

Nov. 23, 1971

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3,621,847

ARCUATE CORE FOR SANITARY NAPKINS WITH A WATER SOLUBLE
CARBOXYMETHYL CELLULOSE BINDER

Filed Dec. 20, 1967

3 Sheets-Sheet 1

Fig. 1

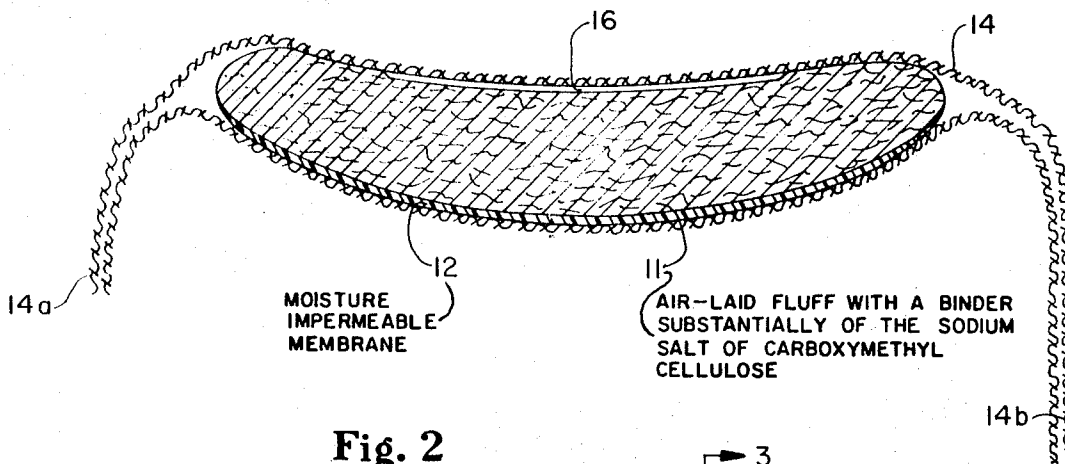


Fig. 2

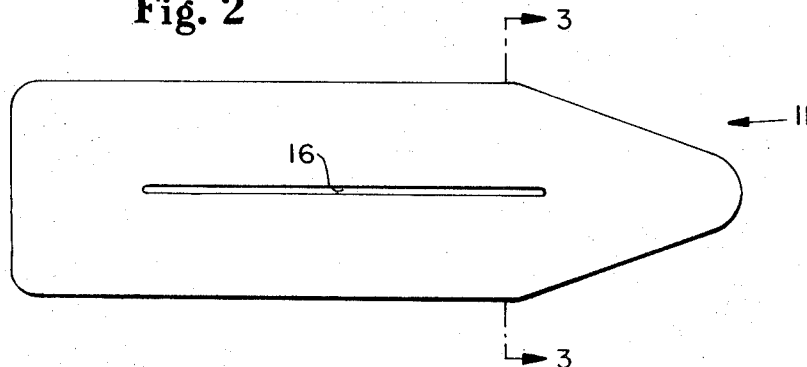
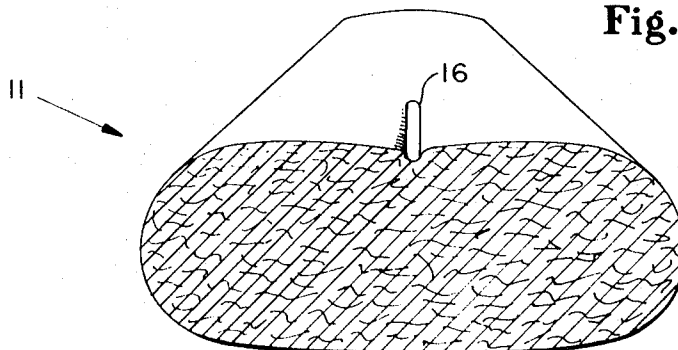


Fig. 3



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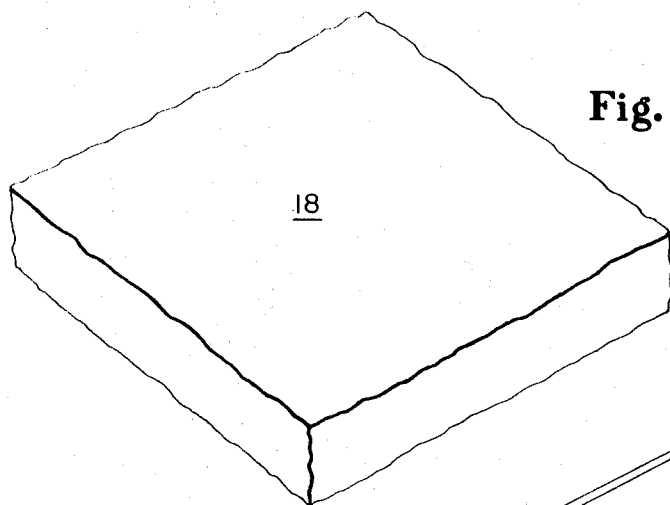
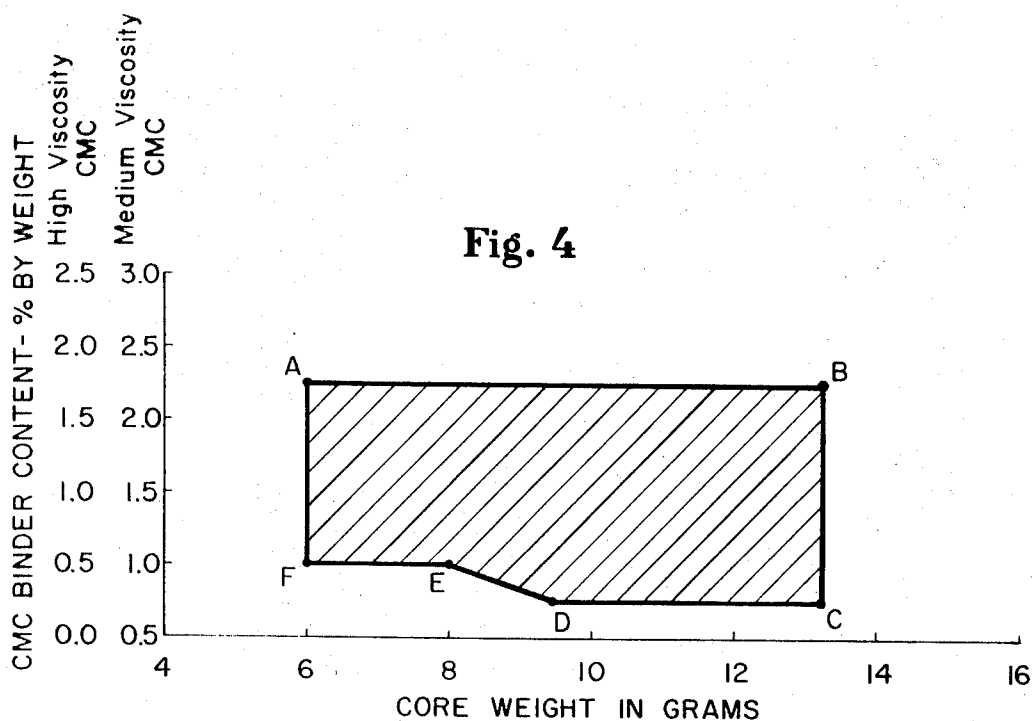
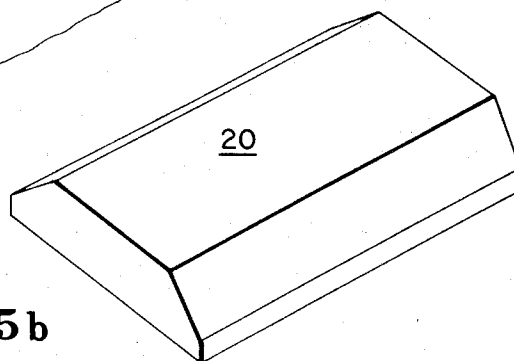


Fig. 5b



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Fig. 5c

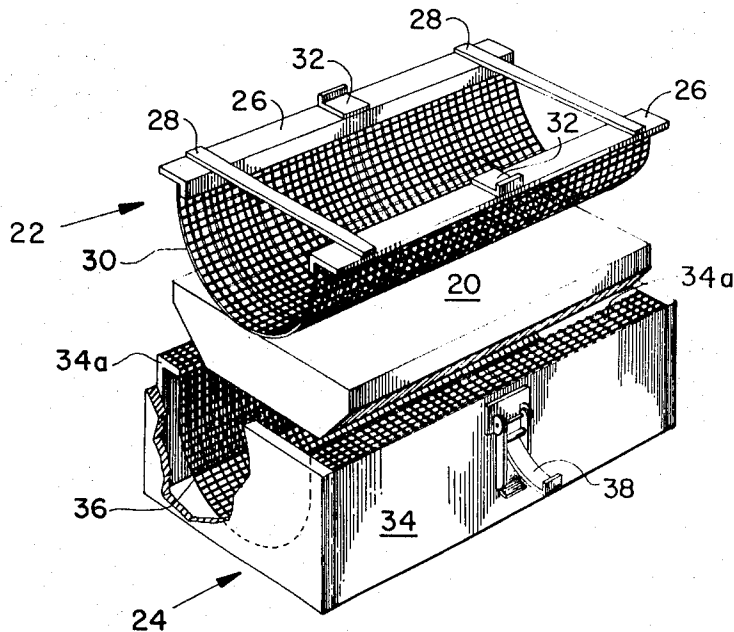


Fig. 5d

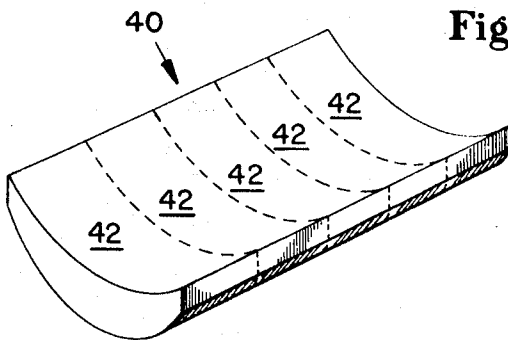


Fig. 5e

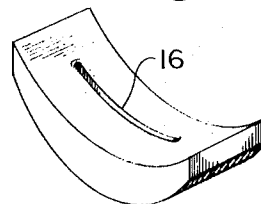
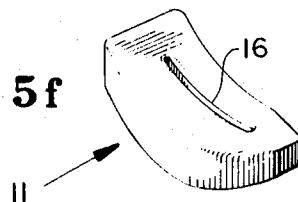


Fig. 5f



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ARCUATE CORE FOR SANITARY NAPKINS WITH A WATER SOLUBLE CARBOXYMETHYL CELLULOSE BINDER

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U.S. Cl. 128—290 R

1 Claim

ABSTRACT OF THE DISCLOSURE

A sanitary napkin having an arcuately configured core containing a water-soluble binder distributed uniformly throughout. The binder consists essentially of the sodium salt of carboxymethylcellulose having a Degree of Substitution of at least 0.4 and being present in specified ranges in accordance with the weight of the core. The binder has a medium to high viscosity such that when dissolved in water to form a 1% solution at 75° F., the viscosity of the solution will be in the range of from about 25 to about 2000 cp.

FIELD OF THE INVENTION

This invention relates to sanitary napkins and more particularly to sanitary napkins which include, as an element thereof, a preformed arcuately-shaped absorbent core.

BACKGROUND OF THE INVENTION

Commercially available sanitary napkins are flat and have, when viewed in plan, a configuration which may be substantially rectangular or, alternately, conformed to fit the user more comfortably, i.e., of trapezoidal or other configuration in which the portion of the napkin to be received between the legs of the user is of reduced width. However, in order to be applied, the napkins have to be bent into a curved shape, when viewed in elevation, which follows the anatomical curves of the user from the perianal area to the area forward and above the vulva. As a result of this bending, transverse ridges and troughs are formed in the top surface of such napkins. These ridges and troughs, because they extend in a transverse direction, encourage the flow of menses to the sides of the napkin, resulting in the soiling of undergarments and the in-use failure of the device substantially before the full utilization of its absorptive capacity.

In an effort to eliminate such problems, it has been proposed to impart an arcuate shape to the napkin prior to use whereby to eliminate the ridges and troughs and thus prevent side flow. The object of the arcuate shape is to allow the user to wear a sanitary napkin more comfortably and for a longer period of time before changing becomes necessary. Although the result should be an improved napkin, this has not been the case since such proposals have involved the use of water-insoluble binding materials. Such binders generally tend to reduce the absorbency of the napkin to a point at which they must be considered poor in absorbency when compared to other sanitary napkin products of like weight and which do not employ a water-insoluble binder. Lack of absorbent capacity reduces potential wearing time and increases the possibility of failure. In addition, such products are not truly disposable inasmuch as the cores are not easily repulped and flushed down a water closet without danger of clogging the plumbing system. A further shortcoming is that usually such products are stiff and uncomfortable to wear.

Water-soluble binders for fibrous material are known and, in general, when these are used in the manufacture of arcuately shaped sanitary napkins the core disposability

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problem is solved and the ultimate absorbent capacity of the product is good. However, the in-use absorbent capacity of the napkin (the quantity of fluids which the napkin actually absorbs prior to failure by leakage) is generally not improved due to the fact that the absorbent material becomes matted and compressed under the pressures exerted on the product by the thighs of the person employing the device.

OBJECTS OF THE INVENTION

It is an object of the present invention to obviate the above problems.

It is another object of the present invention to provide an arcuately shaped sanitary napkin which has an effective in-use capacity which is substantially higher than that of prior art napkins, is comfortable in use, is economical to make and has a core which may be disposed of by flushing down a water closet.

SUMMARY OF THE INVENTION

Briefly stated, in accordance with one aspect of this invention, there is provided a sanitary napkin comprising an arcuately configured core containing a water-soluble binder distributed uniformly throughout. The binder consists substantially of the sodium salt of carboxymethyl cellulose (CMC) of high and/or medium viscosity and having a Degree of Substitution of at least about 0.4. The binder is present in an amount within the limits of the shaded area of the accompanying graph.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the present invention it is believed that the invention will be better understood from the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a vertical longitudinal sectional view of a sanitary napkin including one embodiment of an absorbent airfelt core of the present invention;

FIG. 2 is a plan view of the preformed, arcuately-shaped absorbent core of FIG. 1;

FIG. 3 is an enlarged vertical transverse sectional view of the preformed core taken along line 3—3 of FIG. 2;

FIG. 4 is a graph of percent CMC binder vs. airfelt core weight and illustrating, by means of a shaded area, the limits within which the CMC binder can be used in accordance with the present invention, and

FIGS. 5a through 5f illustrate the condition of the airfelt materials at various points during the course of manufacturing the core.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, there is shown a sanitary napkin having a preformed, arcuately-shaped core 11, hereinafter described in greater detail, which has a moisture impermeable film 12 extending continuously across the lower surface of the core and upwardly along both longitudinal edges thereof. A fabric 14 surrounds the film-covered core, maintaining the elements properly in the assembly and having end extensions 14a and 14b by means of which the napkin is affixed to a sanitary belt. While the described combination of elements is a preferred construction of a napkin employing the embodiment of core 11 shown, it will be understood that the film 12, or fabric 14, can be arranged in various other ways whereby the napkin will derive the benefits of a core of the present invention. In still another embodiment, the film-covered core may be wrapped with a fleece material (i.e., a thin, soft, complaint, absorbent fibrous material) to impart added softness to the sanitary napkin.

The film 12, if used, can comprise any suitable and compliant moisture impervious membrane. It has been found that one-half mil polyethylene film having a length approximating or somewhat more than that of the core 11 and a width somewhat greater than the width of the core 11 (in the embodiment being described, about 9" x 3 1/4") performs satisfactorily in use. When used with a core having reduced width and/or thicknesses in certain portions, the film 12 can be tapered or configured as necessary to compensate for such variations so as to make the side edges thereof align generally with the side edges of the upper surface of core 11.

The fabric 14 is an overwrap which can be about 19" long and has a width sufficient to encircle the transverse section of the napkin with slight overlap permitting the longitudinal edges of the fabric (which extend lengthwise of the napkin) to be united by means of adhesives or by mechanical means. The fabric can be gauze, a knitted scrim or, preferably, a bonded non-woven material which is smooth, soft, porous, liquid permeable, non-pilling and adapted to cover a curved object.

The core 11, as shown in FIGS. 1, 2 and 3, is somewhat boat-like in configuration and is a fibrous, unified structure which contains a network of void spaces or openings to provide high absorbency. Interconnection among the openings exist such that fluid is conveyed through the capillaries in the network. These interconnections or "capillaries" control the rate of fluid transmission (wicking) from one area of the core to another. The upper and lower surfaces of the core 11 are upwardly concave in the longitudinal and lateral directions. The upward lateral concavity does not have to be pronounced and can be virtually imperceptible. In addition, the lateral concavity does not have to be formed by any particular configuration of surface or portion thereof so long as the effect is to make the surface generally upwardly concave, i.e., with the central portion thereof below the level of the portions to either side of it. Preferably, the radius of curvature in the longitudinal dimension of the upper and lower surfaces should be in the range of from about 3 1/2" to about 6", desirably about 4". These radii may be adjusted to yield a maximum thickness of the core 11 along the longitudinal central area thereof so that the thickness decreases, tapers, towards the end. The tapered thickness insures greater comfort and is desirable for cosmetic reasons (less showing of the outline of the napkin during use). Although not essential, the rear end of the core 11 can be tapered inwardly so as to present a width which is more comfortable to the user when applied.

Although overall lengths and widths may be varied in accordance with the size of the napkin desired, it has been found that a core having a length of approximately 8" along the top surface and a width of about 2 1/2" which tapers at the rear end to a width in the range of from about 3/4" to 1" is satisfactory as far as comfort is concerned. This size core advantageously weighs from about 6 to about 13 grams. The taper described may commence at a distance of approximately 3" from the rear end and desirably is uniform on each side of the napkin.

The core 11 can have a longitudinally extending depression 16 which is impressed in the central portion of the upper surface and preferably spaced from each end of the napkin. A single elongated depression 16 is preferred; however, a plurality of parallel or aligned depressions can be used to derive substantially the same advantages as the single line so long as the combined effect of the parallel or aligned depressions is equivalent to the single line. This aspect of the sanitary napkin core embodiment shown in disclosed more fully in Pat. No. 3,430,630, filed Apr. 27, 1966 by Megison and Barton, assigned to the assignee of the present invention, and does not form a part of this invention.

The core 11 of the present invention comprises a bonded airfelt material, i.e., an air-laid fluff or felt comprising air deposited fibers which are sprayed with a

CMC solution. Various apparatus and methods for the production of air-laid fluff are well known in the art. In preparing the airfelt, absorbent fibrous material in sheet (dry lap) form is generally separated into individual fibers in a hammermill and these fibers are carried by air flow to the surface on which the material is formed. At the same time, a binding material is sprayed on the material being formed and/or the fibers approaching it. Specific examples of the various means for spraying binding material on the fibers from which the air-laid fluff is made are disclosed in Canadian Pat. 642,566, which issued to Robert W. Johnson, Jr., et al. on June 12, 1969 for "Catamenial Napkin" and in Williams, U.S. Pat. 1,961,272, issued June 5, 1934 for "Felting Machine." The disclosure of the above-mentioned Johnson et al. and Williams patents are incorporated herein by reference. It will be understood, however, that the type of apparatus used in forming airfelt plays no part in the present invention, the only requirement being that the binder be substantially homogeneously dispersed through the formed airfelt.

The CMC binder used is applied as an aqueous solution in quantities sufficient to result in a binder content of the dry finished core within the limits of the shaded area ABCDEF of the graph of FIG. 4 of the drawings. This area was defined by forming and determining the properties of a number of cores of varying core weight and binder content. Within the limits of area ABCDEF for the particular core weights shown, the core readily disintegrates when wetted, retains its shape when dry, is comfortable and maintains sufficient body in use whereby to minimize twisting, roping and matting and the consequent loss of in-use capacity experienced by other such products when other water-soluble binders are used. Cores in which the core binder content is greater than those of the shaded area of the graph are stiff and uncomfortable in use while those which have less binder than those of the shade area do not retain their shape when dry and/or lack body when used.

The CMC can be of medium viscosity (approximately about 25 to about 500 cp. for a 1% solution in water at 75° F.) or of high viscosity (approximately about 500 to about 2000 cp. for a 1% solution in water at 75° F.). When using medium viscosity CMC, aqueous solution concentrations of from about 0.25% to about 2.5% by weight of CMC, preferably from about 0.5% to about 1.5%, can be used. In spraying the aqueous binder solution to the fibers being formed into the air-laid mat, the fiber weight to solution weight ratio should be maintained in the range of from about 0.5:1 to about 1.5:1, preferably between about 0.75:1 and 1.25:1, whereby a substantially uniform dispersion of binder throughout the mat is achieved without undue evaporative load problems in subsequent drying operations. If high viscosity CMC is used, solution concentrations of from about 0.25% to about 1.5% by weight of CMC, preferably from about 0.5% to about 1% can be used. The fiber weight to solution weight ratio in forming the mat with high viscosity CMC should be maintained in the ranges previously set forth above for the reason stated. Mixtures of medium viscosity and high viscosity CMC, each of which has a relatively narrow range of viscosities, can be used to provide a solution falling within desired portions of the wide viscosity limits given above.

FIG. 5a illustrates a portion of a piece of a flat batt 18 of airfelt made in accordance with the present invention. The batt 18 can have an initial thickness of about 3", a density in the range of from about 0.5 to about 1.2 pounds per cubic foot directly after its formation and desirably has been passed between a pair of rollers to reduce its thickness to about 2 1/2". The fibers comprising this batt 18 can be wood fibers, cotton linters, rayon floc, mixtures thereof, or generally speaking, any fibers which have a range of lengths predominantly from about 1 millimeter to about 6 millimeters. It will be understood that when included in minor amounts, fibers as long as 1" and

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fibers so short as to have almost negligible length can also be used.

The binder must be a water-soluble CMC having a Degree of Substitution (D.S.) of 0.4 or above and can, as mentioned above, be of medium or high viscosity grades. In connection with the D.S. of the CMC, if this is less than 0.4 the material is not satisfactory since it is substantially insoluble in water. Immediately after deposition the batt 18 contains about 0.7 gram of water per gram of fiber when the fiber weight/solution weight ratio used in applying the CMC binder is about 1:1. The batt moisture content is then reduced to about 0.25 gram of water per gram of fiber by drawing air through the structure.

Next, a shaped batt 20 is formed by means of saws, knives, or the like to the cross-sectional configuration of FIG. 5b in which the width is trimmed to about 8" and two corners are equally chamfered at an angle of about 130° with the batt face therebetween whereby the face has a width of 5" and the sides of the shaped batt 20 are about ¾" thick.

Then, the shaped batt 20 is placed in a curved mold as illustrated in FIG. 5c, with the chamfered edges on the concave side. As shown, the mold comprises a top press 22 and a body portion 24. The top press 22 has a pair of oppositely disposed side members 26 constructed of an angular material and maintained in spaced relationship by a pair of bars 28 suitably secured to the top surface of the members 26. A screen 30 is secured at each side to the depending legs of members 26. For the core 11 described the width of the screen 30 intermediate the members 26 can be about 8" with a radius of curvature thereof of about 3". Catches 32 are provided centrally of each member 26. The body portion 24 comprises a hollow frame 34 which is essentially box-like with an open top and bottom and having a pair of edge portions 34a extending longitudinally at the sides of the top, defining the top opening therebetween. A screen 36 is attached at each side to the edge portions 34a, extending vertically at each side into the interior of frame 34 with the intermediate portion curved so as to have a radius of curvature matching that of screen 30. The width of screen 36 between the interior sides of edge portions 34a can be about 12½" so that the vertically extending portions thereof have a length of about 1½" each. A pair of toggle clamps 38 are provided centrally along each side of the frame 34 and are sized and adjusted so as to engage the catches 32 of top press 22 and pull the same downwardly until the lower surfaces of members 26 engage the top of screen 36 along edge portions 34a when screen 30 of the top press is telescoped into the body portion 24 in use.

Following placement of the shaped batt 20 in the body portion 24, the top press 22 is applied and the toggles 38 manipulated to pull the mold members together and squeeze the shaped batt 20 between the screens 30 and 36. Due to the pressure exerted by the mold surfaces, the center thickness of the batt is reduced to approximately 1¾". While in the mold the batt is placed in an oven heated between about 270° F. and about 300° F. and dried to approximately bone dry condition, thereby setting the batt in the curved condition of the log 40 of FIG. 5d by means of the binding action of the dried CMC.

The log 40 is cut transversely (as shown by dotted lines in FIG. 5d) into a multiplicity of 2¼" to 2½" wide blanks 42 whereby the length of each blank 42 extends in the direction of the curve imparted to the log 40 by means of the arcuate conformation of the mold surfaces. The blanks 42 can be separated by any convenient means such as band saw type cutters or the like. These blanks 42 therefore have an inside (concave top) length of approximately 8", a center thickness of about 1¾" and a width of approximately 2¼" to 2½". These dimensions can be varied as desired within a range of sizes acceptable for use in sanitary napkins, but do represent the measure-

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ments of an absorptive core blank which has been found satisfactory.

If the core is to be provided with the longitudinally extending depression 16 impressed in the upper surface thereof, this can be accomplished by means of the apparatus and technique of the above-mentioned application Ser. No. 545,689. This is done between a pair of curved mating die halves, the male one of which has a rib of the desired configuration and dimension of the depression 16. Desirably, the radius of curvature of the working face of each die half is equal to approximately 3½" whereby the upper and lower surfaces of the treated blank will have a similar radius of curvature, thus allowing for subsequent relaxation or partial loss of curvature to give a finished core having about a 4½" radius of curvature. A force in the range of from about 500 to about 2000 pounds can be used to form the depression and this reduces the thickness of the blank to give a density of about 1½ to about 4 pounds per cubic foot and an absorptive capacity (unstressed) of about 0.4 to about 0.6 gram of citrated whole blood per gram of blank. Capacity is determined by noting the amount of fluid held by the blank at the instant of bottom strikethrough following introduction of the liquid into the center of the upper surface of the blank at a rate of about one cubic centimeter per minute. Strikethrough occurs when it is observed that the fluid reaches the bottom surface.

The tapered rear end portion of the core 11 illustrated in FIG. 5f can be produced, if desired, by trimming the excess material at the rear corners by any convenient means, e.g., cutters, saws or the like, whereby to result in a configuration sized as described previously. This tapered rear end portion is designed to fit more comfortably.

Next, the corners of the sides and tapered rear end are removed, rounded, to eliminate sharp edges which could irritate the skin of the user, thus completing the core 11. Such removal may be accomplished, for example, by the use of an abrasive wheel having a coarse, outwardly facing, concave annular abrading surface. The abrading surface is passed along the periphery of the blank, producing a rounded edge as illustrated in FIG. 3, and can, if desired, also be used to form the taper concurrently therewith instead of performing the operations separately. Following trimming, the core 11 can be flexed mechanically or by hand to preliminarily soften the core prior to assembly.

The napkin described is assembled as shown in FIG. 1 by first placing the film 12 along the sides and bottom of the core 11, encircling the film-covered core with the fabric 14 and adhesively attaching the overlapping longitudinal edges of the fabric. This assembly can be performed by machinery which forms no part of the present invention and therefore is not described or, alternatively, may be performed quite adequately by hand. For greatest softness, the completed napkin is worked, i.e., by flexing either by hand or mechanically.

Several examples of sanitary napkins made according to the process of the present invention as described immediately above in detail are presented in the following tables. In all cases, a 3" thick airfelt batt is formed using the indicated fibrous material and binder solution and the length of fibers used fell within the range of from about 1 millimeter to about 6 millimeters. The airflow and pressure drop across the screen on which the batt is formed and the feed rate of the fibers and binder solution are adjusted to result in the indicated initial batt density. This airfelt batt is passed between rollers which reduce its thickness to 2½". Then the batt is processed as described above to give core 11 having the indicated weight and containing the specified amount of CMC binder. Sanitary napkins such as shown in FIG. 1 are assembled as described. Upon evaluation, all napkins are found to provide good dry shape retention, to maintain sufficient body in use to minimize twisting, roping and matting,

to possess excellent absorbent capacity, softness and comfort in use, and to be easily disposed of by flushing without experiencing plumbing problems.

drawings, said binder comprising the sodium salt of carboxymethyl cellulose having a medium to high viscosity such that when dissolved in water to form a 1% solu-

TABLE I
Medium viscosity CMC

	Example Number						
	I	II	III	IV	V	VI	VII
Fiber type.....	Wood	Wood	Wood	Cotton liners	Wood	Wood	Wood
CMC soln. percent by weight.....	1.5	0.75	1.0	1.3	2.5	1.0	1.0
CMC degree of substitution.....	0.65-0.85	0.65-0.85	0.65-0.85	0.38-0.48	0.85-0.95	1.20-1.40	0.38-0.48
Water: fiber, wt. ratio.....	1:1	1:1	1:1	1.5:1	0.6:1	1:1	1.25:1
Initial density, lbs./ft. ³	0.50	0.75	1.00	1.20	0.70	1.0	0.50
Wt. of finished core, grams.....	6	9	11.5	13	8	11.5	6
Percent by wt. of CMC in dry core.....	1.5	0.75	1.0	2.0	1.5	1.0	1.25
Final density, lbs./ft. ³	1.8	2.7	3.4	3.9	2.4	3.4	1.8
Absorptive capacity (unstressed) ¹	0.4	0.5	0.55	0.6	0.5	0.55	0.4

¹ Grams of citrated whole blood per gram of finished core.

TABLE II
High viscosity CMC

	Example Number						
	VIII	IX	X	XI	XII	XIII	XIV
Fiber type.....	Cotton liners	Wood	Wood	Wood	Wood	Wood	Wood
CMC soln. percent by weight.....	1.0	1.5	0.25	0.50	1.0	0.75	1.0
CMC degree of substitution.....	0.65-0.85	0.65-0.85	0.65-0.85	0.85-0.95	0.38-0.48	1.20-1.40	0.65-0.85
Water: fiber, wt. ratio.....	1:1	1:1	1:1	1.5:1	1.5:1	0.8:1	0.5:1
Initial density, lbs./ft. ³	0.75	0.50	1.20	1.00	0.70	1.00	0.75
Wt. of finished core, grams.....	9	6	13	11.5	8	11.5	9
Percent by wt. of CMC in dry core.....	1.0	1.5	0.25	0.75	1.5	0.6	0.5
Final density, lbs./ft. ³	2.7	1.8	3.9	3.4	2.4	3.4	2.5
Absorptive capacity (unstressed) ¹	0.5	0.4	0.6	0.55	0.5	0.55	0.7

¹ Grams of citrated whole blood per gram of finished core.

Many modifications of the above invention may be used and it is not intended to hereby limit it to the particular embodiments shown or described. The terms used in describing the invention are used in their descriptive sense and not as terms of limitation it being intended that all equivalents thereof be included within the scope of the appended claim.

What is claimed is:

1. A sanitary napkin comprising a unified core of absorbent fibrous material and a porous, liquid permeable overwrap enclosing said core, said core being of arcuate shape and comprising a water-soluble binder distributed uniformly throughout, said binder consisting essentially of the sodium salt of carboxymethyl cellulose having a Degree of Substitution greater than about 0.4, said binder being present in an amount falling within the area ABCDEF of the graph of FIG. 4 of the accompanying

tion at 75° F., the viscosity of the solution will be in the range of from about 25 to about 2000 cp.

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RICHARD C. PINKHAM, Primary Examiner
R. J. APLEY, Assistant Examiner

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,621,847 Dated November 23, 1971
Inventor ~~(S)~~ John P. Roberson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 71, "complaint" should read --compliant--.
Column 3, line 26, "throught he" should read --through the--.
Column 4, line 12, "1969" should read --1962--.
Column 4, line 37, "shade" should read --shaded--.
Column 5, line 40, "inermmediate" should read --intermediate--.
Column 6, line 38, "accomplish" should read --accomplished--.
Column 6, line 51, "overlapping" should read --overlapped--.
Column 8, TABLE II, High viscosity CMC, Example Number XIV,
under the column headed "Wood", seventh line down, "2.5"
should read --2.7-- and eighth line down, "0.7" should read
--0.5--.

Signed and sealed this 27th day of June 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents