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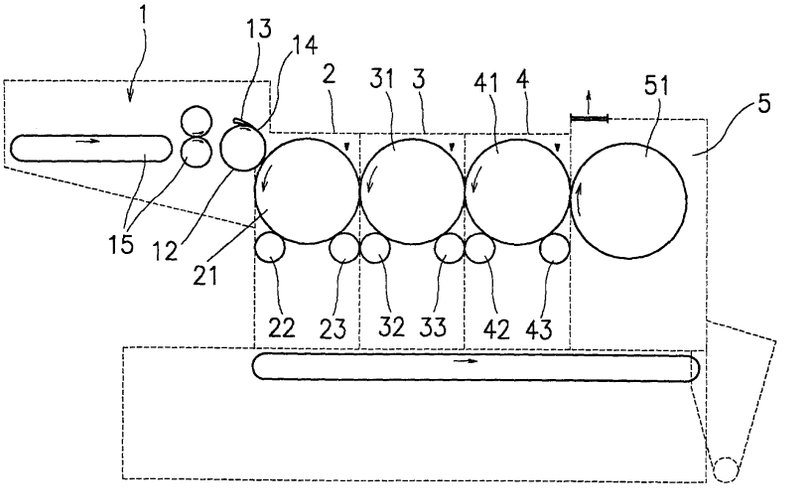
(54) Method of producing spinnable vegetable fibres and products therefrom

(57) Method of production of spinnable vegetable fibers from raw multicellular vegetable fibers, during which are the multicellular vegetable fibers by mechanical action shortened, split, refined, opened and cleaned, while their surface area and diameter gets smaller. In the first step is acted on the raw multicellular vegetable fiber by a system of spikes and/or teeth and/or needles or in another way hacked rugged surfaces of a pair of cylinders (12, 21) rotating in opposite directions, while on the surface of the first of the cylinders (12) are the multicellular vegetable fibers held-down in an adjustable distance from the second cylinder (21), by means of which is reached adjustable controlled shortening of fibers while their simultaneous opening and splitting, in the second step is on the multicellular fibers prepared in the first step acted by the rugged surfaces of at least one pair of the cylinders (21, 31) rotating in the same direction, by means of which is reached a high-performance cleaning, further splitting and refining of fibers, whereas are produced multicellular vegetable fibers capable of further processing by spinning technology.

Further the invention relates to the products from spinnable multicellular vegetable fibers, that is a linear fibrous formation reinforced by means of twisting or twining of parallel arranged fibers formation or bonding and a nonwoven fabric.



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Description

Technical field

[0001] The invention relates to a method of production of spinnable vegetable fibers from raw multicellular vegetable fibers, during which are the multicellular vegetable fibers by mechanical action shortened, split, refined, opened and cleaned, while their surface area and diameter gets smaller.

[0002] Further the invention relates to the products from spinnable multicellular vegetable fibers, that is a linear fibrous formation reinforced by means of twisting or twining of parallel arranged fibers formation or bonding and a non-woven fabric.

Background art

[0003] There are known multicellular vegetable fibers which are usually very hard, raw and little flexible and they are divided into leaf fibers and stalk fibers. Into leaf fibers fall for instance agave fibers, e.g. sisal, bromelia fibers, banana fibers and like, into stalk fibers fall linen, hemp, nettle, jute, ramie and like. They are mostly spinnable only for low-count yarn, or if you like for ropes, strings and floor mats. Today's possibilities of processing multicellular vegetable fibers downgrade this raw material in the case of leaf fibers only for non-textile technical uses and in the case of stalk fibers while using classical technologies is the production of spinnable fibers exigent from the manufacturing and also economical point of view and only in some cases from qualitative selected stalk fibers is succeeded to gain fibers applicable in textile industry for garment manufacture and like.

[0004] In particular for economic purposes it would be appropriate to process multicellular vegetable fibers in such manner, by which they would gain properties enabling their use in textile industry for widening the textile clothing fibers assortment because some of them carry very favourable properties, for instance water transportation and like.

[0005] The goal of the invention is to expand the use of multicellular vegetable fibers to textile industry by creation of a method of their processing providing their increased fineness, cleanliness and processability.

Principle of the invention

[0006] The goal of the invention has been reached by a method of production of spinnable vegetable fibers, whose principle consists in that in the first step is acted on the raw multicellular vegetable fiber by a system of spikes and/or teeth and/or needles or in another way hacked rugged surfaces of a pair of cylinders rotating in opposite directions, while on the surface of the first of the cylinders are the multicellular vegetable fibers held-down in an adjustable distance from the second cylinder, by means of which is reached adjustable controlled shortening of fibers while their simultaneous opening and splitting, in the second step is on the multicellular fibers prepared in the first step acted by the rugged surfaces of at least one pair of the cylinders rotating in the same direction, by means of which is reached a high-performance cleaning, further splitting and refining of fibers, whereas are produced multicellular vegetable fibers capable of further processing by spinning technology.

[0007] The produced spinnable multicellular vegetable fibers have a pleasant feel, high absorbency and they are possible further to process as some of known spinning technologies or, as the case may be, they can be used after further processing in non-woven fabrics production.

[0008] To improve the quality and cleanliness of spinnable vegetable multicellular fibers the vegetable multicellular fibers according to the method of Claims 2 and 3 can be further refined, split and cleaned by means of passing through next pair of cylinders with a rugged surface rotating in the same direction, while the ends of split off multicellular vegetable fibers are by mechanical action thinned, by means of which is reached further improvement of their quality and cleanliness and there are produced multicellular vegetable fibers non-irritant for human complexion, i.e. pleasant on human complexion in direct contact.

[0009] During cleaning, splitting and refining the multicellular vegetable fibers is in the operating area formed vacuum, by means of which are from the operating area sucked off impurities and dust from stalks or leaves.

[0010] Improvement of properties of final products can be reached by blending the spinnable multicellular vegetable fibers with unicellular spinnable natural fibers and/or chemical and/or synthetic spinnable textile fibers in a random ratio and by further cleaning, singling-out and paralleling the blend on a carding machine.

[0011] From spinnable multicellular vegetable fibers or their blend with other spinnable textile fibers can in next spinning operations produce a sliver, which after eventual further refinement and paralleling subsequently undergoes reinforcement by means of a twist or a twine of at least one continuous filament or by bonding forming linear fibrous material capable of further use in textile industry, e.g. knitting industry and also for production of apparel materials for contact with human body, for instance socks, blouses and like.

[0012] Another suitable method of processing spinnable multicellular vegetable fibers is that there is formed a web

from them or their blend with other textile fibers, which is by some of the known methods processed to form a non-woven fabric.

[0013] According to the invention it is possible to produce linear or planar fibrous formations from spinnable multicellular vegetable fibers or their blend with other textile fibers.

[0014] The principle of a blend linear fibrous formation reinforced by means of a twist of a twine of concurrently arranged formation of fibers of bonding consists in that it contains at least 1 % of spinnable non-irritating multicellular vegetable fibers and up to 99 % unicellular natural and/or chemical and/or synthetic spinnable textile fibers or their blends. Properties of such linear fibrous formation are then given by properties of its particular components and their ratio.

[0015] By means of some known textile technologies it is possible from spinnable non-irritant multicellular vegetable fibers to produce a yarn whose properties are then given by the method of the yarn production, length of used fibers, fineness of the fibers and degree of cleanliness of fibers.

[0016] The next possibility of use of spinnable non-irritant multicellular vegetable fibers is a non-woven textile fabric, whose principle consists in that it contains 1 - 99 % of spinnable multicellular vegetable fibers and 99 - 1 % unicellular natural and/or chemical and/or synthetic textile fibers or their blends.

[0017] Non-woven fabric can also be formed only from spinnable multicellular vegetable fibers.

Description of the drawing

[0018] In enclosed drawings is schematically shown a device for carrying out the method of production of spinnable multicellular vegetable fiber according to the invention.

Specific description

[0019] Raw (dry) leaf multicellular vegetable fibers are supplied in bunches just as they were gathered from individual leaves. These bunches consist from fibers with a smooth surface in the length of 0,5 - 1 m and remains of the tissue. Individual bunches of fibers are usually variously crisscross interlaced. Raw stalk multicellular vegetable fibers are supplied for instance as hurds, i.e. unformed number of raw fibers gathered from stalks.

[0020] The method according to the invention can be carried out on a device consisting at least two pairs of cylinders with rugged surface, where the cylinders of the first pair rotate against each other and the cylinders of the second part and, as the case may be, of next pairs rotate in the same direction. Raw multicellular vegetable fibers are fed for example by hands to entry to opening and combing machine, it is for instance possible to use device according to WO 98/35077, where they are from a feeding device **1**. table loaded between a feeding roller **12** fitted with spikes and a holding-down member **13,** composed of segments swiveling in the direction towards or off the feeding roller **12** surface and convertible along its circumference. The point of grip of fibers between the segments of the holding-down member **13** and the feeding roller **12** is further described as a grip line **14.** The opening and combing machine can be fitted with a feeding device **15** for mechanized feeding of raw multicellular vegetable fibers. Behind the feeding device **1** is placed the first opening and cleaning compartment **2,** which comprises an opener roller **21** with rugged surface. The rugged surface of the opener roller **21** and other opener rollers **31, 41** is composed of a system of lugs, spikes, teeth, needles and/or in another way ragged surface, further described as lugs. By adjusting the grip line **14** around the feeding roller **12** circumference is changed the distance of the grip line **14** from the opener roller **21** circumference and thus is adjusted the distance of fibers shortening.

[0021] The feeding roller **12** and the opener roller **21** of the opening and cleaning compartment **2** rotate in opposite direction, the circumferential speed vectors of the feeding roller **12** in the point, where the multicellular vegetable fibers leave the feeding roller **12** and the circumferential speeds of the opener roller **21** in the point, where the multicellular vegetable fibers come into contact with the opener roller **21** are of the same course and direction. The vectors differ only in magnitude, which is due to higher circumferential speed of the opener roller **21.** This is the cause that the multicellular vegetable fibers are from the grip line **14** by the action of rugged surface of the opener roller **21** combed-out in a relatively gentle way and in doing so shortened to predetermined length. Shortened multicellular vegetable fibers are carried away by lugs on the surface of the opener roller **21** along the cleaning devices **22** and **23,** where they get rid of impurities whereupon they are further carried to next opening and cleaning towards the following opener roller **31** in the following opening and cleaning compartment **3.**

[0022] The opener rollers **21** and **31** have the same direction of rotation. In the point of their apparent contact the circumferential speed vectors have the same course but opposite directions. Moreover the absolute magnitude of the circumferential speed vector of the opener roller **31** is due to its higher rotation higher than the absolute magnitude of the vector relating to the opener roller **21.** Hence the opener rollers **21, 31** act in the point of their apparent contact in a very disruptive manner on fibers, resulting in further opening, cleaning and breakdown of the multicellular vegetable fibers with subsequent refinement. During breakdown the ends of the multicellular vegetable fibers are by mechanical

action of the rugged surface of the cylinders favourably thinned, by means of which are produced multicellular vegetable fibers with favourable action on human complexion, which even in direct contact do not irritate the human complexion.

[0023] The entire process of changeover of the multicellular vegetable fibers from one opener roller **21** of one opening and cleaning compartment **2** onto opener roller **31** of the following opening and cleaning compartment **3** and subsequent carrying-away of the fibers that are being opened around cleaning devices **32** and **33** is being repeated so many times as there are the opening and cleaning compartments mounted in the device.

[0024] Regarding that each following opener roller, for instance **31,** contains on its rugged surface more lugs than the foregoing opener roller, for instance **21,** and in addition to this it rotates in a higher circumferential speed, none of the opening and cleaning compartments gets overloaded.

[0025] Shortened, opened, refined and cleaned fibers, which in its turn are further described as spinnable non-irritating multicellular vegetable fibers are from the rugged surface of the last opener roller **41** of the opening and cleaning compartment **4** withdrawn by means of a pick-up cylinder **51** of an outlet mechanism **5** and they are conveyed under pressure for further processing. Formation of vacuum in operating area of the machine, that is in the area around opener rollers of particular compartments of the machine provides drawing-out the impurities, dust and fiber remnants, which were detached from produced multicellular vegetable fibers.

[0026] During passing the machine are the raw multicellular vegetable fibers refined from original fineness e.g. 5.8 tex to that of ten or more times higher. In comparison to common technology of processing for instance linen is by means of the method according to the invention reached a lower content of shorter fibers, impurities and dust in the final material. Withal the device for carrying out the method according to the invention is cheaper and simpler.

[0027] In Table 1 is listed percentage content of cellulose, hemicellulose and lignin in multicellular vegetable fibers. In particular due to the content of hemicellulose and lignin which in its part increases rigidity and roughness and decreases flexibility of the multicellular vegetable fibers, these fibers were not so far considered to be a suitable raw material for production of spinnable fibers suitable for contact with human complexion.

Table 1

Type of Fiber	Contents (%)		
	Cellulose	Hemicellulose	Lignin
Linen	64,1	16,7	2,0
Hemp	67,0	16,0	3,3
Ramie	79,6	7,1	1,2
Jute	64,4	12,0	11,8
Bromelia	70,7	21,1	11,1
Sisal	65,7	12,0	10,0
Cotton	82,7	5,7	0

[0028] In Table 2 is listed comparison of lengths, fineness and tearing strength in various types of fibers.

Table 2

Fiber	Length (mm)	Fineness (tex)	Tearing strength (cN/tex)
Linen	200-1400	1,5-2,7	40-80
Hemp	1000-3000	2,2-4,4	47
Ramie	100-1800	0,6-0,8	59
Jute	1500-3700	2,2-4,4	36,4
Bromelia – cleaned the way as linen	1500	5,8	43,1
Bromelia – comber waste	612	4,8	40,2
Sisal	600-1500	3,3-4,4	36-43
Cotton	30-45	0,1-0,3	26-43

Example of embodiment 1

[0029] Blended linear fibrous formation - yarn of fineness 70 tex made of a blend of 80 % PAN fibers of fineness 3.3 dtex, length 120 mm and 20 % spinnable multicellular vegetable fibers **C,** reinforced by twine of PES filament yarn of 50 tex/18f spun-out by PARAFIL 2000 system at bobbins revolutions 25020 min^{-1}, number of coils 291.43 $coils.m^{-1}$ and winding (drawing-off) speed 83.1 $m.min^{-1}$. The produced yarn is by its nature and very favourable characteristics suitable in particular for outerwear products made by knitting.

Example of embodiment 2

[0030] Blended linear fibrous formation - yarn of fineness 70 tex made of a blend of 43.6% PES fibers of fineness 4.2 dtex, length 110 mm, combed wool 36.4 % of fineness 27 micrometers and 20 % spinnable multicellular vegetable fibers **C,** reinforced by twine of PES filament yarn of 50 tex/18 f spun-out by PARAFIL 2000 system at bobbins revolutions 25020 min^{-1}, number of coils 291,43 $coils.m^{-1}$ and winding (drawing-off) speed 83,1 $m.min^{-1}$. The produced yarn is by its nature and very favourable characteristics suitable in particular for outerwear products made by knitting, or as the case may be, for use in furnishing fabrics.

Example of embodiment 3

[0031] Blended linear fibrous formation - yarn of fineness 70 tex made of a blend of 43.6% PES fibers of fineness 4.2 dtex, length 110 mm, combed wool 36.4 % of fineness 27 micrometers and 20 % spinnable multicellular vegetable fibers **C**, reinforced by a monotonous twist 248 $twists.m^{-1}$ spun-out in a semi-worsted way on a on a ring spinning frame at bobbins revolutions 8000 min^{-1} and drawing-off speed 32.26 $m.min^{-1}$. The produced yarn is suitable in particular for production of hand-knitting yarn, knitted products and products with treated raised pile surface.

Example of embodiment 4

[0032] Blended linear fibrous formation - yarn of fineness 62 tex made of a blend of 65% VS fibers (viscose) of fineness 3.8 dtex, length 85 mm and 35 % spinnable multicellular vegetable fibers, reinforced by a monotonous twist 320 $twists.m^{-1}$ spun-out in a semi-worsted way on a ring spinning frame at bobbins revolutions 8500 min^{-1} and drawing-off speed 26.56 $m.min^{-1}$. The produced yarn is suitable for outerwear product for tropical climate regions.

Example of embodiment 5

[0033] Blended linear fibrous formation - yarn of fineness 58 tex made of a blend of 45% PES fibers of fineness 3.6

dtex, length 100 mm, 40 % VS fibers of fineness 3.3 dtex, length 80 mm and 15 % spinnable multicellular vegetable fibers linearly treated to 70 - 80 mm, reinforced by a monotonous twist 374 twists.m^{-1}, spun-out in a semi-worsted way on a ring spinning frame at bobbins revolutions 8000 min^{-1} and drawing-off speed 23.54 m.min^{-1}.

Example of embodiment 6

[0034] Blended linear fibrous formation - yarn of fineness 70 tex made of a blend of 50% PES fibers of fineness 3.6 dtex, length 75 mm, 30% wool of fineness 32 micrometers and 20 % spinnable multicellular vegetable fibers linearly treated to 65 - 80 mm, reinforced by a monotonous twist 329 twists.m^{-1}, spun-out in a semi-worsted way on a ring spinning frame at bobbins revolutions 6800 min^{-1} and drawing-off speed 20.67 m.min^{-1}.

Example of embodiment 7

[0035] Blended linear fibrous formation - yarn of fineness 100 tex made of a blend of 50% PES fibers of fineness 3.6 dtex, length 70 mm, 30% wool of fineness 28 micrometers and 20 % spinnable multicellular vegetable fibers linearly treated to 65 mm, reinforced by a monotonous twist 269 twists.m^{-1}, spun-out in a woolen carded way on a ring spinning frame at bobbins revolutions 7200 min^{-1} and drawing-off speed 26.7 m.min^{-1}.

Example of embodiment 8

[0036] Blended linear fibrous formation - yarn of fineness 56 tex made of a blend of 50% PES fibers of fineness 3.2 dtex, length 60 mm, 30% VS fibers of fineness 3.2 dtex, length 58 mm and 20% spinnable multicellular vegetable fibers linearly treated to 55 - 60 mm, reinforced by a monotonous twist 410 twists.m^{-1} spun-out in a so-called three-cylinder way on a ring spinning frame at bobbins revolutions 8800 min^{-1} and drawing-off speed 21.46 m.min^{-1}.

[0037] Blended linear fibrous formations containing synthetic fibers can also reinforce by bonding while using some of well-known technologies.

[0038] Considering the properties of spinnable multicellular vegetable fibers it is possible after in-depth opening, cleaning and paralleling of multicellular vegetable fibers by means of some of the known preparation technologies of fibers for spinning these fibers to spin in a blend with a minute amount of other fibers, for instance 1 % PES or VS or spinnable multicellular vegetable fibers or to spin them uncontaminated. However spinning is possible by means of some methods described in Examples 1 to 8 or in another known method, for instance rotor spinning, friction spinning or jet spinning. However for each of the spinning methods must be the spinnable multicellular vegetable fibers suitably prepared and they must be of a required length and fineness, while the desired parameters can be reached by changes in device settings upon which the spinnable multicellular vegetable fibers are produced from raw multicellular vegetable fibers and as the case may be by changes in devise settings, upon which are the spinnable multicellular vegetable fibers further processed. For instance by adjusting the distance of the grip line from circumference of the rugged surface of the opener roller **21,** amount of lugs on the surface of opener rollers **21, 31, 41** of particular compartments, number of compartments, spin velocity of the opener rollers **21, 31, 41** of particular compartments.

[0039] As well as blended linear fibrous formation - yarn described in Examples 1 to 8 it is possible to produce from spinnable multicellular vegetable fibers a three-dimensional or planar fibrous formation - non-woven fabric, which in its part can contain from 1 % to 100 % of spinnable multicellular vegetable fibers, depending on properties of the non-woven fabric.

[0040] Regarding the properties of spinnable multicellular vegetable fibers there can be produced non-woven fabrics not only for technical applications but also for clothing industry, decorative and utility textiles.

Example of embodiment 9

[0041] Non-woven fabric containing a blend of fibers of 80 % PAN fibers of fineness 3.3 dtex and length 120 mm and 20 % spinnable multicellular vegetable fibers. Such non-woven fabric has suitable properties for outerwear products.

Example of embodiment 10

[0042] Non-woven fabric containing a blend of fibers of 43.6 % PES of fineness 4.2 dtex and length 110 mm, 36.4 % combed wool of fineness 27 micrometers and 20 % spinnable multicellular vegetable fibers is in particular suitable for outerwear products or furniture and decorative uses.

Claims

1. Method of production of spinnable vegetable fibers from raw multicellular vegetable fibers, during which are the multicellular vegetable fibers by mechanical action shortened, split, refined, opened and cleaned, while their surface area and diameter gets smaller, **characterized by** that in the first step is acted on the raw multicellular vegetable fibers by a system of spikes and/or teeth and/or needles or in another way hacked rugged surfaces of a pair of cylinders (12, 21) rotating in opposite directions, while on the surface of the first of the cylinders (12) are the multicellular vegetable fibers held-down in an adjustable distance from the second cylinder (21), by means of which is reached adjustable controlled shortening of fibers while their simultaneous opening and splitting, in the second step is on the multicellular fibers prepared in the first step acted by the rugged surfaces of at least one pair of the cylinders (21, 31) rotating in the same direction, by means of which is reached a high-performance cleaning, further splitting and refining of fibers, whereas are produced multicellular vegetable fibers capable of further processing by spinning technology.

2. Method of production as claimed in Claim 1, **characterized by** that from the multicellular vegetable fibers are being separated cells by mechanical action, the fibers are being split, by means of which is reached their refinement.

3. Method of production as claimed in Claim 1 or 2, **characterized by** that by mechanical refinement are the ends of split off fibers thinned.

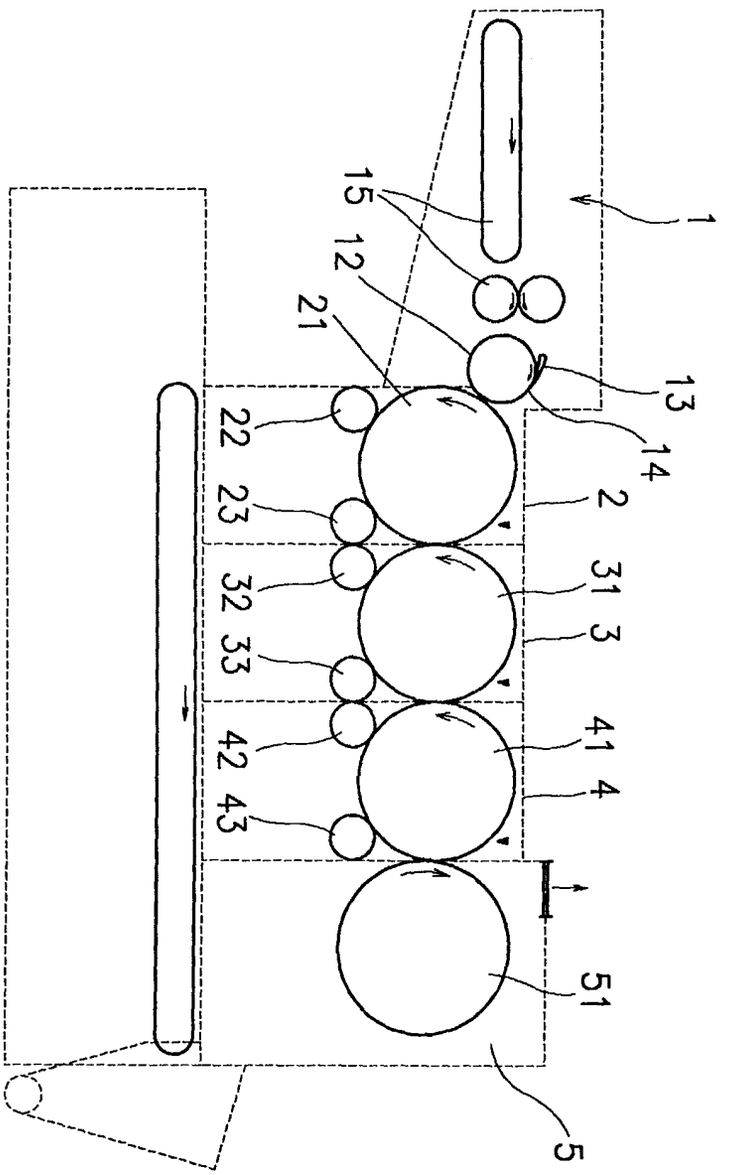
4. Method as claimed in any of Claims 1 to 3, **characterized by** that in the operating area is created vacuum, by means of which is the operating area cleaned from impurities and dust.

5. Linear fibrous formation reinforced by means of twisting or twining of parallel arranged fibers formation, **characterized by** that it is formed by spinnable vegetable multicellular fibers.

6. Blended linear fibrous formation reinforced by means of twisting or twining of parallel arranged fibers formation or bonding, **characterized by** that it consists of spinnable vegetable, in particular multicellular textile fibers in a blend with other natural and/or chemical and/or synthetic spinnable textile fibers in arbitrary blending ratio.

7. Non-woven fabric, **characterized by** that it is composed of spinnable vegetable multicellular textile fibers.

8. Blended non-woven fabric, **characterized by** that it consists of spinnable multicellular vegetable textile fibers in a blend with unicellular natural and/or chemical and/or synthetic spinnable textile fibers in random blending ratio.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