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PAPER FROM LONG SYNTHETIC FIBERS AND PARTIALLY WATER SOLUBLE SODIUM CARBOXYMETHYLCELLULOSE AND METHOD

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The present invention relates to a novel web material and method of making same. More particularly, the invention relates to a web product and method of making same wherein the product is a highly porous, absorbent, soft, low-density web of unique appearance and good tensile strength composed of uniformly intermingled unwoven synthetic fibers bonded together at intersections of the fibers by small discrete deposits of insoluble sodium carboxymethylcellulose, the latter being chemically unaltered and being present in relatively small amount and distributed in minute spots substantially uniformly throughout the web.

The web material of the present invention has particular usefulness in situations where high porosity and good absorbency are essential. On the other hand, the unique and pleasing appearance of the material and its softness render it desirable for many uses regardless of porosity and absorbency requirements. In many cases, the combination of all of these characteristics has been long sought for in the art. In many of the uses of the new material of the present invention which have been carried out successfully results are obtained which greatly surpass in degree and kind the results which have been obtainable with the best materials available heretofore for such purposes. In this connection, it is a feature of the invention that the web product produced may be varied in many particulars such as weight and strength to fit the particular needs of a contemplated use, and the cost of the web material is sufficiently low so that it may be used economically in products of relatively inexpensive types. Among the many uses of the web product of the invention wherein the novel characteristics of the web enhance the utility and desirability of the product may be mentioned infusors, such as teabags; decorative material, such as draperies and curtains; surgical materials, such as catamenial bandages; filtering materials, such as milk filters; packaging material including materials for packing and cleaning lenses; stencil sheets and the like.

A principal aim of the invention is to produce a web by a wet deposit method on paper-making machinery utilizing fibers to form the web which are made up entirely of synthetic fibers and are at least six millimeters in length and preferably longer up to and including fibers of textile length; wherein despite the great length of the fibers and their tendency to flocculate or ball up when suspended in water, a uniform controlled distribution and dispersion of the fibers is obtained; and wherein despite the lack of bonding action of the

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fibers themselves, a coherent web of good strength is produced even in very thin or light weight webs without materially altering the physical characteristics of the web such as its porosity, softness and unique appearance.

As mentioned above, the fibers which are selected for use in accordance with the present invention are composed entirely of synthetic fibers by which is meant fibers formed commercially by spinning or extruding fiber forming materials into continuous fine filaments or threads. Among them may be mentioned particularly the fibers formed from cellulose esters such as viscose rayon and acetate rayon; cellulose ethers such as ethyl and benzyl cellulose; vinyl compounds including vinyl chloride, vinyl acetate, and the copolymers of the same; polymers of styrene; polyamides, i. e. nylon; and proteinaceous materials such as casein and soybean proten. In dealing with fibers of the length of six millimeters or more in paper-making machinery, it is essential that the fibers be uniform in length and thickness and such control can be attained only by the use of fibers which are formed synthetically as mentioned above. Synthetic fibers are conventionally formed, by spinning or extruding, into continuous uniform filaments of any desired denier and may be cut accurately thereafter to any desired length. Furthermore, such synthetic fibers are characterized by a natural sheen or silk-like appearance which is carried over substantially undiminished into the finished web of the invention thereby giving the web a distinctive and pleasing appearance not attainable heretofore in the products formed on paper-making machinery. Furthermore, within the field of synthetic fibers there may be selected fibers of varying absorbency, wet strength, chemical stability, thermoplasticity, etc., to meet the particular requirements desired in the final product. In addition, the synthetic fibers do not hydrate or degenerate to any appreciable extent when handled in aqueous solutions whereby the original fiber structure and characteristics are retained. Moreover, the domestic fabricators of synthetic fibers are able to provide substantially unlimited quantities of uniform fibers from materials of domestic origin and at low cost.

In order to form webs of long length fibers as utilized in the present invention on paper-making machinery, it is necessary to disperse and suspend the fibers in copious quantities of water without entangling and flocculating the fibers. Prior to the present invention, such dispersions of fibers of the length herein defined have been regarded as impracticable due to the tend-

ency of the fibers, which is greatly pronounced in the case of long fibers, to flocculate and ball up when suspended in water. A dispersion of fibers of the order of about 1 part of fibers to 5,000 parts of water is believed to be essential in order to carry out the invention and preferably is of the order of about 1 part of fibers to 10,000 parts of water (approximately 1 lb. of fiber to 5 tons of water).

It is therefore essential in order to practice the invention to provide a material in the suspension which will cause a free dispersion of the fibers therein. It also is essential to provide a material which will be effective when the web is formed to lock the fibers in the position in which they are deposited to give the web suitable strength and coherency without at the same time detracting from the desired physical properties of the web such as porosity, absorbency, and appearance. Synthetic fibers, of course, have little bonding properties by themselves and will not form a self-sustaining web, let alone a web of sufficient strength to have utility.

I have found that the above requirements can be met by a single agent which may be added to the suspension of fibers in water and which will carry out to a remarkably successful degree both the function of producing a non-flocculating uniform distribution and dispersion of the fibers for web-forming purposes and the function of fixing the fibers as deposited in the web to produce a coherent structure of adequate strength, all without adversely affecting the desired properties of the web and resulting in the production of a unique and novel web-like material having unusual advantages and utility as above mentioned. This agent is a particular type or form of sodium carboxymethylcellulose, sometimes referred to as sodium cellulose glycolate, which is derived by the reaction of alkali cellulose and monochloracetic acid. Variations in the properties of sodium carboxymethylcellulose may occur, for example, by reason of variations in the degree of substitution of carboxymethyl groups per anhydroglucose unit of the cellulose molecule, as well as by variations in the uniformity of substitution and the exact place or places of substitution in the cellulose molecule, all of which factors are exceedingly difficult to control. The type of sodium carboxymethylcellulose product which is essential for use in accordance with the present invention is one in which some portions are completely soluble and the other portions are not soluble but have the characteristic of forming minute or microscopic-size discrete gel particles when dispersed in water.

I have found that at the present time the selection of a suitable sodium carboxymethylcellulose product for use in accordance with the present invention cannot be predicated on any known variations in the manufacturing procedure, or by reliance upon any of the usual tests now employed in grading or differentiating sodium carboxymethylcellulose products. For example, it is conventional in the commercial production of sodium carboxymethylcellulose to grade the product on the basis of the degree of substitution of carboxymethyl groups per glucose unit this being, in general, a measure of the solubility of the product. However, I have found that some lots of a particular grade will not be satisfactory for the purpose of the present invention while other lots of the same grade produced by the same manufacturer will be entirely satisfactory, this despite the fact that the lots are believed to be made up by employment of identical techniques and under identical conditions. In general, however, I have found the most likely sources of lots of sodium carboxymethylcellulose which can be used in accordance with the invention to be the commercially available grades having a substitution value in the range of 0.3 to 0.75.

A test which I have devised for selection of a sodium carboxymethylcellulose product which is suitable for use in accordance with the present invention is to disperse a sample of the product in water and then pass the dispersion through a fine screen having openings of the order of 105,625 openings per square inch. If the sodium carboxymethylcellulose product being tested is suitable for use in accordance with the invention, there will be deposited on the screen a multitude of very small microscopic gel particles which when dried to constant weight and weighed will be found to be equal to about 2 to 25% of the weight of the original sample. Apparently the portion of the sodium carboxymethylcellulose which is deposited on the screen is a water insoluble form thereof while the portion which passes through the screen with the water is a water soluble form.

When a sodium carboxymethylcellulose product selected as described above is employed with the selected fibers of long length which are utilized in accordance with the present invention, there results a non-flocculating uniform dispersion of the fibers permitting the wet laying of a controlled and uniform web of unique appearance and in addition the fibers when formed into a web are bonded together by very minute discrete particles of the sodium carboxymethylcellulose which gives the web coherency and produces a useful product having the unexpected advantages herein described. The sodium carboxymethylcellulose utilized is not chemically altered in any way during the operation of the method of my invention and the portion present in the final product is exactly the same chemically as at the outset of the process.

It is believed as a result of the discovery of the present invention that the completely soluble portions of a sodium carboxymethylcellulose product are probably responsible for the dispersing properties thereof, and that the insoluble gel-forming portions are responsible for the bonding properties thereof. It is contemplated that in the future additional knowledge may be gained as to the production of sodium carboxymethylcellulose which will permit the complete predetermination of the properties thereof to permit the preselection of a particular grade for use in accordance with this invention, or conceivably there may result the production of grades consisting entirely of soluble material and insoluble gel-forming material which may be subsequently admixed in desired proportions for use in this process. Until such time, however, the invention may be practiced successfully and satisfactorily in accordance with the teaching herein.

In order to carry out the web forming operations of the process of the present invention, a first step is to form a relatively thick slurry of the selected synthetic fiber in water with the selected sodium carboxymethylcellulose product. The manner in which this is done is not critical. For example, I have found it convenient to introduce the sodium carboxymethylcellulose in dry powder form directly to a slurry of fiber in water.

in a mixing device such as a conventional beater. When utilizing a beater as a mixing device for this purpose, it is advisable to adjust the beater roll well above the bed plate of the machine so that no beating of the fiber takes place and with the result that the beater roll acts merely as an agitating and mixing device. On the other hand, it may be preferred to premix the powdered sodium carboxymethylcellulose in water prior to adding it to the fiber slurry. Premixing can readily be accomplished in any convenient mixing device such as a tank provided with means for slow agitation As mentioned above, the synthetic filaments or threads selected are cut to provide fibers of not less than 6 millimeters in fiber length and up to and including textile fiber lengths. In general, I prefer to utilize a synthetic fiber having a denier in the range of 1½ to 5.

By way of example, a preferred concentration of the slurry at the above stage of the process may be about 1½ parts of fiber to about 50 parts of water, although, of course, this may be varied over a wide range as may be found to be convenient. Prior to forming a web, of course, the slurry is greatly diluted to the extent referred to hereinbefore.

The amount of sodium carboxymethylcellulose which is added to the slurry is dependent in part upon the proportion of insoluble gel-forming portions and soluble portions of the selected product as well as upon the desired properties of the web, it is intended to produce. In general, this amount may vary from as little as one part of the selected sodium carboxymethylcellulose to twenty-five parts of fiber to as high as one part thereof to five parts of fiber.

Inasmuch as the completely soluble portion of the selected sodium carboxymethylcellulose apparently is responsible for its dispersing qualities while the insoluble gel-forming portion apparently is responsible for its bonding properties, it will be apparent that a selected product which is high in content of the former will provide good dispersions but weak bonding when present in small amount, while a selected product which is high in content of the latter will tend to give good bonding but will be less effective as a dispersing agent when present in small amount. In general, it is necessary to have a minimum of 3¾ parts of the completely soluble portion of the sodium carboxymethylcellulose product to 100 parts of fiber in order to obtain adequate dispersion of the fibers and a minimum of 1¼ parts of the insoluble gel-forming portion to 100 parts of fiber in order to produce a self-sustaining web. In most instances, it will be preferred to operate well above these lower limits although it generally is not desirable to exceed a concentration of the order of about one part of the insoluble gel-forming portion to ten parts of fiber for at this concentration and above, the formed web becomes too stiff for most purposes. By way of specific example which is given to assist in the understanding of the invention and not by way of limitation, I have found that 100 parts of fiber to about five parts of a sodium carboxymethylcellulose having a 25% gel-forming content will give good web formation and will produce a very soft and flexible web of moderate tensile strength; when the sodium carboxymethylcellulose content is increased to about 12 parts, good web formation continues and there is a very noticeable increase in web strength with some loss of softness and flexibility; and upon increase of the sodium carboxymethylcellulose to 20 parts a very strong and stiffer web is produced with good web formation.

After a slurry has been formed of the desired proportion of fiber and sodium carboxymethylcellulose, the formation of a web may then be carried out. To form the web, the slurry of fibre containing the sodium carboxymethylcellulose is introduced into the headbox of a paper forming machine in proportion to the amount of water separately introduced therein to form the highly diluted fibre dispersion hereinbefore mentioned. It is preferred to carry out this portion of the method of the present invention by utilizing an apparatus of the type described in my prior Patent No. 2,045,095, issued June 23, 1936, to which reference may be made for details of construction and operation. An important feature of apparatus of this type is the use of a headbox for receiving the dilute fibre dispersion which cooperates with a Fourdrinier wire mounted for travel in an inclined plane adjacent the front of the box. By such novel arrangement of the headbox and Fourdrinier wire, it is possible to form a uniform deposit of intermingled fibres on the wire to produce the desired web formation of the present invention from the highly dilute fibre dispersion herein described.

As described in my prior Patent No. 2,045,095, the major portion of the water is separated from the fibres during the deposit of the fibres on the inclined portion of the Fourdrinier wire and flows freely into a collecting tray or "save-all" from which it may be recovered for reuse. Partial additional drying of the web while on the Fourdrinier wire may be accomplished by the use of suitable suction boxes over which the wire travels. Finally the web is diverted from the Fourdrinier wire through a conventional battery of drying rolls some or all of which may be steamheated to facilitate drying and then wound up on a reel.

I have found that it is particularly important in the practice of my invention to utilize pumps, feeding apparatus, etc. for handling the fibre dispersion which are free of sharp edges and rough surfaces. Because of the exceedingly great length of the fibres utilized in accordance with the invention as distinct from fibres of ordinary paper making lengths, they have a tendency to snag on any sharp projections with which they come in contact. Very frequently small deposits of fibres will build up on such projections until of sufficient weight to break loose and then will deposit on the web without becoming redispersed, thus forming undesirable clots or lumps in the finished web.

It is a particular advantage of my invention that the weight or thickness of the webs produced may be varied over a wide range without affecting their uniform and integral structure and by simple control of the process. I have found that by increasing the dilution of the fibres in the headbox and/or decreasing the area of contact between the headbox and the Fourdrinier wire, webs of decreasing thickness can be made. By my method, webs of a very thin gossamer type having somewhat the appearance of a cobweb and running as light as 50 grains per square yard can be produced. On the other hand, by increasing the fibre concentration in the headbox and/or increasing the area of contact between the headbox and Fourdrinier wire, the weight of the webs may be increased to as high as ½ pound per square yard.

For most uses, it will be desired to form a web composed of fibres which are deposited without any distinctive orientation. An advantage of such webs is a substantially uniform tensile strength either lengthwise or transversely of the web. It is an advantage of my invention that by careful control of the flow of dilute fibre dispersion in the headbox relative to the speed of travel of the Fourdrinier wire, such an unoriented uniform deposit can be accomplished. In general, the fibres will deposit on the wire in general relationship to the flow of the fibre dispersion in the headbox at the area of contact with the Fourdrinier wire. When the rate of flow of the fibre dispersion is properly coordinated with the rate of travel of the Fourdrinier wire, the fibres may be deposited in the form of small swirls giving the web a uniform texture and a very distinctive and appealing appearance. In some instances, it may be preferred to form a web having a pronounced fibre orientation either across or lengthwise of the web. This may be readily accomplished in accordance with the invention by affecting the direction of flow of the dispersion in the headbox. For example, when the Fourdrinier wire is run at a lower rate of speed, the fibres will tend to deposit transversely of the machine and, when it is run at higher speeds, the fibres tend to deposit extending generally in the machine direction.

By the employment of paper making machinery, it is possible, of course, to form webs of continuous length and any suitable width depending upon the capacity of the machines available. Web widths up to 200 inches, for example, are readily possible on present day paper machinery. As a result, the unique and novel web material of the present invention may be produced in large quantities and at a relatively low cost.

In general, it will be preferred to form the webs of the present invention entirely from a specific selected fibre such as viscose rayon fibre, for example, but in some cases as where the web is to be utilized for making heat sealable teabags, it may be preferred to utilize more than one kind of fibre and to deposit different concentrations of the respective fibres in opposite faces of the web. Such a modification of my present invention is readily possible by following the procedure disclosed in my prior Patent No. 2,414,833, issued January 28, 1947. In this modification, the web is formed as before except that a second fibre dispersion containing a different selected fibre such as Vinyon fibre is floated on top of the first fibre dispersion in the headbox thus causing a deposit of the second fibre predominantly in the upper face of the web.

The web-like material produced in accordance with the present invention has a unique and distinctive appearance and structure which clearly distinguishes it from any products heretofore made. The fibres are thoroughly and uniformly dispersed and because of their great length are plainly visible in the finished sheet. The web is of very low density, being of the order of 0.2 to 0.4 gram per cubic centimeter. The interstices between the intermingled fibres are also plainly visible and in thin sheets are so pronounced that it is possible to look through the sheet without difficulty. The openness of the structure is particularly brought out by standard porosity tests. For example, when a sheet of the new web-like material weighing $\frac{3}{16}$ of an ounce per sq. yd. is subjected to a vacuum equivalent to a ½ inch of water, air will flow through the sheet at a rate of 772 cubic feet per square foot per minute. This is nearly eight times the porosity of the most porous sheets of equal weight which have been produced heretofore on paper making machinery.

The fibres themselves appear to be entirely unchanged by the web forming method of my invention and retain all of their original characteristics of appearance such as sheen, translucency and uniformity and their original physical properties such as softness and absorptiveness. When the sheet is held so as to reflect light, it has a very silky or silvery appearance but, on the other hand, when held in close contact with another surface, it is as translucent as glassine.

The fibres in the web-like material have no means of support visible to the naked eye and by reason of the openness and low density of the structure, it comes as a distinct surprise to the casual observer that the material has any tensile strength.

By the use of selective dyes and microscopic examination, I have determined that the fibres of the web are held together by very small deposits or particles of sodium carboxymethylcellulose gum which appears to have an affinity for depositing mainly at the intersections of the fibres and in general will not span across the interstices between the fibres. These spots or deposits of sodium carboxymethylcellulose are very small, being of the order of only $\frac{1}{25}$ to ¼ square millimeters in area. In effect, they appear to form a kind of spot weld between the fibres which effectively locks them in deposited position. Inasmuch as the sodium carboxymethylcellulose has been unchanged chemically during the method of my present invention, it is evident that these deposits are the small gel-like particles which I have identified in ordinary sodium carboxymethylcellulose products.

In the production of the web-like material of the present invention, it is an advantage that the number of deposits and amount of the sodium carboxymethylcellulose gum in the web may be varied over a wide range depending upon the amount and character of the sodium carboxymethylcellulose mixed with the fibres, and it also is an advantage that adequate tensile strength for most purposes can be obtained with very small amounts of the gum. For example, I have formed a web in accordance with the invention having a weight of 130 grains per square yard in which the average number of spots of sodium carboxymethylcellulose was only about 7 per square millimeter and yet the web had a tensile strength of 1000 grams per inch. In general, I prefer to keep the percentage of sodium carboxymethylcellulose in the finished web within the range of 1 to 5% by weight as this gives adequate strength without adversely affecting the desired softness and porosity of the web.

The small amount and character of the deposits of sodium carboxymethylcellulose in the web taken together with the great length of the fibres apparently explains the surprising porosity, softness and translucency of the final product. Furthermore, the sodium carboxymethylcellulose itself is practically transparent and, being in such small and widely separated deposits, is virtually invisible in the finished web, thus accounting for the unique appearance of the web.

The unique structure of the web-like material of the present invention can be further demonstrated by tearing a sheet of the material in any direction. Separation takes place by an unlacing of the fibres producing a deckle-edge of distinc-

tive appearance with the long loose ends of the separated fibres clearly visible.

The material as described above is eminently suitable for all desired uses under dry conditions, but possesses low wet strength. This deficiency can be readily overcome, however, by utilizing wet-strengthening treatments of the paper art. For example, I have found it desirable to wet-strengthen the web-like material produced as described above by running it through a viscose solution bath. This forms a very thin unnoticeable transparent coating over the fibres and particularly the sodium carboxymethylcellulose gum deposits which effectively prevents the weakening action of water, all without any deleterious effects upon the desired properties of the material such as softness, absorbency, and porosity.

It thus will be seen that there has been described a novel web-like material and method of making same, having great utility and usefulness in the art. It will also be apparent that the invention will be subject to considerable variation by one skilled in the art in the light of the disclosure herein, and all such variations are intended to be included within the scope of the invention.

I claim as my invention:

1. A thin, soft, absorbent, extremely porous and light weight web material of substantial strength consisting essentially of synthetic artificially-formed fibers having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths and uniformly distributed and intermingled in the form of a web with the fibers intersecting but spaced apart to form numerous interstices, said fibers being in their original, non-binding, fibrous, unbeaten, ungelatinized and uncoalesced form but being firmly bonded together at their intersections by small, discrete, water-laid deposits of water-insoluble chemically-unaltered sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and present uniformly throughout the web in an amount of from 1 to 5% of the weight of the finished web.

2. A thin, soft, absorbent, extremely porous and low density web material consisting essentially of synthetic artificially-formed fibers in original, non-binding, fibrous, unbeaten, ungelatinized and uncoalesced form and having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths, loosely deposited in uniformly distributed intersecting relationship with relatively large interstices therebetween but firmly bonded together by a small amount of from 1 to 5% based on the weight of the web of water-insoluble chemically-unaltered sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and occurring principally as small discrete, water-laid deposits of from $\frac{1}{25}$ to $\frac{1}{4}$ square millimeters in area at the intersections of the fibers and uniformly distributed throughout the web.

3. A thin, soft, absorbent, extremely porous web material of substantial strength having a maximum density of 0.4 gram per cubic centimeter and a maximum weight of $\frac{1}{2}$ lb. per sq. yd. consisting essentially of synthetic artificially-formed fibers having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths and uniformly distributed and intermingled in the form of a web with the fibers intersecting but spaced apart to form numerous interstices, said fibers being in their original non-bonding, fibrous, unbeaten, ungelatinized and uncoalesced form but being firmly bonded together at their intersections by small, discrete, water-laid deposits of water-insoluble chemically-unaltered sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and present uniformly throughout the web in an amount of from 1 to 5% of the weight of the finished web.

4. A thin, soft, absorbent, extremely porous and low density web material consisting essentially of synthetic artificially-formed fibers in original fibrous, unbeaten, ungelatinized and uncoalesced form and having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths loosely deposited in uniformly distributed intersecting relationship with relatively large interstices therebetween but firmly bonded together at their intersections by small discrete, water-laid deposits of water-insoluble chemically-unaltered sodium carboxymethylcellulose, having a substitution value of from 0.3 to 0.75, said deposits ranging in area from $\frac{1}{25}$ to $\frac{1}{4}$ square millimeters and the number thereof being of the order of 7 per square millimeter of web.

5. A thin, soft, absorbent, extremely porous and light weight web material of substantial strength consisting essentially of synthetic artificially-formed fibers having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths and uniformly distributed and intermingled in the form of a web with the fibers intersecting but spaced apart to form numerous interstices, said fibers being in their original non-binding, fibrous, unbeaten, ungelatinized and uncoalesced form but being firmly bonded together at their intersections by small discrete, water-laid deposits of water-insoluble chemically-unaltered sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and present uniformly throughout the web in an amount of from 1 to 5% of the weight of the finished web.

6. A thin, soft, absorbent, extremely porous and light weight web material of substantial strength consisting essentially of synthetic artificially-formed viscose rayon fibers having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths and uniformly distributed and intermingled in the form of a web with the fibers intersecting but spaced apart to form numerous interstices, said fibers being in their original non-binding, fibrous, unbeaten, ungelatinized and uncoalesced form but being firmly bonded together at their intersections by small discrete, water-laid deposits of water-insoluble chemically-unaltered sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and present uniformly throughout the web in an amount of from 1 to 5% of the weight of the finished web.

7. A thin, soft, absorbent, extremely porous and light weight web material of substantial strength consisting essentially of synthetic artificially formed viscose rayon fibers having a fiber length within the range of from 6 millimeters up to and including textile fiber length deposited in intermingled web form in admixture with synthetic artificially formed fibers of a copolymer of vinyl acetate and vinyl chloride, the latter being more concentrated in one surface of the web than the other, said fibers being in their original, non-binding, fibrous, unbeaten, ungelatinized and uncoalesced form and being deposited in intersecting but spaced relationship to provide

numerous interstices, said web being held together by minute, water-laid particles of water-insoluble chemically-unaltered sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and occurring as discontinuous deposits at the interstices of the fibers uniformly throughout the web and in an amount of from 1 to 5% of the weight of the finished web.

8. A method of preparing a thin, soft, highly absorbent and porous web material of low density which comprises forming a highly diluted aqueous slurry of unbeaten, synthetic, artificially-formed fibers having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths with the addition of a small quantity of water-dispersible sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and containing from 2 to 25% by weight of water-insoluble gel-forming particles, said sodium carboxymethylcellulose being added in an amount of one part by weight to from 5 to 25 parts of fiber by weight and having a dual function in that the water-soluble content disperses and deflocculates the fiber in the suspension and the water-insoluble particles bind the fibers at their intersections in the finished sheet, forming a web by flowing the dispersion onto a traveling meshed sheet-forming screen to cause the fibers and gel particles of sodium carboxymethylcellulose adhering to the intersections of the fiber to deposit uniformly thereon while permitting the remainder of the slurry to flow rapidly and freely through the screen, and drying the web to cause the water-insoluble sodium carboxymethylcellulose contained therein to bind the fibers in deposited web form, and maintaining said sodium carboxymethylcellulose in chemically-unaltered form throughout.

9. A method of preparing a thin, soft, highly absorbent and porous web material of low density which comprises forming a highly diluted aqueous slurry containing from 5000 to 10000 parts of water to 1 part by weight of unbeaten, synthetic, artificially-formed fibers having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths with the addition of a small quantity of water dispersible sodium carboxymethylcellulose containing from 2 to 25% by weight of water-insoluble gel-forming particles, said sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and being added in an amount of one part by weight to from 5 to 25 parts of fiber by weight and having a dual function in that the water-soluble content disperses and deflocculates the fiber in the suspension and the water-insoluble particles bind the fibers at their intersections in the finished sheet, forming a web by flowing the dispersion onto a traveling meshed sheet-forming screen to cause the fibers and gel particles of sodium carboxymethylcellulose adhering to the intersections of the fiber to deposit uniformly thereon while permitting the remainder of the slurry to flow rapidly and freely through the screen, and drying the web to cause the water-insoluble sodium carboxymethylcellulose contained therein to bind the fibers in deposited web form, and maintaining said sodium carboxymethylcellulose in chemically-unaltered form throughout.

10. A method of preparing a thin, soft, highly absorbent and porous web material of low density which comprises forming a highly diluted aqueous slurry containing from 5000 to 10000 parts of water to 1 part by weight of unbeated, synthetic, artificially-formed fibers having a fiber length in the range of 6 millimeters up to and including textile fiber lengths with the addition of a small quantity of water dispersible sodium carboxymethylcellulose containing from 2 to 25% by weight of water-insoluble gel-forming particles, said sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and being added in an amount of one part by weight to from 5 to 25 parts of fiber by weight and having a dual function in that the water-soluble content disperses and deflocculates the fiber in the suspension and the water-insoluble particles bind the fibers at their intersections in the finished sheet, forming a web by flowing the dispersion onto a traveling meshed sheet-forming screen to cause the fibers and gel particles of sodium carboxymethylcellulose adhering to the intersections of the fiber to deposit uniformly thereon while permitting the remainder of the slurry to flow rapidly and freely through the screen, and drying the web to cause the water-insoluble sodium carboxymethylcellulose contained therein to bind the fibers in deposited web form, and maintaining said sodium carboxymethylcellulose in chemically-unaltered form throughout.

11. A method of preparing a thin, soft, highly absorbent and porous web material of low density which comprises forming a highly diluted aqueous slurry of unbeaten, synthetic, artificially-formed fibers having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths with the addition of a small quantity of water dispersible sodium carboxymethylcellulose containing from 2 to 25% by weight of water-insoluble gel-forming particles, said sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and being added in an amount sufficient to provide a minimum of 3¾ parts of completely soluble sodium carboxymethylcellulose and from 1¼ to 10 parts of water-insoluble gel-forming particles to 100 parts of fiber by weight, said completely soluble portion being effective to uniformly disperse and deflocculate the said fibers, forming a web by flowing the dispersion onto a traveling meshed sheet-forming screen to cause the fibers and gel particles of sodium carboxymethylcellulose adhering to the intersections of the fiber to deposit uniformly thereon while permitting the remainder of the slurry to flow rapidly and freely through the screen, and drying the web to cause the water-insoluble sodium carboxymethylcellulose contained therein to bind the fibers in deposited web form, and maintaining said sodium carboxymethylcellulose in chemically-unaltered form throughout.

12. A method of preparing a thin, soft, highly absorbent and porous web material of low density which comprises forming a highly diluted aqueous slurry of unbeaten, synthetic, artificially-formed fibers having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths with the addition of a small quantity of water-dispersible sodium carboxymethylcellulose containing from 2 to 25% by weight of water-insoluble gel-forming particles, said sodium carboxymethylcellulose having a substitution value of from 0.3 to 0.75 and being added in an amount of one part by weight to from 5 to 25 parts of fiber by weight and having a dual function in that the water-soluble content disperses and deflocculates the fiber in the suspension and the water-insoluble particles bind the fibers at

their intersections in the finished sheet, forming a web by flowing the dispersion onto a traveling meshed sheet-forming screen to cause the fibers and gel particles of sodium carboxymethylcellulose adhering to the intersections of the fiber to deposit uniformly thereon while permitting the remainder of the slurry to flow rapidly and freely through the screen, and drying the web to cause the water-insoluble sodium carboxymethylcellulose contained therein to bind the fibers in deposited web form, and maintaining said sodium carboxymethylcellulose in chemically-unaltered form throughout.

13. A method of preparing a thin, soft, highly absorbent and porous web material of low density which comprises providing a sodium carboxymethylcellulose compound having a carboxymethyl substitution value of from 0.3 to 0.75 which when dispersed in water and passed through a screen having approximately 105,625 openings per inch will yield from 2 to 25% (by dry weight) of microscopic gel-forming particles, said carboxymethylcellulose having a dual function in that the water-soluble content disperses and deflocculates the fiber in the suspension and the water-insoluble particles bind the fibers at their intersections in the finished sheet, forming a highly diluted aqueous slurry of unbeaten, synthetic, artificially-formed fibers having a fiber length within the range of from 6 millimeters up to and including textile fiber lengths with the addition of one part of said sodium carboxymethylcellulose to from 5 to 25 parts of fiber by weight, forming a web by flowing the dispersion onto an inclined traveling meshed sheet-forming screen to cause the fibers and gel particles of sodium carboxymethylcellulose adhering to the intersections of the fiber to deposit uniformly thereon while permitting the remainder of the slurry to flow rapidly and freely through the screen, and drying the web to cause the water-insoluble sodium carboxymethylcellulose contained therein to bind the fibers in deposited web form, and maintaining said sodium carboxymethylcellulose in chemically-unaltered form throughout.

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