate how starch fibers can be arranged to form a starch fiber structure. The pseudo-thermoplastic starch fibers of Example 1 were cut into 8 mm length staple fibers. The starch staple fibers at a basis weight of 55 g/m^2 were air laid onto a papermaking forming fabric as described in U.S. Pat. No. 4,637,859 issued to Trokhan, January 20, 1987, incorporated herein by reference. The fibers were misted with water at a level of 20%, based on the weight of the fibers, and then dried at an elevated temperature to produce a bonded starch fiber structure.

Example 3 :Starch Fibers Extruded Using A Vented Twin Screw Extruder

The purpose of this example is to illustrate a vented twin screw extruder configuration, depicted in Figure 2a, used to make starch fibers for the present invention. Starch fibers are made using a an APV Baker (Peterborough, England) twin screw extruder 200, a capillary die 212, and a winder (not shown).

As show in Figure 2a, the twin screw extruder comprises a barrel 202 that is separated into five zones. The barrel 202 encloses the extrusion screws and mixing elements and serves as a containment vessel during the extrusion process. A solid feed port 204 is disposed in zone 1 and liquid feed ports 206 and 208 are disposed in zone 1 and zone 2. A vent 210 is included in zone 4 for venting the pseudo-thermoplastic melt to decrease the water content of the mixture prior to extrusion through the die 212.

The screw and mixing element configuration 300 for the twin screw extruder 200 is illustrated in Figure 2b. The twin screw extruder comprises a plurality of twin lead screws (TLS) and single lead screws (SLS) installed in series. Screw elements are characterized by the number of continuous leads and the pitch of these leads.

A lead is a flight (at a given helix angle) which wraps the core of the screw element. The number of leads indicates the number of flights wrapping the core at any given location along the length of the screw. Increasing the number of leads

reduces the volumetric capacity of the screw and increase the pressure generating capability of the screw.

The pitch of the screw is the distance needed for a flight to complete one revolution of the core. It is expressed as the number of screw element diameters per one complete revolution of a flight. Decreasing the pitch of the screw increase the pressure generated by the screw and decreases the volumetric capacity of the screw.

The length of a screw element is reported as the ratio of length of the element divided by the diameter of the element.

This example uses TLS and SLS. Screw element 310 is a TLS with a 1.0 pitch and a 1.5 length ratio. Screw element 320 is a TLS with a 1.0 pitch and a 1.0 L/D ratio. Screw element 340 is a SLS with a ¼ pitch and a 1.0 length ratio. Screw element 350 is a SLS and a ¼ pitch and a ½ length ratio.

Bilobal paddles 360 serving as mixing elements are also included in a series with the SLFS and TLFS screws in order to enhance mixing. Various configurations of bilobal paddles 360 and reversing elements 340 and 350 are used in order to control flow and corresponding mixing time.

In zone 1, Durabond A starch and sorbitol are fed into the solid feed port 204 and urea is fed into the liquid port 208 forming a mixture with a 60/20/20 weight ratio. These materials are combined inside the extruder with water added at the liquid feed port 206 to form a pseudo-thermoplastic melt. The temperature, pressure, and corresponding function of each zone are provided in Table I.

Table I

Zone	Temperature (deg F)	Pressure (gauge PSI)	Description of Screw
1	70	0	Feeding
2	193	34	Mixing
3	268	0	Mixing
4	210	0	Pressure Decreasing Conveying
5	205	0-10	Pressure Generating
Die	194	430	Shaping

Example 4 :Starch Fibers Extruded With A Non-Vented Twin Screw Extruder

The purpose of this example is to illustrate a non-vented twin screw extruder configuration, depicted in Figure 3a, used to make starch fibers for the present invention. Starch fibers are made using an APV Baker (Peterborough, England) twin screw extruder 200, a capillary die 212, and a winder (not shown).

The non-vented twin screw extruder configuration is illustrated in Figure 3a. The twin screw extruder comprises a barrel 202 that is separated into five zones. The barrel 202 encloses the extrusion screws and mixing elements and serves as a containment vessel during the extrusion process. A solid feed port 204 is disposed in zone 1 and liquid feed ports 206, and 208 are disposed in zone 1 and zone 2.

The screw and mixing element configuration for the twin screw extruder is illustrated in Figure 3b.

In zone 1, Durabond A starch and sorbitol are fed into the solid feed port 204 and urea is fed into the liquid port 208 forming a mixture with a 60/20/20 weight ratio. These materials are combined inside the extruder with water added at the liquid feed port 206 to form a pseudo-thermoplastic melt. The temperature, pressure, and corresponding function of each zone are provided in Table II.

Table II

Zone	Temperature (deg F)	Pressure (gauge PSI)	Description of Screw
1	70	0	Feeding
2	180	0	Mixing
3	260	0	Mixing
4	215	0	Pressure Decreasing Conveying
5	193	30	Pressure Generating
Die	172	150	Shaping

Example 5 :Foamed Starch Fibers Extruded With A Non-Vented Twin Screw Extruder

The purpose of this example is to illustrate the various zones of a twin screw extruder without a vent and the operating parameters associated with each zone for producing foamed starch fibers which are lower in density and having a higher absorbent capacity relative to non-foamed starch fibers. Foamed starch fibers are made using a fiber making apparatus comprising the twin screw extruder configuration depicted in Figures 3a and 3b.

In zone 1, Durabond A starch and sorbitol are fed into the solid feed port 204 and urea is fed into the liquid port 208 forming a mixture with a 60/20/20 weight ratio. These materials are combined inside the extruder with water added at the liquid feed port 206 to form a pseudo-thermoplastic melt. The temperature, pressure, and corresponding function of each zone are provided in Table III.

Table III

Zone	Temperature (deg F)	Pressure (gauge PSI)	Description of Screw
1	70	0	Feeding
2	180	0	Mixing
3	260	0	Mixing
4	240	0	Pressure Decreasing Conveying
5	220	30	Pressure Generating
Die	225	150	Shaping

Pseudo-thermoplastic Starch Melt Fiber Spinning

The production of fibers according to the invention from the pseudo-thermoplastic melt compositions occurs by the usual melt spinning processes. Devices for producing non-woven thermoplastic fabric structures from extruded polymers are well known in the art. Extruded polymers under pressure, are forced through a spinneret forming a vertically oriented curtain of downward advancing fibers. The fibers are quenched with air in conjunction with a suction-type drawing or attenuating air slot. U.S. Pat. No. 5,292,239 issued to Zeldin, et al., March 8, 1994, discloses a device that reduces significant turbulence in the air flow in order to uniformly and consistently apply a drawing force to the fibers.

For the present invention, structures are produced from a mixture comprising starch, water, plasticizers, and other optional additives. As shown in Figure 4, the mixture is converted to a pseudo-thermoplastic melt in an extruder and conveyed through a spinneret 10 to a drawing unit 20 forming a vertically oriented curtain of downward advancing fibers F.

The spinneret 10 comprises an assembly which is known in the art. The spinneret 10 includes a plurality of nozzle bores 12 with hole diameters customary for fiber production. The spinneret assembly 10 can be adapted to the fluidity of the melt so that every nozzle bore 12 has the same rate of flow.

The drawing unit 20 comprises an open upper end 22, an open lower end 24, and an air supply manifold 26 supplying compressed air to internal nozzles (not shown) oriented in a downward direction. As compressed air flows through the internal nozzles, air is drawn into the open upper end 22 of the drawing unit 20 forming a rapidly moving stream of air flowing in the downward direction. The air stream produces a drawing force on the fibers causing them to be attenuated or stretched before exiting the open lower end 24 of the drawing unit 20.

For the present invention, the fibers exiting the drawing unit 20 can have a size ranging from about 0.01 decitex to about 135 decitex. Preferably, the fibers exiting the drawing unit 20 have a size ranging from about 0.02 decitex to about 30 decitex. Most preferably, the fibers exiting the drawing unit 20 have a size ranging from about 0.02 decitex to about 5 decitex.

Upon exiting the drawing unit 20, the fibers are deposited on a moving conveyor belt 30 to form flexible, low density structure comprising fibers. The fibers are then joined to each other through conventional techniques. A preferred process for producing structures of the present invention is described in U.S. Pat. No. 5,688,468 issued to Lu, November 18, 1997, which is incorporated herein by reference.

In addition to spunbonded structures, mono-fibers, multi-fibers, staple fibers, hollow fibers, shaped fibers, such as multi-lobal fibers and multi-component fibers can all be produced by using the compositions and methods of the present invention. The process for the production of these fibers may be in one stage with a compounding extruder producing a pseudo-thermoplastic starch melt and conveying it without cooling through a melt filter to a spinneret. Staple starch fibers may also be converted to flexible, low density structures by carding, air laying, and similar processes known in the art.

(3) Material Properties

Products such as disposable towels, toilet tissue, facial tissue, napkins and wet wipes manifest various physical characteristics which include basis weight and apparent density, both of which have been previously defined. For the present invention, the structure comprising pseudo-thermoplastic starch fibers can have a basis weight ranging from about 10 g/m^2 to about 450 g/m^2. More preferably, the structure can have a basis weight ranging from about 12 g/m^2 to about 150 g/m^2. Moreover, the structure of the present invention can have an apparent density ranging from about 0.02 g/cm^3 to about 0.20 g/cm^3; more preferably, an apparent density ranging from about 0.04 g/cm^3 to about 0.15 g/cm^3 and most preferably, an apparent density ranging from about 0.04 g/cm^3 to about 0.12 g/cm^3.

The products listed above also exhibit certain mechanical properties, particularly, strength, flexibility, and absorbency. Measures of strength include geometric mean dry tensile strength (GMDT), and geometric mean wet tensile strength (GMWT) wherein GMWT includes initial wet tensile strength and decayed wet tensile strength. Flexibility is related to stiffness and can attribute to softness.

Absorbency relates to the products' ability to take up fluids as well as the capacity to retain them.

Geometric mean dry tensile strength (GMDT), previously defined, provides a measure of the dry tensile strength of the structure. The method used to determine this measure is described below. For the present invention, the structure comprising pseudo-thermoplastic starch fibers can have a GMDT ranging from about 10 g/cm to about 1200 g/cm. More preferably, the structure can have a GMDT ranging from about 30 g/cm to about 600 g/cm. Most preferably, the structure can have a GMDT ranging from about 40 g/cm to about 475 g/cm.

Geometric mean wet tensile strength (GMWT), previously defined, provides a measure of the wet tensile strength of the structure. The initial geometric mean tensile strength is the wet tensile strength of a structure after it has been immersed in water for five seconds. The method used to determine this measure is described below. For the present invention, the structure comprising pseudo-thermoplastic starch fibers can have a GMWT ranging from about 2 g/cm to about 400 g/cm. More preferably, the structure can have a GMWT ranging from about 2 g/cm to about 200 g/cm.

Geometric mean decayed wet tensile strength (GMDWT) is a measure of the wet tensile strength of the structure after being immersed in water for thirty minutes. For the present invention, the structure comprising pseudo-thermoplastic starch fibers can have a GMDWT ranging from about 0 g/cm to about 20 g/cm. More preferably, the structure can have a GMDWT ranging from about 0 g/cm to about 10 g/cm.

Softness has been described as a physiologically perceived attribute which is generally measured by expert or non-expert panel evaluations. Perceived softness can be broken down into two components; bulk softness and surface softness. Bulk softness has been correlated to sheet stiffness and flexibility while surface softness has been related to surface texture and smoothness. High softness requires flexibility. The method used for determining the total flexibility of a structure is defined below. For the present invention, the structure has a total flexibility ranging

from about 1.0 g/cm to about 75 g/cm; preferably from about 2.0 g/cm to about 50 g/cm; and more preferably from about 2.0 g/cm to about 35 g/cm.

Products such as disposable towels, toilet tissue, facial tissue, napkins, and wet wipes require a certain level of absorbency. Herein, absorbency means absorbent capacity which is a measure of the amount of distilled water absorbed and retained by the structure. The method used for determining the absorbency of a structure is defined below. For the present invention, the structure has an absorbency ranging from about 1 $g_{Water}/g_{Dry\ Structure}$ to about 15 $g_{Water}/g_{Dry\ Structure}$; preferably from about 2 $g_{Water}/g_{Dry\ Structure}$ to about 14 $g_{Water}/g_{Dry\ Structure}$; more preferably from about 3 $g_{Water}/g_{Dry\ Structure}$ to about 13 $g_{Water}/g_{Dry\ Structure}$.

(4) Analytical Methods

(a) Sample Conditioning And Preparation:

Prior to testing, samples are conditioned at a relative humidity of 48% to 50% and within a temperature range of 22°C to 24°C until a moisture content of from about 5% to about 16% by weight as measured by TGA (Thermo Gravimetric Analysis) is achieved. For Thermo Gravimetric Analysis, a Hi-res. TGA2950 Termogravimetric analyzer from TA Instruments is used. Approximately 20 mg of sample is weighed into a TGA pan. Following the manufacturer's instructions, the sample and pan are inserted into the unit and the temperature is increased at a rate of 10°C/minute to 250°C. The % moisture in the sample is determined using the weight lost and the initial weight as follows:

$$\%\ \text{Moisture} = \frac{\text{Start Weight} - \text{Weight @ } 250^{\circ}\text{C}}{\text{Start Weight}} * 100\%$$

where all weights are in milligrams.

(b) Basis Weight

One stack of 8 plies is made from the preconditioned samples. The stack of 8 plies is cut into a 4 inch by 4 inch square. A rule die from Acme Steel Rule Die Corp. (5 Stevens St. Waterbury Conn., 06714) is used to accomplish this cutting.

For the actual measurement of the weight of the sample, a top loading balance with a minimum of 0.01 g readability is used. The stack of 8 plies is laid on the pan of the top loading balance. The balance is protected from air drafts and other disturbances using a draft shield. Weights are recorded when the readings on the balance become constant. Weights are measured in grams.

The weight reading is divided by the number of plies tested. The weight reading is also divided the weight reading by the area of the sample which is normally 16 square inches, which is approximately equal to 0.0103 square meters.

The unit of measure for basis weight as used herein is grams/square meter. This is calculated using the 0.0103 square meter area noted above.

(c) Caliper

Preconditioned samples are cut to a size greater than the size of the foot used to measure the caliper. The foot to be used is a circle with an area of 3.14 square inches.

The sample is placed on a horizontal flat surface and confined between the flat surface and a load foot having a horizontal loading surface, where the load foot loading surface has a circular surface area of about 3.14 square inches and applies a confining pressure of about 15 g/square cm (0.21 psi) to the sample. The caliper is the resulting gap between the flat surface and the load foot loading surface. Such measurements can be obtained on a VIR Electronic Thickness Tester Model II available from Thwing-Albert, Philadelphia, Pa. The caliper measurement is repeated and recorded at least five times. The result is reported in millimeters.

The sum of the readings recorded from the caliper tests is divided by the number of readings recorded. The result is reported in millimeters (mm).

(d) Dry Tensile Strength

The dry tensile strength is determined on one inch wide strips of sample using a Thwing-Albert Intelect II Standard Tensile Tester (Thwing-Albert Instrument Co., 10960 Dutton Rd., Philadelphia, Pa., 19154). This method is intended for use on finished paper products, reel samples, and unconverted stocks.

Two stacks of 8 plies are made from the preconditioned samples. From one of these stacks of 8 plies, four strips are cut 1 inch by 7 inch with the long 7 inch dimension running parallel to the machine direction. Note these samples are machine direction samples. An additional four strips 1 inch by 7 inch with the long 7 inch dimension running parallel to the cross direction. All cuts are made using a cutter (JDC-1-10 or JDC-1-12 with safety shield from Thwing-Albert Instrument Co., 10960 Dutton Road, Philadelphia, Pa., 19154). A total of eight samples are produced: four 1 inch by 7 inch strips, 8 plies thick, with the 7 inch dimension running parallel to the machine direction and four 1 inch by 7 inch strips, 8 plies thick, with the 7 inch dimension running parallel to the cross direction.

Each of the four eight ply stacks of machine direction and cross machine direction sample tensile strips are measured in the Thwing-Albert Intelect II Standard Tensile Tester. The four measurements of the 8 ply stacks of machine direction sample tensile strips are summed and divided by four, which is the number of machine direction strips tested. The sum is also divided by eight, which the number of usable units per tensile strip. The calculation is repeated for the cross machine direction measurements.

All results are in units of grams/inch. Appropriate unit conversions may be made to achieve units of grams/cm as reported herein.

(e) Initial Wet Tensile Strength

For the initial wet tensile strength determination, a portion of the test sample is immersed in water for five seconds prior to the tensile strength measurement. The wet tensile strength is determined on one inch wide strips of sample using a Thwing-Albert Intelect II Standard Tensile Tester (Thwing-Albert Instrument Co., 10960 Dutton Rd., Philadelphia, Pa., 19154) and a Finch Wet Strength Device, Catalog

Number 731D (Thwing-Albert Instrument Co., 10960 Dutton Rd., Philadelphia, Pa., 19154).

Prior to sample preparation and wet tensile testing, the samples should be cured in a forced draft oven at 105 ± 3 degree Celsius for a period of 5 minutes ± 10 seconds. The samples should be suspended in the oven such that the forced air can circulate between them.

Sample preparation and all aspects of the wet tensile testing should take place within the confines of the constant temperature and humidity room. Two stacks of 5 plies each are made from the cured samples after conditioning. From one of these stacks of 5 plies, four strips are cut 1 inch by 4 inch with the long 4 inch dimension running parallel to the machine direction for machine direction samples. An additional four strips are cut 1 inch by 4 inch with the long 4 inch dimension running parallel to the cross direction for cross direction samples. All cuts are made using a paper cutter (JDC-1-10 or JDC-1-12 with safety shield from Thwing-Albert Instrument Co., 10960 Dutton Road, Philadelphia, Pa., 19154). There are a total of eight samples: four 1 inch by 4 inch strips which are 5 plies thick with the 4 inch dimension running parallel to the machine direction and four 1 inch by 4 inch strips which are 5 plies thick with the 4 inch dimension running parallel to the cross direction.

Each of the four five ply stacks of machine direction and cross machine direction sample tensile strips are measured in the Thwing-Albert Intelect II Standard Tensile Tester. The four measurements of the 5 ply stacks of machine direction sample tensile strips are summed and divided by four, which is the number of machine direction strips tested. The sum is also divided by five, which the number of usable units per tensile strip. The calculation is repeated for the cross machine direction measurements.

All results are in units of grams/inch. Appropriate unit conversions may be made to achieve units of grams/cm as reported herein.

(f) Decayed Wet Tensile (Soaked for 30 minutes)

Same as the Initial Wet Tensile Strength except the samples are allowed to soak in the water for 30 minutes (± 30 seconds) prior to Wet Tensile Strength Testing.

(g) Flexibility

Flexibility as used herein is defined as the slope of the secant of the graph-curve derived from force vs. stretch % data which secant passes through the origin (zero % stretch, zero force) and through the point on the graph-curve where the force per centimeter of width is 20 grams. For example, for a sample which stretches 10% (i.e., 0.1 cm/cm of length) with 20 grams of force per cm of sample width, the slope of the secant through (0%, 0) and (10%, 20) is 2.0 using the formula:

$$Slope = \frac{Y_2 - Y_1}{X_2 - X_1}$$

Total Flexibility as used herein means the geometric mean of the machine-direction flexibility and cross-machine-direction flexibility. Mathematically, this is the square root of the product of the machine-direction flexibility and cross-machine-direction flexibility in grams per cm.

(h) Absorbency

Absorbency herein is defined as the amount (grams) of distilled water at 73 ± 2 °F per gram of sample held by the sample after it has been submerged in a water bath for a period of 30 ± 3 seconds and then allowed to sit in a horizontal position for 120 ± 5 seconds followed by 60 ± 5 seconds sitting at a 75° angle (as measured off of horizontal).

A preconditioned sample is cut to a size of 11 inches by 11 inches. The Machine Direction of the sample is marked and the sample is weighed on a torsion balance to ± 0.01 grams and recorded. This is known as the Sample Dry Weight. After weighing the sample, the dry sample rack (further described below) is placed

on the balance and the weight is recorded to ± 0.01 grams. This is known as the Rack Dry Weight.

The sample is placed on a rack and covered with a rack cover, further described below. The sample, contained by the rack and rack cover, is gently and completely submerged (to a depth of 2 to 3 inches) horizontally in a bath of distilled water at a temperature of 73 ± 2 °F for 30 ± 3 seconds.

After being submerged for 30 ± 3 seconds, the sample is gently raised (horizontally), the rack cover is gently removed, and the sample and rack are allowed to sit for a period of 120 ± 5 seconds in order to drain. While the sample is sitting in the horizontal position, water sitting on the rack is gently wiped off without touching the sample.

Following the drying of the rack and the completion of the horizontal sitting period, the rack and sample together are gently raised so that the Machine Direction is at an angle of 75° from horizontal and allowed to sit in this position for a period of 60 ± 5 seconds. After this sitting period is completed, the rack and sample are returned to a horizontal position and once again the rack is dried of standing water. The rack and sample are gently placed on the balance and the weight ± 0.01 grams is recorded. This is known as the Sample and Rack Wet Weight.

The absorbency measurement is made and recorded for three (3) machine direction samples and three (3) cross machine direction samples. During the cross machine direction measurement, the cross-machine direction of the sample is placed at an angle of 75° from horizontal.

An illustration of the sample rack and cover is shown in Figure 5. Both include frames 400 constructed of 16 GA Aluminum (Teflon Coated after Fabrication) with a cross-section shown in Figure 6. The outside dimensions 405, 410 of the frames 400 are about 13.75 inches by about 16.75 inches. Nylon thread 420 (0.3mm diameter) is tightly strung across the Aluminum frames 400 in a pattern shown in Figure 5. All diagonal threads go over those threads running perpendicular and/or parallel to the frames 400.

For each of the 6 tests, the following calculation is made (all units are grams):

Sample Wet Weight = Sample and Rack Wet Weight - Rack Dry Weight

$$\text{Absorbency} = \frac{(\text{Sample Wet Weight} - \text{Sample Dry Weight})}{\text{Sample Dry Weight}}$$

The calculation is repeated for each of the 6 measurements and all 6 absorbency numbers are averaged together and reported as $g_{Water}/g_{Dry\ Structure}$ (grams of water / grams of sample dry weight).

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is intended to cover in the appended claims all such changes and modifications that are within the scope of the invention.

What is claimed is:

1. An absorbent, flexible structure comprising pseudo-thermoplastic starch fibers.

2. The structure of Claim 1, wherein the structure has an apparent density ranging from about 0.02 g/cm^3 to about 0.20 g/cm^3.

3. The structure of Claim 2, wherein the structure has an apparent density ranging from about 0.04 g/cm^3 to about 0.15 g/cm^3.

4. The structure of Claim 3, wherein the structure has an apparent density ranging from about 0.04 g/cm^3 to about 0.12 g/cm^3.

5. The structure of Claim 1, wherein the starch fibers have a size ranging from about 0.01 dtex to about 135 dtex.

6. The structure of Claim 5, wherein the starch fibers have a size ranging from about 0.02 dtex to about 30 dtex.

7. The structure of Claim 6, wherein the starch fibers have a size ranging from about 0.02 dtex to about 5 dtex.

8. The structure of Claim 1, wherein the structure has a geometric mean dry tensile strength ranging from about 10 g/cm to about 1200 g/cm.

9. The structure of Claim 8, wherein the structure has a geometric mean dry tensile strength ranging from about 30 g/cm to about 600 g/cm.

10. The structure of Claim 9, wherein the structure has a geometric mean dry tensile strength ranging from about 40 g/cm to about 475 g/cm.

11. The structure of Claim 1, wherein the structure has an initial geometric mean wet tensile strength ranging from about 2 g/cm to about 400 g/cm.

12. The structure of Claim 11, wherein the structure has an initial geometric mean wet tensile strength ranging from about 2 g/cm to about 200 g/cm.

13. The structure of Claim 1, wherein the structure has a geometric mean dry tensile strength per unit basis weight ranging from about 200 m to about 2500 m.

14. The structure of Claim 13, wherein the structure has a geometric mean dry tensile strength per unit basis weight ranging from about 200 m to about 1500 m.

15. The structure of Claim 14, wherein the structure has a geometric mean dry tensile strength per unit basis weight ranging from about 200 m to about 1200 m.

16. The structure of Claim 1, wherein the structure has a geometric mean wet tensile strength per unit basis weight ranging from about 10 m to about 1500 m.

17. The structure of Claim 16, wherein the structure has a geometric mean wet tensile strength per unit basis weight ranging from about 10 m to about 1000 m.

18. The structure of Claim 17, wherein the structure has a geometric mean wet tensile strength per unit basis weight ranging from about 10 m to about 500 m.

19. The structure of Claim 1, wherein the structure has a geometric mean decayed wet tensile strength ranging from about 0g/cm to about 20 g/cm.

20. The structure of Claim 19, wherein the structure has a geometric mean decayed wet tensile strength ranging from about 0g/cm to about 10 g/cm.

21. The structure of Claim 1, wherein the structure has a basis weight ranging from 10 g/m2 to about 450 g/m2.

22. The structure of Claim 21, wherein the structure has a basis weight ranging from 12 g/m2 to about 150 g/m2.

23. The structure of Claim 1, further comprising a plasticizer selected from the group consisting of sorbitol, monosaccharides, disaccharides, glycerol, polyvinyl alcohol, and polyethylene glycol.

24. The structure of Claim 23, wherein said plasticizer comprises, based on total weight of the structure, from about 5 wt % to about 70 wt %.

25. The structure of Claim 24, wherein said plasticizer comprises, based on total weight of the structure, from about 15 wt % to about 60 wt %.

26. The structure of Claim 1, further comprising cross-linking agents selected from the group consisting of, polyamide-epichlorohydrin resins, urea-formaldehyde resins, glyoxylated polyacrylamide resins, melamine formaldehyde resins, polyethylenimine resins, Caldas 10 resin, CoBond 1000 resin.

27. The structure of Claim 26, wherein said cross-linking agents are present in amounts ranging from about 0.1 wt % to about 10 wt. %, based on the total weight of the structure.

28. The structure of Claim 27, wherein said cross-linking agents are present in amounts ranging from about 0.1 wt % to about 3 wt. %, based on the total weight of the structure.

29. The structure of Claim 1, wherein the structure has an absorbency ranging from about 1 $g_{Water}/g_{Dry\ Structure}$ to about 15 $g_{Water}/g_{Dry\ Structure}$.

30 The structure of Claim 29, wherein the structure has an absorbency ranging from about 2 $g_{Water}/g_{Dry\ Structure}$ to about 14 $g_{Water}/g_{Dry\ Structure}$.

31. The structure of Claim 30, wherein the structure has an absorbency ranging from about 3 $g_{Water}/g_{Dry\ Structure}$ to about 13 $g_{Water}/g_{Dry\ Structure}$.

32. The structure of Claim 1, wherein the structure has a total flexibility ranging from about 1.0 g/cm to about 75 g/cm.

33. The structure of Claim 32, wherein the structure has a total flexibility ranging from about 2.0 g/cm to about 50 g/cm.

34. The structure of Claim 33, wherein the structure has a total flexibility ranging from about 2.0 g/cm to about 35 g/cm.

35. A structure comprising pseudo-thermoplastic starch fibers wherein the fibers have a Tg of at least about -30 °C and the structure has a geometric mean decayed wet tensile strength ranging from about 0g/cm to about 20 g/cm.

36. The structure of Claim 35, wherein said fibers have a Tg ranging from about -30 °C to about 150 °C.

37. The structure of Claim 36, wherein said fibers have a Tg ranging from about -30 °C to about 100°C.

38. The structure of Claim 37, wherein said fibers have a Tg ranging from about -30 °C to about 25°C.

39. The structure of Claim 35, wherein said structure has a geometric mean decayed wet tensile strength ranging from about 0g/cm to about 10 g/cm.

40. The structure of Claim 36, wherein said structure has a geometric mean decayed wet tensile strength ranging from about 0g/cm to about 10 g/cm.

41. The structure of Claim 35, wherein said fibers have a size ranging from about 0.01 dtex to about 135 dtex.

42. The structure of Claim 41, wherein said fibers have a size ranging from about 0.02 dtex to about 30 dtex.

43. The structure of Claim 42, wherein said fibers have a size ranging from about 0.02 dtex to about 5 dtex.

44. An absorbent structure comprising one or more plies wherein at least one ply comprises pseudo-thermoplastic starch fibers, and wherein the at least one ply has a basis weight ranging from about 10 g/m^2 to about 100 g/m^2, a GMDT ranging from about 40 g/cm to about 475 g/cm, an apparent density ranging from about 0.04 g/cm^3 to about 0.12 g/cm^3, and an initial GMWT ranging from about 2 g/cm to about 200 g/cm.

45. The structure of Claim 44, wherein the at least one ply has a geometric mean decayed wet tensile strength ranging from about 0 g/cm to about 20 g/cm.

Abstract

A flexible absorbent structure is produced comprising starch fibers. Naturally occurring starch in the presence of water, plasticizers and other additives is melt extruded and spun bonded to form low density, absorbent, flexible structures. The structures exhibit properties matching those of consumer paper products such as paper towels, toilet tissue, facial tissue, napkins, wet wipes, and the like.

DECLARATION COMBINED WITH POWER OF ATTORNEY

Attorney Docket No. 7456

206
201

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Absorbent, Flexible, Structure Comprising Starch Fibers

the specification of which

[X] is attached hereto.

[ ] was filed on _____ as United States Application No. or PCT International Application Number _____ and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37 Code of Federal Regulations §1.56.

I hereby claim foreign priority benefits under Title 35 United States Code §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT International application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or Inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
			[ ]	[ ]
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
			[ ]	[ ]
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code §119(e) of any United States provisional application(s) listed below.

Application Serial No.	Filing Date	Application Serial No.	Filing Date

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s), or §365(c) of any PCT International application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

U.S. Parent Application Number	PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (If applicable)

As named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Atty Name	Atty Reg Number		
Jay A. Krebs	41,914	Edward J. Milbrada	40,090
E. Kelly Linman	26,759	Donald E. Hasse	29,387
Larry L. Huston	32,994	Julia A. Glazer	41,783
Vladimir Vitenberg	42,204	Jacobus C. Rasser	37,043
Roddy M. Bullock	37,290	T. David Reed	32,931
Kevin D. Hogg	31,839	Timothy B. Guffey	41,048

DIRECT ALL CORRESPONDENCE TO:

Jay A. Krebs — Phone No.: (513) 634-1151
The Procter & Gamble Company — Facsimile No.: (513) 634-3612
Winton Hill Technical Center, 6100 Center Hill Avenue, Cincinnati, Ohio 45224

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first joint inventor, if any Larry Neil Mackey
Inventor's signature Larry Neil Mackey 3-8-99
Date

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Citizenship U.S.A.
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Inventor's signature James Daniel Miller II 3-8-99
Date

Residence 4108 Benkert Drive, Cincinnati, Ohio 45241
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Post Office Address 6100 Center Hill Avenue
Cincinnati, Ohio 45224

Full name of third joint inventor, if any Mark Ryan Richards
Inventor's signature Mark Ryan Richards 3-8-99
Date

Residence 2912 Elmo Place, Middletown, Ohio 45042
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Cincinnati, Ohio 45224

Full name of fourth joint inventor, if any John Gerhard Michael
Inventor's signature John Gerhard Michael 3/8/99
Date

Residence 2536 Briarcliff Avenue, Cincinnati, Ohio 45212
Citizenship U.S.A.
Post Office Address 6100 Center Hill Avenue
Cincinnati, Ohio 45224

Full name of fifth joint inventor, if any David William Cabell
Inventor's signature David William Cabell 3/8/99
Date

Residence 6646 Powner Farm Drive, Cincinnati, Ohio 45248
Citizenship U.S.A.
Post Office Address 6100 Center Hill Avenue
Cincinnati, Ohio 45224

208
103

Full name of sixth joint inventor, if any Valerie Ann Bailey
Inventor's signature Valerie Ann Bailey 3/8/99
Date

Residence 516 Grouse Court, Elsmere. Kentucky 41018
Citizenship U.S.A.
Post Office Address 6100 Center Hill Avenue
Cincinnati, Ohio 45224

09254103 . 030599

FIGURE 1a:

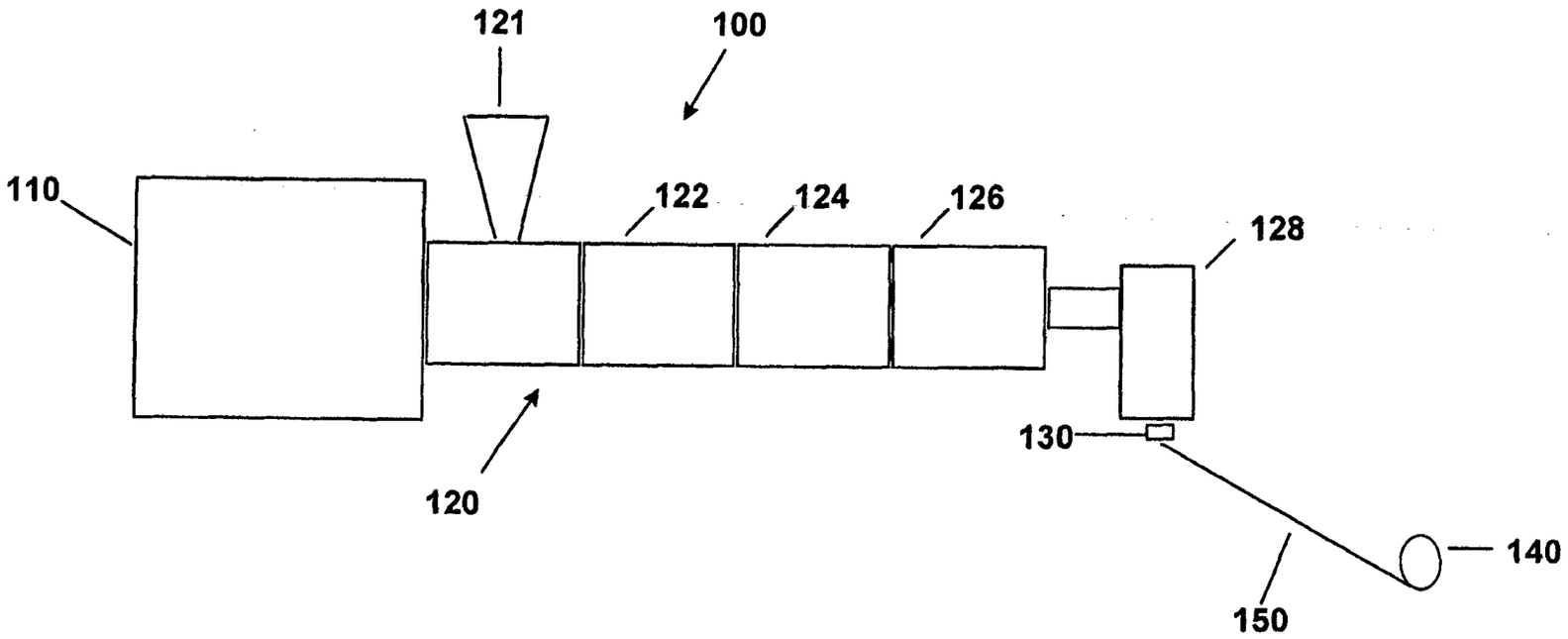
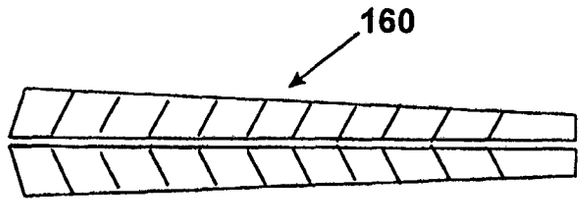


FIGURE 1b:



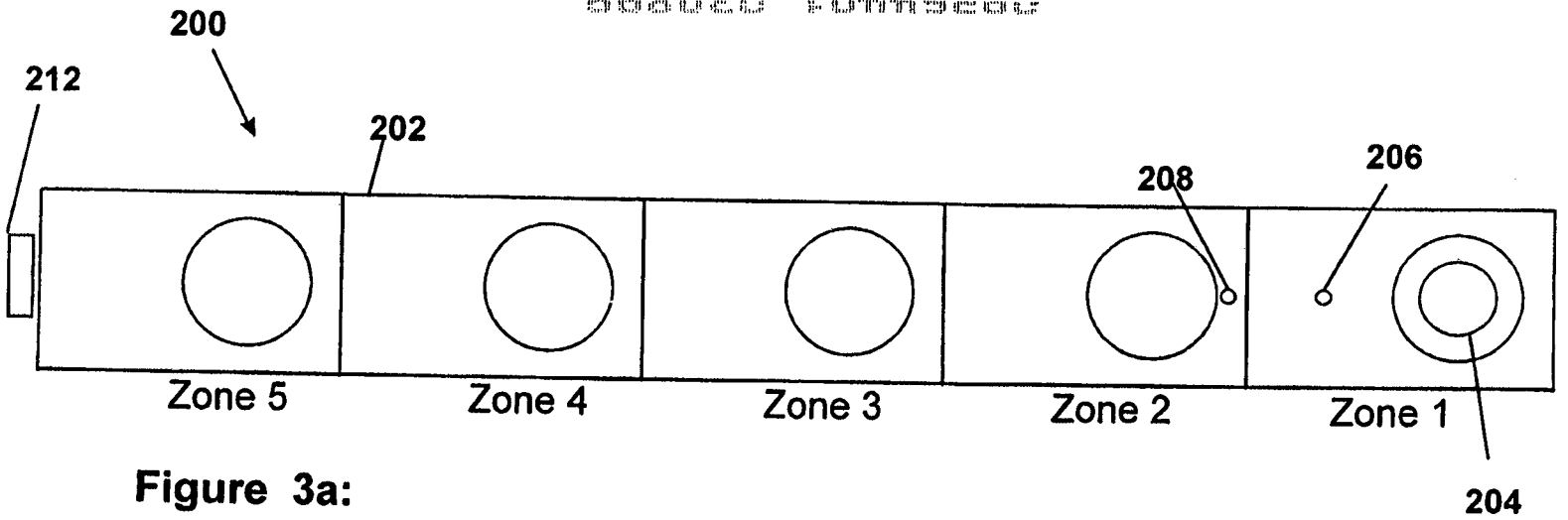


Figure 3a:

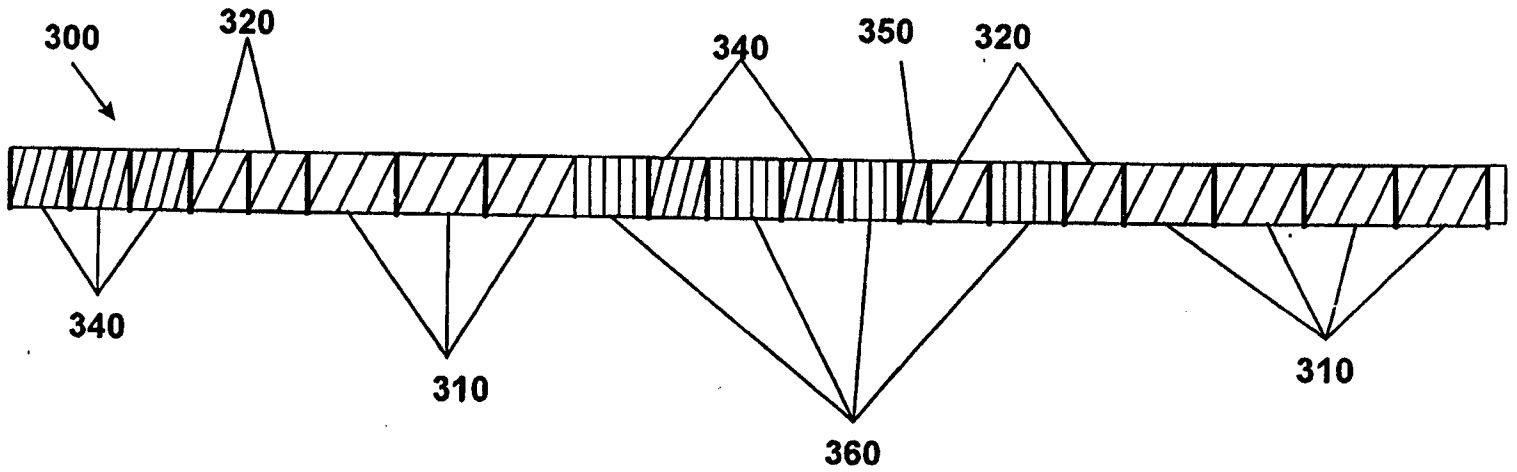


Figure 3b:

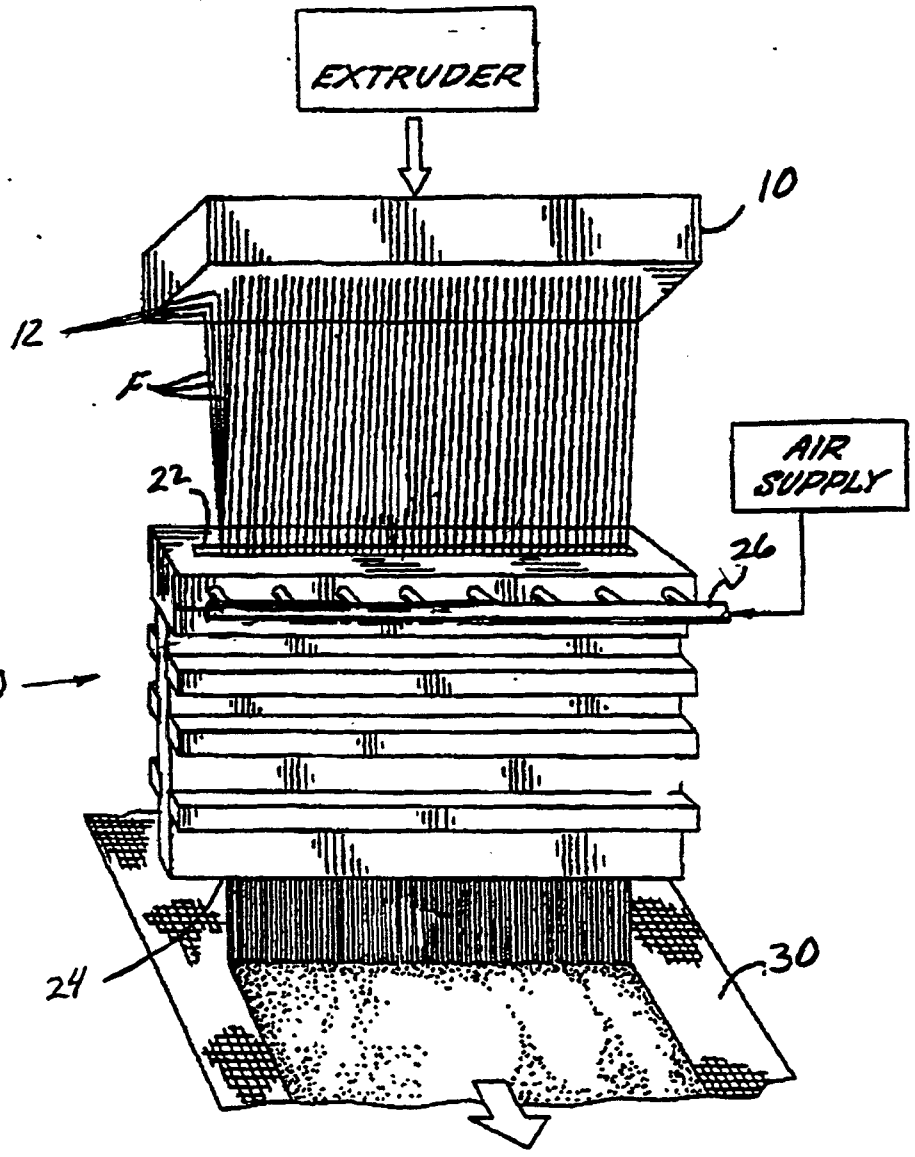


FIGURE: 4

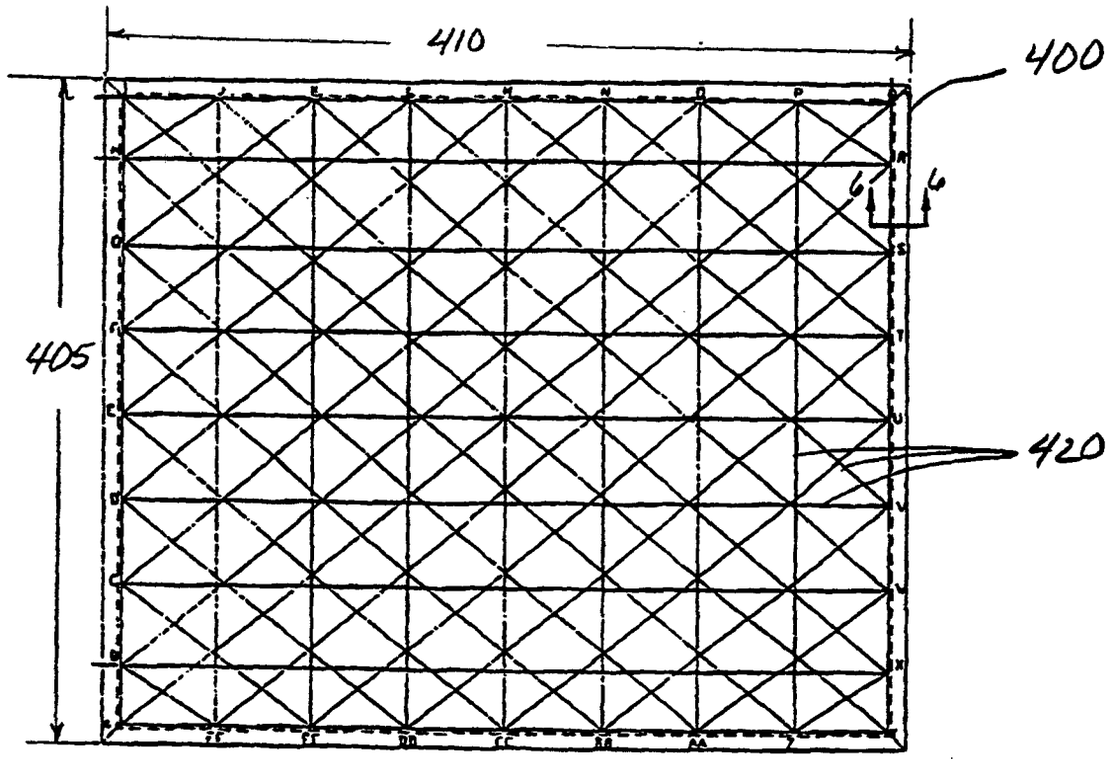


FIGURE 5:

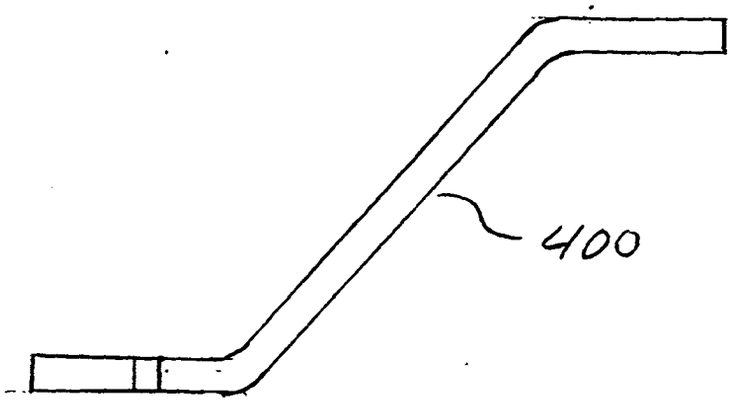


FIGURE 6:

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ESCOBAR - URIBE ASOCIADOS

A B O G A D O S

Carrera 11A No. 94-76 Of. 305 - P.O. Box 94948, Santafé de Bogotá, Colombia, S.A.
Tels.: (571) 6162051 - 6162061 - 6161859 - 6161869
Fax: (571) 61618'

2320/P

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISION DE NUEVAS CREACIONES
E. S. D.

Re: Expediente No. 00016913
Solicitud de patente a nombre de
HUMATRO CORPORATION

Yo, IGNACIO ESCOBAR URIBE, identificado como aparece al pie de mi firma, domiciliado en la Carrera 11 A No. 94-76, of. 305-306, obrando como apoderado sustituto de la sociedad Humatro Corporation (en virtud del documento de sustitución que acompaño al presente memorial), domiciliada en Nueva York, Nueva York, Estados Unidos de América, solicitante de la patente de la referencia, en respuesta al auto No. 0670 del 28 de marzo de 2000, relacionado con el concepto técnico 499 del 24 de marzo de 2000, me permito manifestar lo siguiente:

1. Acompaño al presente memorial copia auténtica del poder a mí otorgado por la sociedad *HUMATRO CORPORATION* y del certificado de existencia y representación de dicha sociedad. De los documentos mencionados se acompaña la correspondiente traducción oficial. Igualmente, acompaño sustitución del poder que me faculta para obrar en este caso.

2. Anexo al presente memorial copias de las páginas 50 y 51 (folios 55 y 56) en las cuales se encuentran correctamente escritas y legibles las fórmulas que allí aparecen.

3. Acompaño al presente memorial nuevo capítulo reivindicatorio en el cual se reflejan las correcciones hechas al mismo, basándose en las objeciones hechas por el examinador.

4. Acompaño nuevas páginas 13, 17, 19, 69, 70, 75 (tabla I), 77 (tabla II), 79 (tabla III), 84, 85, 86, 100, 116, 122, 125, 126 y 132 de la memoria descriptiva, en las cuales se han realizado las correspondientes conversiones al Sistema Internacional.

5. Anexo al presente memorial dibujos, de acuerdo con lo establecido en el artículo 4-d del Decreto 117 de Decreto 117 de 1994.

6. Anexo al presente memorial las artes finales en tamaño 12 x 12 centímetros (por duplicado) y una copia en tamaño 6 x 6 centímetros de la figura característica.

ESCOBAR - URIBE ASOCIADOS
ABOGADOS

Carrera 11A No. 94-76 Of. 305 - P.O. Box 94948, Santafé de Bogotá, Colombia, S.A.
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7. La copia certifica de la prioridad fue presentada ante ese despacho el día 31 de mayo de 2000.

8. No se entiende la razón por la cual en el concepto técnico No. 499 se indica que la solicitud no contiene el extracto para publicación y las tarjetas de archivo temático si estas fueron presentadas con la solicitud. Acompaño nueva copia de los mimos.

Espero con esto haber dado cabal cumplimiento a lo solicitado por ese despacho. En caso de que la anterior respuesta no se adecue técnica o jurídicamente al requerimiento, solicito atentamente que ese despacho proceda de conformidad con lo indicado en la Circular Interna No. 001 del 13 de febrero de 1997 expedida por la Delegatura para la Propiedad Industrial de la Superintendencia de Industria y Comercio y que de conformidad con lo indicado en los artículos 3°., inciso 3, 35 inciso 2 y 59 inciso 2 del CCA, al analizar este memorial, se traten todas las cuestiones planteadas con motivo del mismo.

Señor Superintendente,

IGNACIO ESCOBAR URIBE
C.C. 2886770 de Bogotá
T.P. 12.772

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ESCOBAR - URIBE ASOCIADOS

A B O G A D O S

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SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISIÓN DE NUEVAS CREACIONES
E. S. D.

RE: Solicitud de Patente a nombre de **HUMATRO CORPORATION**
Expediente: **00016913**

Yo, *JIMENA ESCOBAR URIBE*, domiciliada en Santafé de Bogotá, D.C., portadora de la tarjeta profesinal No. 68.228, atentamente digo a usted que sustituyo el poder con que obro al doctor *IGNACIO ESCOBAR URIBE*, domiciliado en Santafé de Bogotá, D.C. portador de la tarjeta profesional No. 12.772, con las mismas facultades con que me fueron conferidas para este caso.

Señor Superintendente,

JIMENA ESCOBAR URIBE
C.C. 39.779.452 de Usaquén
T.P. 68.228

Acepto la sustitución

IGNACIO ESCOBAR URIBE
C.C. 2.886.770 de Bogotá
T.P. 12.772

3

Uribe Jimena Escobar
cc 39229452
Vsigen

212

Consulado General de Colombia
500 NORTH MICHIGAN AVENUE, SUITE 2040
CHICAGO, ILLINOIS 60611
TEL.(312)923-1196 FAX(312)923-1197

No.707

Chicago, mayo 17 de 2000

El suscrito Cónsul General de Colombia, **CERTIFICA,** que el señor(a) JAMES CISSELL, quien como SECRETARIO DE LA CORTE DEL CONDADO DE HAMILTON, autenticó la firma del signatario del poder precedente, ejercía en la fecha las funciones indicadas y su firma corresponde a la registrada en este Consulado. Que la compañía HUMATRO CORPORATION, es una sociedad constituida de acuerdo con las leyes de EE.UU. y cumple su objeto conforme a las mismas. Que el(a) señor(a) DAVID R. WHITE, quien en su carácter representante legal de la citada compañía confiere el poder precedente.

La presente certificación se expide en cumplimiento del artículo 480 del Código de Comercio.

El Cónsul General no asume responsabilidad alguna por el contenido del documento.

PAGADO IMPUESTO DE TIMBRE Y DERECHOS CONSULARES
US$57.oo (Cincuenta y siete dólares)

CONSULADO GENERAL DE COLOMBIA CHICAGO

JOSE FERNANDO GOMEZ MORA
Cónsul General de Colombia

MINISTERIO DE RELACIONES EXTERIORES

NO SE ASUME RESPONSABILIDAD DEL TEXTO

2000

√

UNITED STATES OF AMERICA) STATE OF OHIO) SS: COUNTY OF HAMILTON)	ESTADOS UNIDOS DE AMERICA) ESTADO DE) SS: CONDADO DE
I, DONITA J. KONRAD, a Notary Public in and for the above-mentioned County and State Certify:	Yo, Notario Publico en y para el Condado y Estado arriba citados, certifico;
On the 24th day of MARCH, 2000, before me personally appeared David R. White to me known and known to me to be the person who signed the foregoing instrument as President of HUMANTRO CORPORATION	Que en el día de de 19 , compareció ante mi a quien conozco y quién me consta que es la persona que firmó el instrumento que antecede en su calidad de de la
a corporation duly organized and legally existing under the laws of the State of Delaware, United States of America, whose home office is located in c/o Ladas & Parry, 26 W. 61st. Street New York, 10023 State of New York, United States of America.	sociedad anónima debidamente constituida y con existencia legal bajo las leyes del Estado de de los Estados Unidos de Norteamérica con domicilio en el Estado de , Estados Unidos de Norteamérica.
I further certify that said individual is duly authorized to sign the foregoing instrument in the name of said corporation and that the purposes for which said instrument are granted are within the scope of the objects or activities of said corporation.	Certifico, además, de que dic persona está debidamente facultada pa firmar el instrumento que antecede en nombre de la citada sociedad y que l objetivos y finalidades para los que se otorga el mencionado instrumento están comprendidos dentro de los objetivos o actividades de la mencionada sociedad.
The foregoing is based on the dated which I have seen.	Lo que antecede se basa en la de fecha que he tenido a la vista.

NOTARIO PUBLICO Donita J. Konrad (SEAL)

DONITA J. KONRAD
Notary Public, State of Ohio
My Commission Expires May 5, 2000

NOTARIAL SEAL STATE OF OHIO

PLEASE NOTE THAT IN ACCORDANCE WITH ARTICLE I (3) OF THE "PROTOCOL ON UNIFORMITY OF POWERS UTILIZED ABROAD", ADOPTED BY THE SEVENTH INTERNATIONAL CONFERENCE OF AMERICAN STATES, THE NOTARY PUBLIC MUST COMPLETE THE BLANK SPACES AT THE END OF THIS DECLARATION BY INDICATING THE SPECIFIC DOCUMENT OR DOCUMENTS ON WHICH HIS INFORMATION IS BASED, E.G., THE ARTICLES OF INCORPORATION, BY-LAWS, OR RESOLUTIONS OF THE BOARD OF DIRECTORS AND THE DATES THEREOF.

CERTIFICADO NOTARIAL (INDIVIDUO)	NOTARIAL CERTIFICATE (INDIVIDUAL)
Estados Unidos de America Estado de } ss. Condado de	United States of America State of } ss: County of
A los.........dias del mes de.......................19......, compareci personalmente ante mí, Notario Público en y por el condado antes citado, ...	On this..............day of............................19......, personally appeared before me, a Notary Public, in and for the above mentioned county...............................
a quien doy fé de conocer y me consta que es/son la persona descrita y firmante del documento que precede, declarando ante mí que otorg el mismo para los fines y propósitos que en él se expresan.	to me known, and known to me to be the person described in and who executed the foregoing document, and he duly acknowledged to me that he executed same for the uses and purposes therein expressed.

Notary Public (Notario Público)...

TPC&T 320

CASE: 7967
COLOMBIA

COUNTRY

PODER

POWER OF ATTORNEY

abajo firmad

nombr por el presente á

apoderado verdadero y legal con poder especial, amplio y suficiente para recabar de las oficinas y authoridades nacional que correspondan, la obtención de

á cuyo efecto le facult para dar ante dichas authoridades todos los pasos necesarios al objeto indicado; elevar solicitudes, declaraciones, y reclamos; formular descripciones, enmiendas, oposiciones y apelaciones; desistir; abonar todos los impuestos y cuotas y efectuar todos los otros pagos determinados por la ley; recibir todos los documentos y valores dando el descargo respectivo; llenar cualesquiera otros requisitos y tomar en fin todas las medidas que creyere conducentes al resguardo de intereses; y en caso de producirse oposición pasando los antecedentes á los Tribunales, queda facultado para tomar intervención como demandante ó demandado ante los Jueces que sean competentes, pudiendo transar, someter á árbitros, desistir, percibir, apelar y todas las demás facultades que resulten necesarias, y por el presente declar desde ahora válido y bueno todo cuanto dicho apoderado hiciere en beneficio, dándole asimismo facultad para substituir el presente si lo juzgare conveniente y en caso necesario revocar dichas substituciones.

Dado y firmado .....

.....

the undersigned

HUMATRO CORPORATION, a corporation organized under the laws of the State of Delaware, United States of America, of c/o Ladas & Parry, 26 W. 61st. Street, New York, New York 10023, United States of America

hereby appoint JIMENA ESCOBAR URIBE
Y/O IGNACIO ESCOBAR URIBE

true and legal agent with special, ample and sufficient power to obtain from the respective National Offices and authorities

for which purpose authorize to take before the said authorities all the necessary steps to the said end; to file petitions, declarations and claims; to draw up specifications; to make amendments, opposition and appeal; desist; to pay all taxes and installments, and effect all other payments prescribed by law; to receive all documents and securities, giving proper receipts, to comply with all other requirements and in short, to take all those measures which may deem fit for the protection of interests; and in case of opposition where the proceedings be passed over to the Courts, authorize said agent to act on behalf as complainant as well as defendant before the competent Judges, with full power to make arrangements, submit to arbitrators; to desist, to collect, to appeal, and in short with all such further powers as may be required; and hereby declare from now on as valid, and good all that the said agent may do for benefit, authorizing also to substitute these presents if think proper, and revoke such substitutions, if necessary.

Given and signed this 29th day of March, 2000

HUMATRO CORPORATION

David R. White, President

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STATE of OHIO
COUNTY OF HAMILTON } ss.

I, JAMES CISSELL Clerk of the Common Pleas Court, the same being a court of record for aforesaid county, having by law a seal do hereby certify that DONITA J. KONRAD Esq., whose name is subscribed to the attached certificate was at the time a NOTARY PUBLIC, duly commissioned and sworn, and at the time of taking said acknowledgement, proof or affidavit, was residing in said county, and was, as such, an officer of said state, duly authorized by the laws thereof to take and certify the same, as well as to take and certify the proof and acknowledgement of deeds and other instruments in writing to be recorded in said state, and that full faith and credit are and ought to be given to his official acts; and I further certify that I am well acquainted with his handwriting, and verily believe that the signature to the attached certificate is his genuine signature. I further certify that the filing of the impression of the notary seal is not required in this state.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal this 24th day of APRIL, XX 2000

JAMES CISSELL
Clerk of Common Pleas Court, Hamilton County, Ohio

TRADUCCION OFICIAL DEL INGLES del sello y de la legalización de la firma de la Notaria que suscribe la certificación adjunta al poder que la compañía HUMATRO CORPORATION domiciliada en New York, N. Y., Estados Unidos de América, otorga a Jimena Escobar-Uribe y/o Ignacio Escobar-Uribe.

[Sello:] DONITA J. KONRAD
Notaria Pública, Estado de Ohio
Mi comisión expira Mayo 9 del 2000

ESTADO DE OHIO
CONDADO DE HAMILTON

Yo, James Cissell, Secretario de la Corte de Causas Comunes, que es una corte de registro y por ley tiene sello, certifico que DONITA J. KONRAD, cuyo nombre aparece suscrito la certificación adjunta era en el momento de firmar dicha certificación NOTARIA PUBLICA debidamente comisionada y juramentada, y en el momento de tomar dicho reconocimiento, prueba o declaración residía en el condado mencionado, y como tal era funcionaria del mencionado Estado, debidamente autorizada por las leyes de éste para tomar y certificar dicho reconocimiento, prueba o declaración, así como también para tomar y certificar la prueba y el reconocimiento de actas y otros instrumentos escritos que han de ser registrados en el Estado mencionado, y que todos sus actos oficiales merecen toda fe y crédito; y certifico además que conozco bien la firma de dicha Notaria y estoy convencido de que la firma que aparece en la certificación adjunta es su firma genuina. Certifico además que en este Estado no se requiere registrar el sello de los notarios.

----------(continúa en la 2ª página)----------

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En testimonio de lo cual yo he colocado aquí abajo mi firma y mi sello oficial hoy 24 de Abril del 2000.

JAMES CISELL, Secretario de la Corte de Causas Comunes

Condado de Hamilton, Ohio

(Firma y Sello Oficial)

El documento traducido oficialmente del inglés fue legalizado bajo el sello No. 272606 el día 30 de Mayo del 2000 en la Oficina de Legalizaciones del Ministerio de Relaciones Exteriores.

M. Méndez S.

JOSE MIGUEL MENDEZ

NO SE ASUME RESPONSABILIDAD DEL TEXTO

2000 JUN 12

JEFE DE LEGALIZACIONES SANTAFE DE BOGOTA D.C.

MINISTERIO DE RELACIONES EXTERIORES

279008

MIGUEL MENDEZ

CUYA FIRMA APARECE EN EL DOCUMENTO DESEMPEÑA LAS FUNCIONES INDICADAS

GILBERTO [illegible] NOTARIO

$$\varepsilon = \int_0 \varepsilon^{\bullet}(t')\,\partial\, t'$$

Esta tensión dependiente del tiempo o historia se llama la tensión se Hencky (ε_H). Para un alargamiento uniaxial homogéneo ideal, la proporción de tensión experimentada por cada elemento fluido es igual a la tensión impuesta por el esfuerzo aplicado, tal como los esfuerzos aplicados de manera externa por el instrumento, dispositivo o proceso. En un caso ideal, la tensión de Hencky se correlaciona directamente con la deformación/alargamiento de la muestra.

$$\varepsilon_H = ln\,(L/L_o)$$

Esta respuesta ideal a la tensión al esfuerzo aplicado frecuentemente se observa más en fluidos Newtonianos.

La relación de Trouton (Tr) se usa frecuentemente para expresar el comportamiento de flujo de extensión. La relación de Trouton se define como la relación entre la viscosidad de extensión (η_c) y la viscosidad de corte (η_s),

$$Tr = \eta_e(\varepsilon^{\bullet}, t) / \eta_s$$

en donde la viscosidad de extensión η_e es dependiente de la velocidad de deformación ($\dot{\varepsilon}$) y tiempo (t). Para un fluido Newtoniano, la relación de Trouton extensión uniaxial tiene un valor constante de 3. Para un fluido no Newtoniano, la viscosidad de extensión es dependiente de la velocidad de deformación ($\dot{\varepsilon}$) y al tiempo (t).

La viscosidad de corte (η_s) se relaciona a la capacidad de procesamiento en estado fundido de la composición de almidón usando técnicas normales de procesamiento de polímeros, tal como extrusión, moldeo por soplado, moldeo por compresión, moldeo por inyección, y similares. Una composición de almidón que tiene una viscosidad de corte, medida de acuerdo al método de prueba descrito posteriormente en la presente, de menos de aproximadamente 30 Pa•s, de manera preferente desde cerca de 0.1 hasta aproximadamente 10 Pa•s, en forma más preferente desde aproximadamente 1 hasta aproximadamente 8 Pa•s, es útil en los procesos de atenuación en estado fundido en la presente. Algunas composiciones de almidón en la presente pueden tener

REIVINDICACIONES

1. Una estructura flexible, absorbente, caracterizada porque comprende fibras de almidón, seudo-termoplásticas.

2. La estructura de conformidad con la reivindicación 1, caracterizada porque las fibras de almidón tienen un tamaño que varía desde 0.01 dtex hasta 135 dtex.

3. La estructura de conformidad con la reivindicación 1, caracterizada porque la estructura tiene una resistencia a la tracción, en seco, promedio, geométrica que varía desde 0.098 N/cm hasta 11.76 N/cm, una resistencia a la tracción, en húmedo, promedio, geométrica, inicial que varía desde 0.0196 N/cm hasta 3.92 N/cm, y una resistencia a la tracción, en húmedo, decaída, promedio, geómetrica, que varía desde 0 N/cm hasta 0.196 N/cm.

4. La estructura de conformidad con la reivindicación 1, caracterizada porque la estructura tiene un peso base que varía desde 10 g/m^2 hasta 450 g/m^2.

5. La estructura de conformidad con la reivindicación 1, caracterizada porque, además comprende un plastificante seleccionado a partir del grupo que consiste de sorbitol monosacáridos, disacáridos, glicerol, alcohol polivinílico y polietilenglicol, en donde el plastificante comprende, en base al peso total y la estructura desde 5% en peso hasta 70% en peso.

6. La estructura de conformidad con la reivindicación 1, caracterizada porque, además comprende agentes de reticulación seleccionados a partir del grupo que consiste de, resinas de poliamida-epiclorhidrina, resinas de urea-formaldehído, resinas de poliacrilamida glioxilada, resinas de melamina-formaldehído, resina de polietilenimina, resina Caldas 10, resina CoBond 1000, en donde los agentes de reticulación están presentes en cantidades que varían desde 0.1% en peso hasta 10% en peso en base al peso total de la estructura.

7. La estructura de conformidad con la reivindicación 1, caracterizada porque la estructura tiene una absorbencia que varía desde 1 gagua/gestructura seca hasta 15 gagua/gestructura seca.

8. La estructura de conformidad con la reivindicación 1, caracterizada porque la estructura tiene una flexibilidad total que varía desde 0.0098 N/cm hasta 0.735 N/cm.

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9. Una estructura que comprende fibras de almidón, seudo-termoplásticas en donde las fibras tiene una Tg de al menos -30 °C y la estructura tiene una resistencia a la tracción, en húmedo, decaída, promedio, geométrica que varía desde 0 N/cm hasta 0.196 N/cm en donde estas fibras tienen un tamaño que varía desde 0.01 dtex hasta 135 dtex.

10. Una estructura absorbente que comprende uno o más pliegos, caracterizada porque al menos un pliego comprende fibras de almidón seudo-termoplásticas, y en donde al menos un pliego tiene un peso base que varía desde 10 g/m^2 hasta 100 g/cm^2, una GMDT que varía desde 0.392 N/cm hasta 4.655 N/cm, una densidad aparente que varía desde 0.04 g/cm^3 hasta 0.12 g/cm^3, y una GMWT inicial que varía desde 0.0196 N/cm hasta 1.96 N/cm.

hasta aproximadamente 100°C, y de manera más preferente desde aproximadamente –30°C hasta aproximadamente 25°C.

Las propiedades físicas de ejemplo de la estructura flexible de la presente invención incluyen resistencia a la tracción en seco y resistencia a la tracción en húmedo. La resistencia a la tracción en seco de la estructura, que se mide como una resistencia a la tracción intermedia promedio, geométrica, puede variar desde aproximadamente 0.098 N/cm a aproximadamente 11.76 N/cm, de manera más preferente desde aproximadamente 0.294 N/cm hasta aproximadamente 5.88 N/cm y de manera más preferente desde aproximadamente 0.392 N/cm hasta aproximadamente 4.655 N/cm. La resistencia a la tracción en húmedo de la estructura, que también se mide como una resistencia a la tracción, promedio, geométrica, puede variar desde aproximadamente 0.0196 N/cm hasta aproximadamente 3.92 N/cm, y de manera más preferente desde aproximadamente 0.0196 N/cm hasta aproximadamente 1.96 N/cm.

BREVE DESCRIPCION DE LOS DIBUJOS

Estas y otras características, aspectos y ventajas de la presente invención se llegarán a

reportada en gramos por metro cuadrado.

El calibrador es el espesor macroscópico de una muestra medida como se describe posteriormente.

La densidad aparente es el peso base de la muestra dividido por el calibrador con las conversiones unitarias apropiadas incorporadas en la presente. La densidad aparente usada en la presente tiene las unidades de gramos / centímetros cúbicos (g/cm^3).
La dirección de la maquina, designada MD, es la dirección paralela al flujo de la estructura de fibra de almidón a través del equipo de fabricación del producto.

La dirección transversal a la máquina, designada CD, es la dirección perpendicular a la dirección de la máquina en el mismo plano de la estructura de fibras de almidón.

La resistencia a la tracción, en seco, promedio, geométrica (GMDT) es la raíz cuadrada del producto de las resistencias a la tracción en seco en la dirección de la máquina y en la dirección transversal a la máquina (en Newtons/cm). El valor de GMDT se reporta en Newtons/cm.

La resistencia a la tracción, en húmedo, promedio, geométrica (GMWT) es la raíz cuadrada del

tracción en húmedo decaída, promedio, geométrica de al menos aproximadamente 0.196 N/cm, y en forma más preferente de menos de aproximadamente 0.098 N/cm.

El término "agua unida" significa el agua encontrada que se presenta de manera natural en el almidón y antes del mezclado del almidón con otros componentes para ser la composición de la presente invención. El término "agua libre" significa el agua que se adiciona al hacer la composición de la presente invención. Una persona experta en la técnica reconocerá que una vez que se mezcla los componentes en una composición, el agua no se puede distinguir por más tiempo por su origen.

Todos los porcentajes, relaciones y proporciones usados en la presente son por ciento en peso en la composición, a menos que se especifique de otra manera.

La especificación contiene una descripción detallada de (1) materiales de ejemplo de la presente invención (2) procesos de ejemplo para producir la presente invención, (3) propiedades de material de la presente invención, y (4) procedimientos analíticos para medir las propiedades de la presente invención.

de impulsión 110 y se colocan dentro del barril 120. Un dado capilar se hace para ajustar el dado 130, con un diámetro de orificio de 0.5 mm y una longitud de 5.6 mm. El re-bobinador de mandril 140 comprende un núcleo de 7.62015 cm montado a un árbol de 7.62015 cm de diámetro, impulsado por CD, simple. El núcleo de 7.62015 cm puede lograr velocidades superficiales desde 150 a 2000 fpm.

Las materias primas utilizadas incluyen las siguientes:

45 % en peso de almidón de maíz Durabond A de National Starch

25 % en peso de agua

15 % en peso de Urea disponible de Aldrich Chemicals

15% en peso de Sorbitol disponible de Aldrich Chemicals

Todas las materias primas se mezclaron fuera de línea hasta que se formó una suspensión espesa. Luego, se alimentó manualmente la suspensión espesa en el orificio de alimentación 121 del montaje 100 de reómetro de par de fuerzas o de torsión.

Los ajustes en el reómetro de torsión

fueron como sigue:

PI PM	50
Temperatura de barril	110°C
Temperatura del dado	105°C
Velocidad de alimentación	1.7 gramo/minuto

Después de correr el reómetro durante aproximadamente 20 minutos, el proceso se estabilizó y una fibra de almidón 150 seudo-termoplástica, individual salió del dado 13. La fibra individual 150 se enrolló manualmente alrededor del bobinador de mandril 140. El bobinador 140 luego se aceleró lentamente a 27,432.054cm/minuto de velocidad superficial a fin de arrastrar o jalar la fibra 150 incrementando la longitud de la fibra y disminuyendo el área de sección transversal. El diámetro de la fibra enrollada 150 estaba entre 70 y 90 micras.

EJEMPLO 2

El propósito de este ejemplo es ilustrar cómo las fibras de almidón se pueden arreglar para formar una estructura de fibra de almidón. Las fibras de almidón seudo-termoplásticas del Ejemplo 1 se cortaron en fibras cortas de 8 mm de longitud.

Tabla I

Zona	emperatura (°C °F))	Presión (Pascales)	Descripción del tornillo
1	(70) 21.1	0	Alimentación
2	(193) 89.4	3,333.32 Pa	Mezclando
3	(268) 131,1	(0) 0	Mezclando
4	(210) 98.8	(0) 0	Disminución de presión de transporte
5	(205) 96.1	0 – 68.6273 Pa	Generación de presión
Dado	(194) 90	3,556.8549 Pa	Formación

EJEMPLO 4

Fibras de Almidones Extruídas con un Extrusor de Tornillos Gemelos, sin Desfogue

El propósito de este ejemplo es ilustrar una configuración de extrusor de tornillos gemelos, sin desfogue, representada en la Figura 3a, usada para hacer fibras de almidón para la presente invención. Las fibras de almidón se hacen usando un extrusor de tornillo gemelo APV Baker (Paterborough, Inglaterra) 200, un dado capilar 212, y un bobinador

Tabla II

Zona	emperatura (°C °F))	Presión (Pascales)	Descripción del tornillo
1	(70) 21.1	(0) 0	Alimentación
2	(180) 82.2	(0) 0	Mezclando
3	(260) 126.6	(0) 0	Mezclando
4	(215) 101.66	(0) 0	Disminución de presión de transporte
5	(193) 89.4	206.86229 Ra	Generación de presión
Dado	(172) 77.7	5, 543.125 Pa	Formación

EJEMPLO 5

Fibras de Almidón Espumadas Extruídas con un Extrusor de Tornillos Gemelos, Sin Desfogue

El propósito de este ejemplo es ilustrar las varias zonas de un extrusor de tornillos gemelos sin un desfogue y los parámetros de operación asociados con cada zona para producir fibras de almidón, espumadas que son de menor densidad y que tienen una mayor capacidad absorbente con relación a las fibras de almidón, no espumadas. Las fibras de

Tabla III

Zona	emperatura (°C °F))	Presión (Pascales)	Descripción del tornillo
1	(70) 21.1	(0) 0	Alimentación
2	(180) 82.2	(0) 0	Mezclando
3	(260) 126.6	(0) 0	Mezclando
4	(240) 115.5	(0) 0	Disminución de presión de transporte
5	(220) 104.4	896.07646 Pa	Generación de presión
Dado	(225) 102.22	1,033.9683 Pa	Formación

Hilado de Fibras Fundidas de Almidón Pseudo- termoplásticas

La producción de fibras de acuerdo con la invención a partir de composiciones fundidas pseudotermoplásticas ocurre por los procesos de hilado en fusión, usuales. Los dispositivos para producir estructuras de tejido termoplásticas, no tejidas a partir de polímeros extruídos son bien conocidos en la técnica. Los polímeros extruídos bajo presión, se fuerzan a través de un aparato para hilar, que forma una cortina verticalmente orientada de fibras

también exhihen ciertas propiedades mecánicas, particularmente resistencia flexibilidad y absorbencia. Las medicinas de la resistencia incluyen la resistencia a la tracción, en seco, promedio, geométrica (GMDT), y la resistencia a la tracción, en húmedo, promedio, geométrica (GMWT) en donde la GMWT incluye resistencia a la tracción en húmedo, inicial y resistencia a la tracción en húmedo de caída. La flexibilidad sobre la zona a la rigidez se puede atribuirse a la suavidad. La absorbencia se relaciona a la capacidad de los productos para tomar fluidos así como la capacidad para retenerlos.

La resistencia a la tracción, en seco, promedio, geométrica (GMDT), definida previamente, proporciona una medida de la resistencia a la tracci6n en seco de la estructura. El método usado para determinar esta medición se describe posteriormente. Para la presente invención, la estructura que comprende fibras de almidón pseudotermoplásticas puede tener una GMDT que varía desde aproximadamente 0.294 N/cm hasta aproximadamente 11.76 N/cm De manera preferente, la estructura puede tener una GMDT que varía desde aproximadamente 0.294 N/cm hasta aproximadamente 5.88 N/cm. De manera más

preferente, la estructura puede tener una GMDT que varía desde aproximadamente 0.392 N/cm hasta aproximadamente 4.655 N/cm.

La resistencia a la tracción, en húmedo, promedio, geométrica (GMWT), definida previamente, proporciona una medida de la resistencia a la tracción en húmedo de la estructura. La resistencia a la tracción, promedio, geométrica, inicial es la resistencia a la tracción, en húmedo y una estructura después de que se ha sumergido en agua durante 5 minutos. El método usado para determinar esta medición se describe posteriormente. Para la presente invención, la estructura que comprende las fibras de almidón, pseudo-termoplásticas puede tener una GMDWT que varían de aproximadamente 0.0196 N/cm hasta aproximadamente 3.92 N/cm. De manera más preferente la estructura puede tener una GMDWT que varía desde aproximadamente 0.0196 N/cm hasta aproximadamente 1.96 N/cm.

La resistencia a la tracción, en húmedo, decaída, promedio, geométrica (GMDWT) es la medida de la resistencia a la tracción en húmedo de la estructura después de que se sumerge en agua durante 30 minutos. Para la presente invención, la estructura que comprende las fibras de almidón,

pseudo-termoplásticas puede tener una GMDWT que varía desde aproximadamente 0 N/cm hasta aproximadamente 0.196 N/cm. De manera más preferente, la estructura puede tener una GMDWT que varía desde aproximadamente 0 N/cm hasta aproximadamente 0.098 N/cm.

La suavidad se ha descrito como un atributo fisiológicamente percibido que se mide en general por evaluaciones de paneles de expertos o no expertos. La suavidad percibida se puede descomponer en dos componentes; suavidad monométrica o suavidad superficial. La suavidad monométrica se ha correlacionado a la rigidez de la hoja y la flexibilidad mientras que la suavidad superficial se ha relacionado a la textura y suavidad de la superficie. Una alta suavidad requiere flexibilidad. El método usado para determinar la flexibilidad total de una estructura se define posteriormente. Para la presente invención, la estructura tiene una flexibilidad total que varía desde aproximadamente 0.098 N/cm hasta aproximadamente 0.735 N/cm; de manera preferente desde aproximadamente 0.0196 N/cm hasta aproximadamente 0.49 N/cm; de manera más preferente aproximadamente 0.0196 N/cm hasta aproximadamente 0.343 N/cm.

Absorbencia = (Peso Húmedo de Muestra = Peso Seco de Muestra)/Peso Seco de Muestra

el cálculo se repite para cada una de las 6 mediciones se promedian los 6 números de absorbencia de manera conjunta y se reportan como g_{agua}/g_{agua} (gramos de agua/gramos de peso seco de muestra.

(i) VISCOSIDAD DE CORTE

La viscosidad de corte de la composición se mide usando el viscosímetro rotacional (Modelo DSR 500, fabricado por Rheometrics). Se carga una composición de muestra pre-calentada en la sección de barril del reómetro, y se rellena sustancialmente la sección de barril (aproximadamente 60 gramos de muestra se usa). El barril se mantiene a una temperatura de prueba de 90°C. Después de la carga, el aire se burbujea en gereral a la superficie y no 20 crea problemas para la corrida . Para una muestra más viscosa, se puede usar la comparación antes de la corrida de la prueba para liberar a la muestra fundida del aire atrapado. El viscosímetro, se programa para inclinar los esfuerzos aplicados desde 10^{-4} N/cm a 5 10^{-2}N/cm. La tensión

Temperatura de barril	
Zona 122	70°C
Zona 124	90°C
Zona 126	90°C
Zona 128	90°C

Torsión	100 rpm
Temperatura del gas	126.7°C
Temperatura del aire	126.7°C
Presión del Aire	248.155kPa
Bomba	40 rpm

La mezcla se transporta desde el extrusor a través de la bomba hacia el dado de soplado en estado fundido. Los filamentos atenuados resultantes (o fibras finas) de la invención tienen diámetros de fibra que varían desde 8 a 40 micras.

Se señala que el por ciento en peso de almidón en la composición procesada en estado fundido incluye en el peso del almidón y el peso del agua unida (que es en promedio aproximadamente 8% en peso de almidón). Se va a entender que las composiciones como se preparan se usan para los procesos de extensión uniaxial y biaxial. Sin

Temperatura de Barril

Zona 122	70"C
Zona 124	90°C
Zona 126	90°C
Zona 128	90°C

Torsión	140 rpm
Velocidad de alimentación	16 gm/min
Temperatura del dado	137.8°C
Temperatura del Aire	137.8°C
Presión del aire	344.65985kPa
Bomba	40 rpm

Los filamentos atenuados, resultantes o fibras finas) de la invención tienen diámetro de fibra que varía desde 10 a 30 micras. Las fibras se colocan con aire sobre un tejido de formación de papel como se describe en la patente de los Estados Unidos número 4,637,859, con los tejidos de las patentes de los Estados Unidos números 5,857,498, 5,672,248, 5,211,815 5,098,519, todas incorporadas en la presente como referencia, también que se juzgan adecuadas para este propósito.

usa fibras hechas a partir de una composición sin polímeros altos. Se cree que cuando la composición de la presente invención se usa, el producto mostrará mejor desempeño o desempeños equivalentes.

Se prepara una muestra de cemento, comparativa como sigue: se mezclan 5 partes de cemento de fijación Quikrete con 1.5 partes de agua de grifo limpia hasta que se obtiene una consistencia de jarabe espeso. En el espacio de 5 minutos de mezclado, el cemento se introdujo en moldes cilíndricos a fin de obtener una muestra de dimensión constante para la evaluación. Se rellenaron dos moldes de pared de 12.700 cm de largo por 0.5842 cm de diámetro interior (es decir, popotes comercialmente disponibles) al impulsar la mezcla de cemento pastosa hasta el fondo. Este método de relleno elimina la inclusión de aire en la muestra terminada. Las muestras se dejan curar durante 5 días antes de la evaluación. El molde se marca cuidadosamente en la superficie exterior para no dañar el interior de la muestra, el molde luego se desprende para recuperar la muestra comparativa (ejemplo 20b).

Se prepara una composición procesable en estado fundido al mezclar 45% en peso de almidón

(Duranbond® disponible de National Starch and Chemicals Corp., Bridgewater, NJ), 15% en peso de urea, 15% en peso de sorbitol, y 25% en peso de agua para formar una suspensión espesa. La suspensión espesa se alimenta en un reómetro de torsión (modelo Rheocord 90) como se ilustra en la figura 1c y se opera bajo la condición como se describe en el ejemplo 19 anterior. Las fibras son de aproximadamente 0.0508 cm de diámetro que se cortan a una longitud de 2.540005 cm para el uso en la presente. Las hebras tipo espagueti, delgadas, extruídas se incorporan en el cemento como sigue: 5 partes del cemento Quikrete comercialmente disponibles se mezclan con 1.5 partes de agua de grifo limpia y 0.5% (en una base de peso seco) de fibras de almidón. La cantidad adicional de agua adicionada a la presente se requiere para lograr la consistencia comparable como la muestra comparativa anterior. Los moldes de muestra se rellenan y las muestras (ejemplo 20) se curan y recuperan de la misma manera como antes.

Las muestras se evalúan subjetivamente al doblar a mano hasta la falla. El ejemplo 20 se juzgó subjetivamente que es ligeramente más débil que el ejemplo 20b comparativa. El ejemplo 20 tiene

transparentes útiles como bolsitas de almacenamiento de alimentos, sellables, bolsas de tiendas, bolsas de basura, bolsas de abarrotes, y similares. Se colocan dos piezas de películas de 10.16 cm por 10.16 cm (4 pulgadas por 4 pulgadas) con una pieza de papel de liberación interpuesto entre ellas. El papel de liberación debe ser más pequeño que las películas de modo que al menos tres bordes de las películas están en contacto directo entre sí. Un sellador de impulso es Vertrod (Modelo 24LAB-SP) se usa para sellar los tres lados de las películas sobrepuestas. El sellador se ajusta a 50 % de voltaje, presión de 412.74419 Pa un tiempo de hinchamiento de seis segundos (un segundo de encendido y 5 segundos apagados), y un tiempo de sellado total de un minuto. La bolsa resultante muestra sellos soldados, uniformes en los tres lados. El cuarto lado se puede sellar de manera opcional para formar una bolsa completamente sellada.

EJEMPLO 25

Este ejemplo ilustra las composiciones de almidón insolubles en agua de la presente invención. Se prepara una composición al mezclar 50% en peso

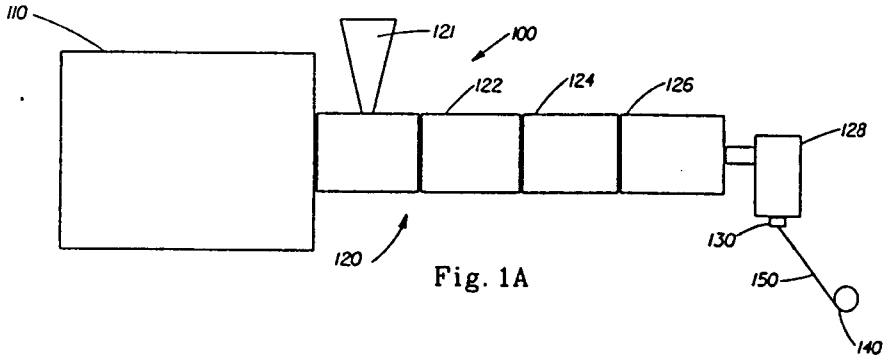

Fig. 1A

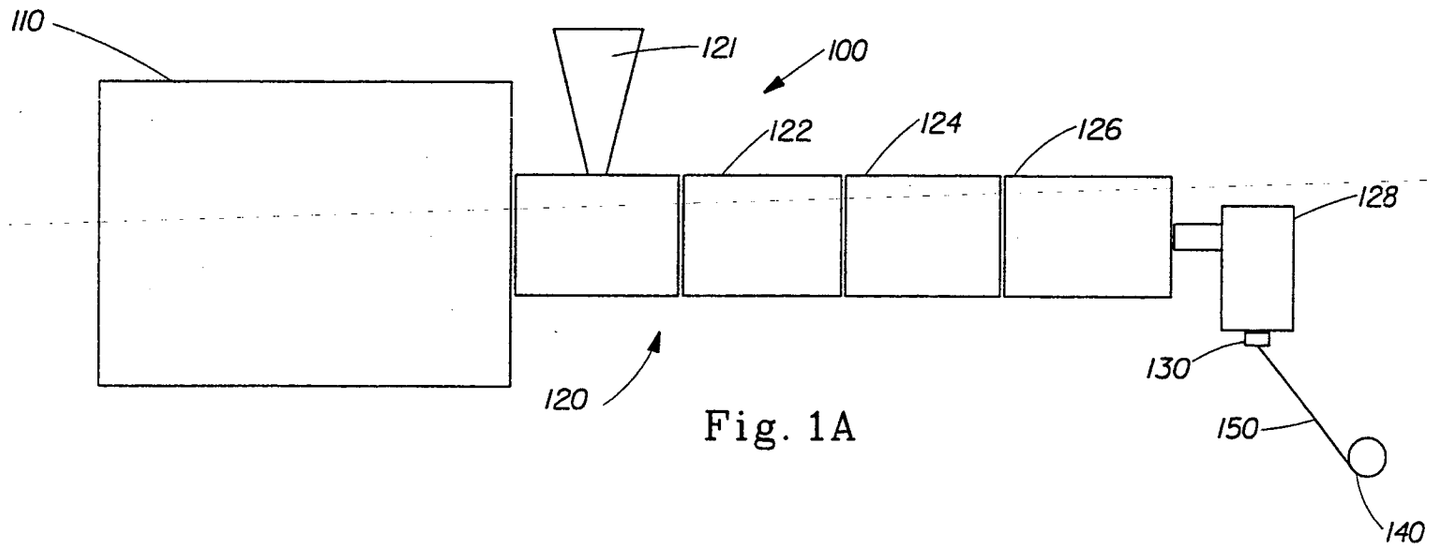

Fig. 1A

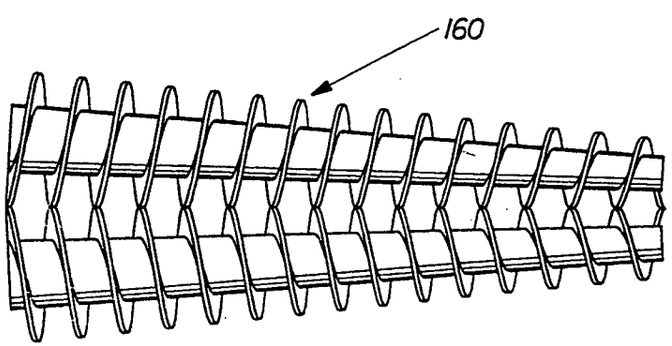

Fig. 1B

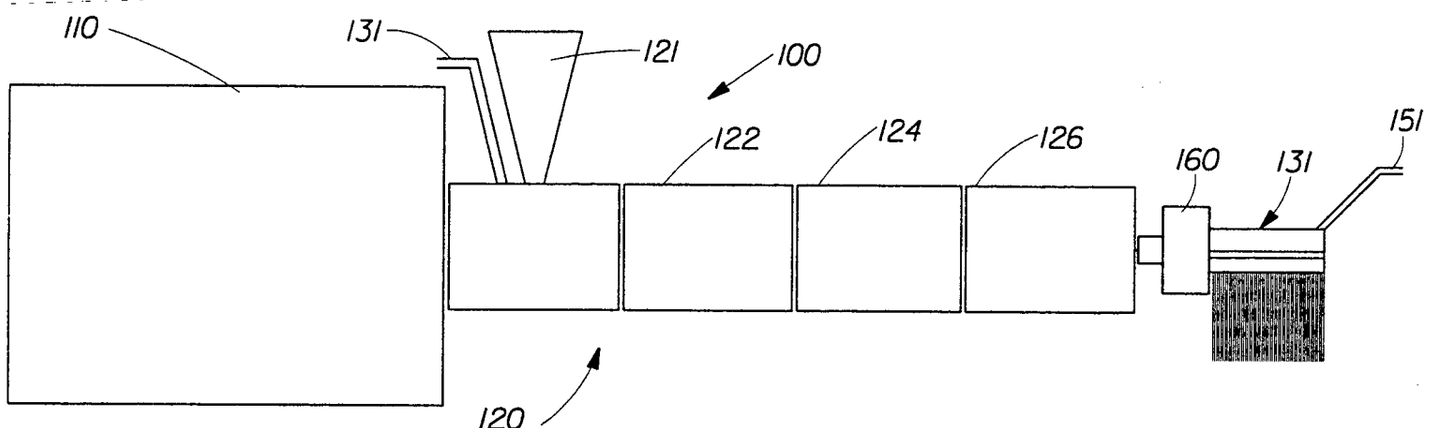

Fig. 1C

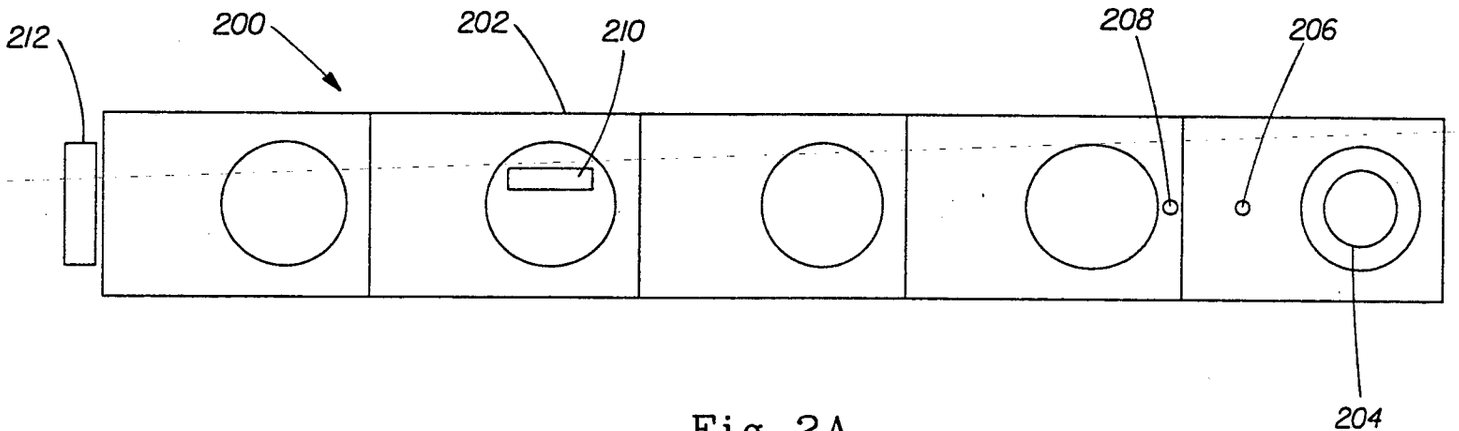

Fig. 2A

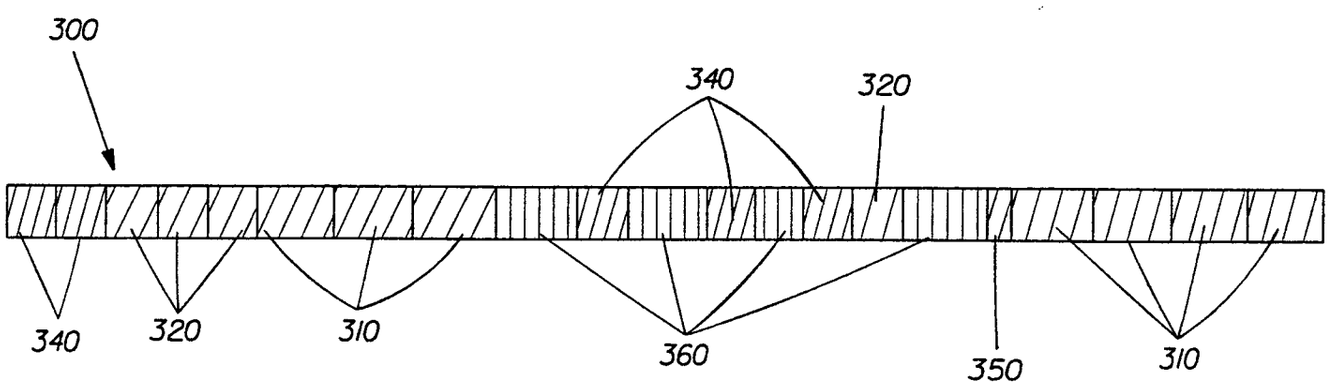

Fig. 2B

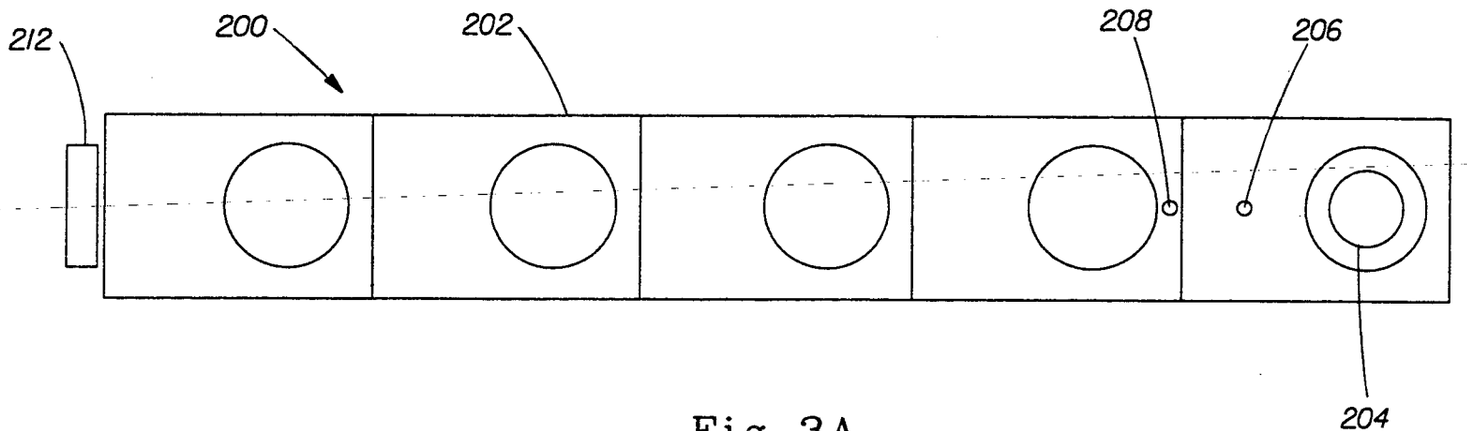

Fig. 3A

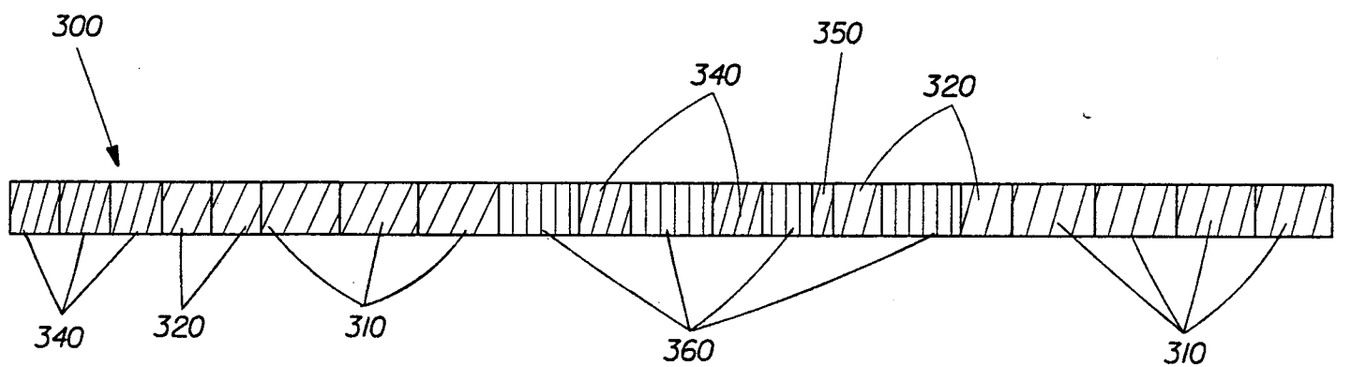

Fig. 3B

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293

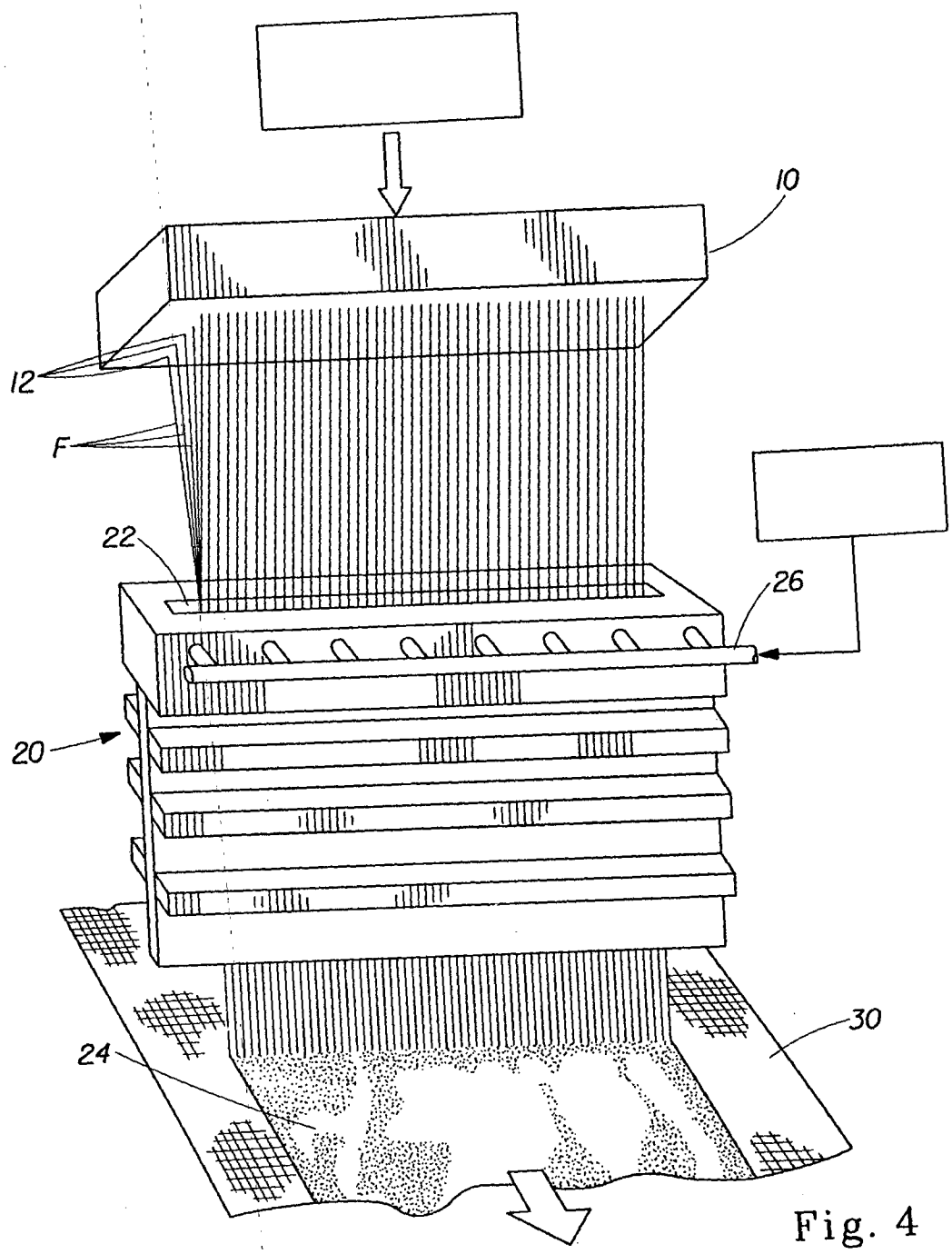

Fig. 4

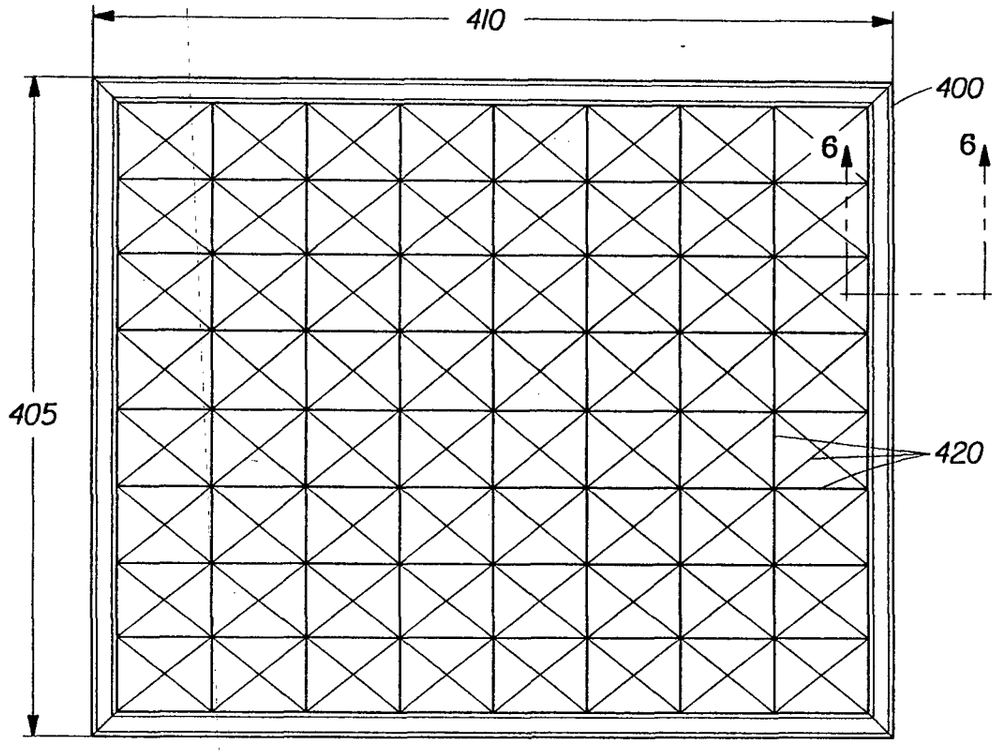

Fig. 5

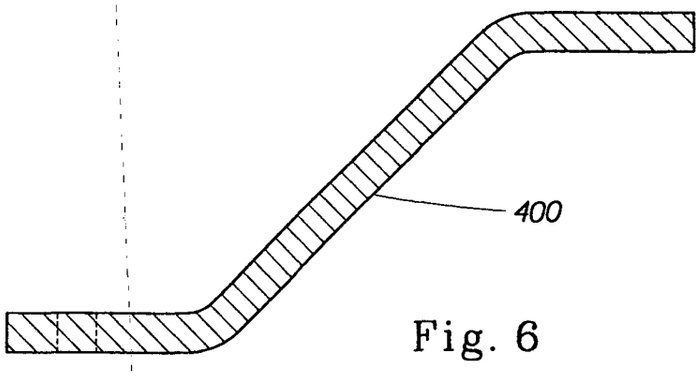

Fig. 6

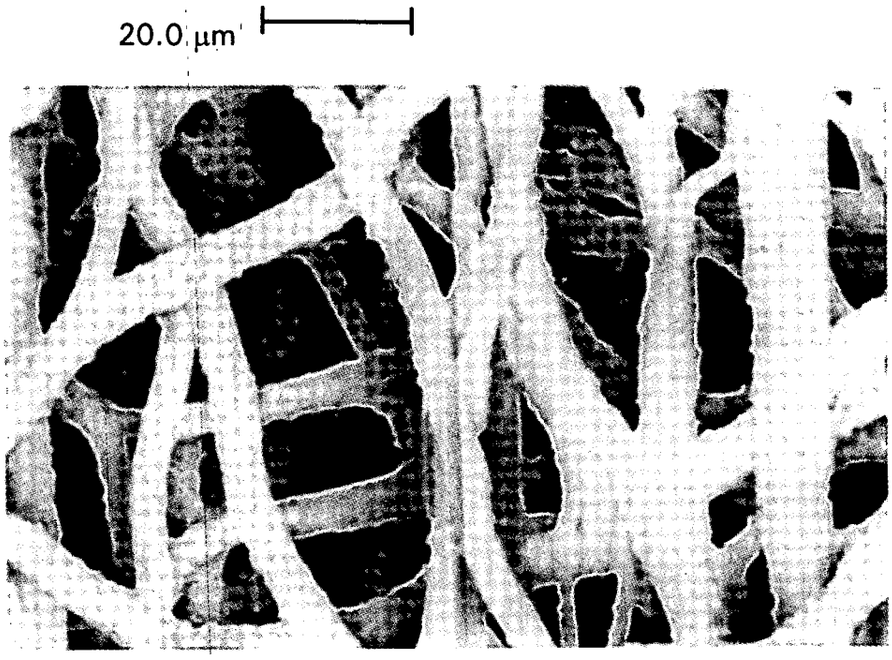

Fig. 7A

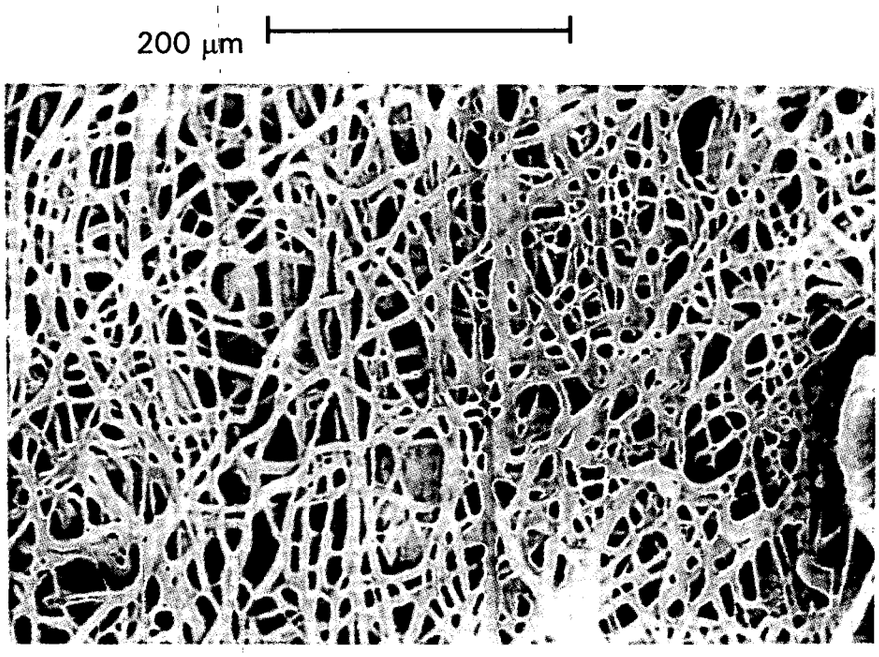

Fig. 7B

HOJA ANEXA

256
246

*** Según lo establecido en los artículos 4 ter del convenio de París, y 15 del C. C. los inventores renuncian expresamente al derecho de ser mencionados en la patente y, por lo tanto, solicitan que sus nombres no sean publicados en la Gaceta de Propiedad Industrial.**

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