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PROCESS AND APPARATUS FOR MAKING FORESHORTENED CELLULOSIC STRUCTURE

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FIELD OF THE INVENTION

The present invention is related to processes and apparatuses for making strong, soft, absorbent cellulosic webs. More particularly, this invention is concerned with processes and apparatuses for making foreshortened paper webs.

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BACKGROUND OF THE INVENTION

Paper products are used for a variety of purposes. Paper towels, facial tissues, toilet tissues, and the like are in constant use in modern industrialized societies. The large demand for such paper products has created a demand for improved versions of the products. If the paper products such as paper towels, facial tissues, toilet tissues, and the like are to perform their intended tasks and to find wide acceptance, they must possess certain physical characteristics. Among the more important of these characteristics are absorbency, softness, and strength.

Absorbency is the characteristic of the paper that allows the paper to take up and retain fluids, particularly water and aqueous solutions and suspensions. Important not only is the absolute quantity of fluid a given amount of paper will hold, but also the rate at which the paper will absorb the fluid. Softness is the pleasing tactile sensation consumers perceive when they use the paper for its intended purposes. Strength is the ability of a paper web to retain its physical integrity during use.

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There is a well-established relationship between strength and density of the web. Therefore efforts have been made to produce highly-densified paper webs. One of such methods is disclosed in the U.S. Patent 4,112,586 issued Sept. 12, 1978;



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incorporated by reference herein. Alternatively or additionally, foreshortening may be accomplished via wet- microcontraction, as taught in commonly-assigned U.S. Patent 4,440,597, issued April 3, 1984 to Wells et al., the disclosure of which patent is incorporated by reference herein.

5 In any process where the primary purpose is to form a uniformly-densified strong paper (such for example, as a paper board), the use of foreshortening is highly-objectionable. In contrast with the methods for producing uniformly-densified papers, cellulosic structures currently made by the present assignee contain multiple micro-regions defined most typically by differences in density. The
10 differential-density cellulosic structures are created by -- first, an application of vacuum pressure to the wet web associated with a papermaking fabric, thereby deflecting a portion of the papermaking fibers to generate low-density micro-regions, and -- second, pressing, for a relatively short period of time, portions of the web comprising non-deflected papermaking fibers against a hard surface, such as a
15 surface of a Yankee dryer drum, to form high-density micro-regions. The high-density micro-regions of the resulting cellulosic structure generate strength, while the low-density micro-regions contribute softness, bulk and absorbency.

Such differential density cellulosic structures may be produced using through-air drying papermaking belts comprising a reinforcing structure and a resinous
20 framework, which belts are described in commonly assigned U.S. Patent 4,514,345 issued to Johnson et al. on Apr. 30, 1985; U.S. Patent 4,528,239 issued to Trokhan on July 9, 1985; U.S. Patent 4,529,480 issued to Trokhan on July 16, 1985; U.S. Patent 4,637,859 issued to Trokhan on Jan. 20, 1987; U.S. Patent 5,334,289 issued to Trokhan et al on Aug. 2, 1994. The foregoing patents are incorporated herein by
25 reference.

Now it has been found that soft and, at the same time, strong differential-density paper webs may be successfully produced by first -- highly densifying at least selected portions of the web between two press surfaces, and then -- creping the

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20 Jan. 20, 1987; U.S. Patent 5,334,289 issued to Trokhan et al on Aug. 2, 1994. The foregoing patents are incorporated herein by reference.

PCT Application WO-A-97/43483 describes cellulosic webs that can be dewatered to consistencies of about 70% or greater in high
25 intensity extended nip press while retaining a substantial amount of bulk.

French Application, Publication No. 2520770, describes a drying process for a web formed at the wet end of a papermaking machine,

wherein the web is supported on an endless, flexible metallic band whose movement is essentially planar. The underside of the band is heated, preferably by infrared radiation, to a temperature of 140-200°C. for a sufficient length to ensure complete drying of the web, and
5 the web is held against the upper surface of the band by a synchronously-moving drying felt. An exhaust hood above the band removes the water vapour expelled from the web.

Now it has been found that soft and, at the same time, strong differential-density paper webs may be successfully produced by first –
10 highly densifying at least selected portions of the web between two press surfaces, and then – creping the web off one of the press surfaces to which the web has adhered during pressing. The commonly assigned co-pending patent applications entitled "Differential Density Cellulosic Structure and Process for Making
15 Same" filed on June 6, 1997 in the name of Trokhan et al., and "Fibrous Structure and Process for Making Same" filed on August 15, 1997 in the name of Trokhan et al. are all incorporated by reference herein. It has also been found that foreshortening of the paper web may beneficially be accomplished in these processes,
20 completely eliminating a need for the Yankee dryer drum as a creping surface.

Accordingly, it is an object of the present invention to provide an apparatus and an improved papermaking process for making a foreshortened strong and – at the same time – soft paper web,
25 eliminating the need for a Yankee dryer.

The web and the fabric move in a machine direction. The first press surface may be smooth or, alternatively, patterned. Similarly, the belt's web-side may be patterned. For the belt having a patterned web-side, a belt having a resinous framework joined to a reinforcing structure is preferred.

5 The first press surface is heated to create a temperature differential between the first and second press surfaces. The second press surface may also be heated to a lesser temperature, relative to a temperature of the first press surface. Alternatively, the second surface may be maintained at ambient temperature, or be cooled. The temperature differential causes water contained in the web to move from a relatively
10 hot area to a relatively cold area (due to at least partial evaporation followed by condensation), e. g., from the web into the fabric, thereby dewatering the web.

Under the pressure caused by the first and second press surfaces wherein the first press surface imprints the web into the belt, at least selected portions of the web become densified and adhered to the first press surface which can be treated with a
15 creping adhesive. The creping adhesive may be applied to the first press surface uniformly, or -- alternatively -- according to a pre-selected pattern. An adhesive applicator may comprise a printing roll, spraying nozzles, extrusion devices, and other devices known in the art.

After the web is released from the pressure, the web is foreshortened by a
20 foreshortening means. Foreshortening may be accomplished by creping, by transferring the web from the first press surface to a slower moving transfer fabric, or by the combination thereof.

Creping is preferably performed with a creping doctor blade juxtaposed with the creping surface having the web adhered thereto. The creping surface may
25 comprise the first press surface. Alternatively, the creping surface comprises a surface separate from the first press surface. While creping may be used with both the smooth crepe surface and the patterned crepe surface, preferably the creping

FIG. 3 is a schematic side-elevational view of another embodiment of a continuous process and an apparatus of the present invention, showing a web being foreshortened by transferring it from a first press surface to a transfer fabric.

FIG. 4 is a schematic side-elevational view of a continuous process and an apparatus of the present invention, showing a web being foreshortened by transferring it from a papermaking fabric to a transfer fabric, using a vacuum pick-up shoe.

FIG. 5 is a schematic side-elevational view of a continuous process and an apparatus of the present invention, showing a web being foreshortened by transferring it from a first press surface to a transfer fabric, then pressing the web using an auxiliary press surface, and creping the web off a convex creping surface.

FIG. 6 is a schematic side-elevational view of a continuous process and an apparatus of the present invention, showing a web being foreshortened by transferring it from the first press surface to the transfer fabric, then pressing the web using an auxiliary press surface, and creping the web off a concave creping surface.

FIG. 7 is a schematic side-elevational view of a continuous process and apparatus of the present invention, showing a web being foreshortened by transferring it from the first press surface to the transfer fabric, and then creping the web off the flat creping surface.

FIG. 7A is a schematic fragmental view of the apparatus taken along the arrow 7A in FIG. 7, and showing an adhesive applicator comprising a printing roll in contact with a creping surface.

FIG. 8 is a schematic fragmental cross-sectional view of a web and a papermaking belt being pressed between a first press surface and a second press surface, the first press surface having an extending three-dimensional pattern therein.

FIG. 9 is a schematic top plan view of the first press surface shown in FIG. 8, and taken along lines 9-9 of FIG. 8.

A means 40 for creating a temperature differential between the first press surface 11 and the second press surface 12 is provided. The means 40 for creating a temperature differential is shown schematically in several drawings as a heating apparatus 41 for heating the first press surface 11, and an optional cooling apparatus 42 for cooling a second press surface 12. The means 40 for creating a temperature differential may also comprise -- alternatively or additionally -- steam-heating of the first press surface 11 and/or water-cooling of the second press surface 12. Other conventional means for creating a temperature differential between the first and second press surfaces 11, 12 may also be utilized in the apparatus 10 of the present invention. Of course, the second press surface 12 does not need to be affirmatively cooled: it may be maintained having an ambient temperature, or it may even be heated to a temperature which is less than the temperature of the first press surface 11. The important factor is to maintain the temperature differential sufficient to drive the water contained in the web 60 in the direction from the first press surface 11 towards the second press surface 12, due to at least partial evaporation followed by condensation.

A transporting means 50 is provided for moving the press surfaces 11, 12, and the fabric 20 with the associated web 60 in a machine direction (MD). A variety of the transporting means, well known in the art, may be used in the apparatus 10 of the present invention.

The apparatus 10 further comprises a foreshortening means 70 for foreshortening the web 60 after the web 60 is released from the pressure between the press surfaces 11, 12. The foreshortening means 70 will be discussed in sufficient detail herein below.

As used herein, the term "papermaking fabric" is a generic term including stationary papermaking plates and endless papermaking belts. In the context of the preferred continuous processes, fragments of which are shown in FIGs. 1 - 7, the papermaking fabric 20 comprises an endless belt traveling in the machine direction

In the preferred continuous process schematically illustrated in FIGs. 1 -- 7, the first press surface 11 is a surface of a first endless band 31, and the second press surface 12 is a surface of a second endless band 32. The transporting means 50 are schematically illustrated as comprising rotating return rolls around which the endless
5 bands 31 and 32 travel in the machine direction MD. The first endless band 31 travels around return rolls 51 and 52; and the second endless belt 32 travels around return rolls 55 and 56. Both the first and second bands 31, 32 have a first velocity V1 schematically indicated by the directional arrow V1 in FIGs. 1 -- 7.

Other embodiments of the first and second press surfaces 11 and 12 may be
10 used in the apparatus of the present invention. As has been noted in the BACKGROUND, the following U. S. Patents, incorporated by reference herein, show different arrangements of the pressing surfaces or their equivalents: 4,112,586 issued Sept. 12, 1978; 4,506,456 and 4,506,457 both issued Mar. 26, 1985; 4,899,461 issued Feb. 13, 1990; 4,932,139 issued Jun. 12, 1990; 5,594,997 issued
15 Jan. 21, 1997; 4,622,758 issued Nov. 18, 1986; and 4,958,444 issued Sept. 25, 1990. As an example, one of the first press surface 11 and the second press surface 12 may comprise a surface of a rotating cylinder (not shown).

In FIGs. 1 -- 7, the first and second press surfaces 11, 12 define an X-Y plane. As used herein, the X-Y plane is a reference plane which is parallel to the general
20 plane of the belt 20. A direction perpendicular to the X-Y plane is a Z-direction. Thickness of the belt 20 and caliper of the web 60 are measured in the Z-direction; and the web 60 and the belt 20 associated therewith are pressed by and between the bands 31, 32 in the Z-direction. One skilled in the art will understand that the press surfaces 11, 12 need not be planar and may comprise curved surfaces (not shown), in
25 which instance the Z-direction is a direction normal to the tangent in any point of the curved press surfaces.

In papermaking, the machine direction MD indicates that direction which is parallel to and has the same direction as the flow of the web 60 (and therefore the

combination thereof. Other types of the fluid-latent indigenous polymers may also be utilized if desired. European Patent Application EP 0 616 074 A1 discloses a paper sheet formed by a wet-pressing process and adding a wet-strength resin to the papermaking fibers.

5 Alternatively or additionally, the fluid-latent indigenous polymers may be supplied independently from the papermaking fibers and added to the web 60 (or to the fibers) before the web 60 has been formed. Independent deposition of the fluid-latent indigenous polymers in the web 60 or in the fibers may be preferred if the fibers do not inherently contain a sufficient amount of the fluid-latent indigenous
10 polymers, or do not inherently contain the fluid-latent indigenous polymers at all (as, for example, synthetic fibers). The fluid-latent indigenous polymers may be deposited in/on the web 60 (or the fibers) in the form of substantially pure chemical compounds. Alternatively, the fluid-latent indigenous polymers may be deposited in the form of cellulosic fibers containing the fluid-latent indigenous polymers. The
15 fluid-latent indigenous polymers may be added uniformly, or – alternatively – in discrete spots. Such discrete spots may comprise a predetermined pattern and may or may not be registered with highly-densified micro-regions of the paper web.

When the web 60 enters the press nip between the first and second press surfaces 11, 12, the web 60 preferably has a fiber-consistency in the range of from
20 about 5% to about 60%. More preferably, the fiber-consistency of the web 60 just prior to being pressed between the press surfaces 11 and 12 (at or about the point B in FIG. 2) is from about 15% to about 50%.

The web 60 and the belt 20 are interposed between the first and second press surfaces 11, 12 such that the first press surface 11 contacts the web 60, and the
25 second press surface 12 contacts the backside of the belt 20. A pressing means 30 presses the first and second press surfaces 11, 12 towards each other. The pressing means 30 shown in FIGs. 1 -- 3 comprises members pressing the corresponding (in the Z-direction) sections of the bands 31 and 32 towards each other, wherein these

relatively hot area to the relatively cold area, i. e., towards and into the belt 20. Therefore, the belt 20 should preferably have a sufficient amount of void volume to be able to accumulate the water driven into the belt 20 from the web 60. If necessary, an additional fabric juxtaposed with the belt 20 may be used for receiving
5 the water driven from the web 60.

FIGs. 8 and 9 show one embodiment of the first press surface 11 which is patterned. In FIGs. 8 and 9, the first press surface 11 comprises an essentially continuous, macroscopically monoplanar, and patterned network area 11a, and a plurality of discrete depressions 11b which are dispersed throughout and
10 encompassed by the network area 11a. The network area 11a protrudes in the Z-direction from the level of the depressions 11b, as best shown in FIG. 8. The continuous network 11a allows creping to be performed off such a network with a creping blade, as discussed in sufficient detail herein below.

As shown in FIGs. 8 and 9, selected portions 61 of the web 60 correspond (in
15 the Z-direction) to the network area 11a of the first press surface 11; and portions 62 of the web 60 correspond (in the Z-direction) to the depressions 11b of the first press surface 11. Thus, when the first press surface 11 presses the web 60 against the belt 20, the network area 11a of the first press surface 11 densifies primarily the selected portions 61, leaving the rest of the web 60, including the portions 62, undensified (or
20 densified, if desired, to a significantly lesser degree). The first press surface 11 embosses the web 60 according to a specific pattern of the network area 11a. In the finished paper product, the densified portions 61 of the web 60 form a continuous network 61 having a pattern which in plan view is essentially identical with the pattern of the network 11a of the first press surface 11. The continuous and
25 densified network 61 of the final paper product provides strength, while the low-density portions 62 generate bulk providing softness and absorbency.

If desired, the portions 62 of the web 60 may also be impressed by the depressions 11b of the first press surface 11. In this instance, both the portions 61

against the first press surface 11 and thereby densified, while the portions 62 of the web 60, corresponding in the Z-direction to the deflection conduits 22, are not subjected (or subjected to a significantly lesser degree, if desired) to densification.

In the embodiment shown in FIGs. 10 and 11, the framework 21 comprises an essentially continuous pattern, and the plurality of deflection conduits 22 comprises a plurality of discrete orifices, or holes, extending from the web-side surface 21a to the backside surface 21b of the framework 21. Preferably, the discrete conduits 22 are arranged in a pre-selected pattern in the framework 21, and more preferably, the pattern of the arrangement of the conduits 22 is non-random and repeating, such as, for example, a continuously-reticulated pattern. The papermaking belt 20 having a continuous framework 21 and discrete deflection conduits 30 is primarily disclosed in the commonly assigned and incorporated by reference herein U.S. Patents 4,528,239 issued Jul. 9, 1985 to Trokhan; 4,529,480 issued Jul. 16, 1985 to Trokhan; 4,637,859 issued Jan. 20, 1987 to Trokhan; 5,098,522 issued Mar. 24, 1992 to Trokhan et al.; 5,275,700 issued Jan. 4, 1994 to Trokhan; 5,334,289 issued Aug. 2, 1994 to Trokhan; and 5,364,504 issued Nov. 15, 1985 to Smurkoski et al.

The belt 20 may also have the framework 21 comprising a plurality of discrete protuberances extending from the reinforcing structure 25 and separated from one another by an area of essentially continuous deflection conduits. This embodiment is not shown in the drawings but may easily be visualized by one skilled in the art. The individual protuberances may or may not have the discrete deflection conduits disposed therein and extending from the web-side surface 21a to the backside surface 21b of the framework 21. The papermaking belt 20 having the framework 21 comprising the discrete protuberances is primarily disclosed in the commonly assigned and incorporated by reference herein U.S. Patent 4,245,025 issued Sep. 14, 1993 to Trokhan et al. and U.S. Patent 5,527,428 issued June 18, 1996 to Trokhan et al. Also, the papermaking belt 20 having the discrete protuberances raised above the

the impact angle ranges from about 70 degrees to about 90 degrees. A cleaning blade (well known in the art and therefore not shown) may also be used to remove contaminant build-up and excess coating from the creping surface. The web 60 preferably becomes adhered to the first press surface 11 during the step of pressing. According to the present invention, a creping adhesive may be applied directly to the creping surface. Creping adhesives comprising polyvinyl alcohol, animal-based protein glues, or mixtures thereof, well known in the art, may be utilized. The commonly-assigned U.S. Patent 3,926,716 issued to Bates on Dec. 16, 1975, and incorporated herein by reference, teaches a polyvinyl alcohol creping adhesive. The U.S. Patent 4,501,640 issued to Soerenis on Feb. 26, 1985; U.S. Patent 5,187,219 issued to Furman, Jr. on Feb. 16, 1993; U.S. Patent 5,494,554 issued to Edwards et al. on Feb. 27, 1996 describe various types of creping adhesives. Optionally, various plasticizers may be used in conjunction with the creping adhesive. For example, the plasticizer commercially sold as CREPETROL R 6390 is available from Hercules Incorporated of Wilmington, DE.

The creping adhesive may be uniformly applied to the first press surface 11. Alternatively, the creping adhesive may be deposited to discrete spots, continuous areas, or combination thereof. In the instance of the non-uniform deposition of the creping adhesive, the pattern may be random or – alternatively – non-random and repeating. The non-random pattern is preferred. The discrete spots or areas may comprise a pre-selected pattern. The pre-selected pattern may be registered with the portions 61 of the web 60, which portions 61 are highly-densified relative to the rest of the web 60, including the portions 62. Such devices as a printing roll 92 (FIGs. 1, 6, 7, and 7A), spraying nozzles 91 (FIGs. 1A and 5), and extrusion devices (not shown), well known in the art, may be utilized as an adhesive applicator 90 in the present invention.

FIG. 1A schematically shows the adhesive applicator 90 comprising a plurality of spraying nozzles 91. The nozzles 91 may be arranged in the cross-machine

filament of adhesive as it is discharged from the nozzle and extrudes to the face of the lamina to be adhesively joined.

U.S. Patent No. 4,949,668 issued August 21, 1990 to Heindel, et al. discloses an apparatus for depositing hot melt adhesive onto a substrate in a semi-cycloidal pattern. The semi-cycloidal pattern closely controls the cross-directional positioning of the adhesive filament to reduce overspray and waste.

U.S. Patent No. 4,891,249 issued January 2, 1990 to McIntyre and U.S. Patent No. 4,996,091 issued February 26, 1991 to McIntyre disclose an apparatus and process for generating fluid fiber adhesive droplets and combinations of fibers and droplets. The fibers, droplets and combinations thereof are generated by funneling a cone of pressurized air symmetrically about the adhesive filament. This results in a pattern of randomly laid criss-crossing fiber deposits onto the face of the lamina.

Commonly assigned U.S. 5,143,776, issued September 1, 1992 to Givens and incorporated herein by reference teaches the adhesive applied in a longitudinally oriented stripe. The stripe is deposited either in a spiral pattern, or, preferably, in a melt blown pattern.

The patterned application of the adhesive to the creping surface may be beneficial because it allows one to control the level of adhesion of the web to the creping surface. The degree to which the web is adhered to the creping surface prior to creping with the creping blade is believed to be one of the key factors determining softness, bulk, absorbency, and stretchability of the paper web after creping. The patterned application of the adhesive to the creping surface creates conditions for differential adhesion of the paper web to the creping surface, and thus – for creating a paper web having differential regions.

According to the present invention, the creping surface may have different shapes: convex (FIGs. 1 and 6), flat (FIG. 7), and concave (FIG. 5). The concave creping surface 75 shown in FIG. 5 may be formed as a result of the pressure caused by the creping blade 73. Alternatively or additionally, the concave creping surface

to the fiber-consistency of the web used in the wet-microcontraction method described in the above-referenced patent. It is believed that the Z-directional pattern of the web 60 creates conditions for "microcontracting" even the relatively dry web 60 in and around the web's areas 62, which are not densified or densified to a significantly lower degree relative to the areas 61. In accordance with the present invention, the preferred fiber-consistency of the web 60 after it has been pressed between the first and second press surfaces 11, 12 and before it was transferred to the transfer fabric 111 is at least 30%. The preferred velocity differential $V2/V1$ is from about 0.95 to about 0.75 (meaning that the second speed $V2$ is from about 5% to about 25% lower than the first velocity $V1$). The preferred transfer fabric 111 comprises an endless belt having a textured web-receiving surface. The papermaking belts made by the present assignee according to several patents referenced herein may be used as the transfer fabric 111.

In the embodiment shown in FIG. 2, the belt 20 carries the web 60 from the press nip formed between the first and the second press surfaces 11, 12 to the transfer fabric 111. The roll 55 with the associated second band 32, and the roll 72 with the associated transfer fabric 111 form a transfer nip therebetween into which the web 60 is continuously directed. More precisely, the transfer nip is formed between the papermaking belt 20 and the transfer fabric 111 in the area TN in FIG. 2. The transfer nip is designed to receive the web 60. The transfer fabric 111 may be treated with adhesive to facilitate adherence of the web 60 to the transfer fabric 111 thereby assisting the separation of the web 60 from the belt 20.

In the embodiment shown in FIG. 3, the web 60 is continuously directed into the transfer nip formed in the area TN between the roll 51 having the associated first band 31 thereon and the roll 72 having the associated transfer fabric 111 thereon. More precisely, in FIG. 3, the transfer nip is formed between the first band 31 and the transfer fabric 111, to receive the web 60.

75. As shown in FIGs. 5-7, the transferal of the web 60 to the creping surface 75 may involve foreshortening by microcontraction of the web 60, wherein a velocity differential exists between the first press surface 11 and the transfer fabric 111.

Intermediate belts, separate from both the papermaking belt 20 and the transfer
5 fabric 111, may also be used in the present invention. U.S. Patent 5,607,551, issued on Mar. 4, 1997 to Farrington and assigned to Kimberly-Clark Corporation is incorporated by reference herein. Also, the transferal of the web 60 from the belt 20 to the transfer fabric 111 may be accomplished by using a transfer gap between the belt 20 and the fabric 111. PCT Application WO 96/13635, published on
10 9 May 1996, shows a method of using such a transfer gap.

The process and the apparatus of the present invention may be utilized in making a paper web having no differential density regions. In this instance, both the first press surface 11 and the web-side 20a of the belt 20 should preferably be smooth, as one skilled in the art will readily appreciate. Regardless of the type of
15 the paper web made by the proposed apparatus and process, the web 60 may optionally be calendered after being foreshortened.

apparatus further comprising an adhesive applicator for depositing a creping adhesive on said creping surface.

3. The apparatus according to Claim 1, wherein said foreshortening means comprises a transfer fabric designed to receive said web after said web has been pressed between said first and second press surfaces, said transfer fabric moving in said machine direction at a second velocity less than said first velocity, preferably said transfer fabric comprising an endless belt having a textured web-receiving surface, optionally said foreshortening means further comprising a vacuum apparatus for transferring said web from said papermaking fabric to said transfer fabric.
4. The apparatus according to Claim 3, wherein said foreshortening means further comprises a transfer nip preferably formed between said transfer fabric and either said papermaking belt or said first press surface.
5. The apparatus according to Claims 1, 2, 3, and 4 wherein said papermaking fabric comprises a macroscopically-monoplanar and fluid-permeable papermaking belt having a web-side and a backside opposite to said web-side, preferably said belt further comprising a framework having a web-side surface, a backside surface opposite to said web-side surface, and a plurality of deflection conduits extending between said web-side surface and said backside surface, said web-side surface of said framework defining said web-side of said belt, and more preferably said belt further comprising a reinforcing structure joined to said framework and positioned between said web-side surface and said backside surface of said framework.

- (b) providing a fluid-permeable papermaking fabric having a web-side and a backside opposite to said web-side;
 - (c) providing a web of wet cellulosic fibers;
 - (d) disposing said web on said web-side of said papermaking fabric;
 - (e) interposing said web and said papermaking fabric between said first and second press surfaces;
 - (f) pressing said first and second press surfaces towards each other to impress said papermaking fabric into said web, thereby densifying at least selected portions of said web, preferably said first press surface contacting said web and said second press surface contacting said papermaking fabric;
 - (g) creating a temperature differential between said first press surface and said second press surface, thereby moving water from said web into said papermaking fabric;
 - (h) releasing said web from the pressure between said first and second press surfaces; and
 - (i) foreshortening said web to form said foreshortened paper web.
8. The process according to Claim 7, wherein said step of foreshortening comprises creping said web off a creping surface with a doctor blade, preferably said process further comprising a step of adhering said web to said first press surface with a creping adhesive.
9. The process according to Claim 7, wherein said step of foreshortening comprises transferring said web from said papermaking fabric to a transfer fabric moving at a second velocity less than said first velocity.

What is claimed is:

1. An apparatus (10) for making a foreshortened paper web (60), in combination with an endless papermaking fabric (20), said apparatus (10) comprising:
 - a first press surface (11) and a second press surface (12), said first and second press surfaces (11, 12) forming a press nip therebetween and being structured to receive a web (60) of wet cellulosic fibers in association with said papermaking fabric (20) interposed between said first and second press surfaces (11, 12) such that said first press surface (11) contacts said web (60), and said second press surface (12) contacts said papermaking fabric (20);
 - a pressing means (30) for pressing said first and second press surfaces (11, 12) towards each other to cause densification of at least selected portions (61) of said web (60);
 - a means (40) for creating a temperature differential between said first press surface (11) and said second press surface (12) to move water from said web (60) into said papermaking fabric (20);
 - a transporting means (50) for moving said web (60) in a machine direction at a first velocity; and
 - a foreshortening means (70) for foreshortening said web (60),said apparatus being characterized in that each of said first and second press surfaces (11, 12) comprises an endless band, said first press surface (11) is parallel to said second press surface (12), and said foreshortening means is disposed in the machine direction immediately after said press nip, wherein said apparatus does not use a Yankee dryer.
2. The apparatus according to Claim 1, wherein said foreshortening means (70) comprises a creping blade (73) juxtaposed with a creping surface (75), said creping surface (75) comprising said first press surface (11).

3. The apparatus according to Claims 1 and 2, further comprising an adhesive applicator (90) for depositing a creping adhesive on said creping surface (75), in a substantially pre-determined pattern.
4. The apparatus according to Claims 1, 2, and 3, wherein said belt comprises a framework having a web-side surface, a backside surface opposite to said web-side surface, and a plurality of deflection conduits extending between said web-side surface and said backside surface.
5. The apparatus according to Claim 1, wherein said foreshortening means (75) comprises a transfer fabric (111) having a textured web-receiving surface and structured to receive said web (60) after said web (60) has been pressed between said first and second press surfaces (11, 12), said transfer fabric (111) moving in said machine direction at a second velocity less than said first velocity, and said web (60) has a fiber-consistency of at least about 30% after said web (60) is released from the pressure caused by said first and second press surfaces (11, 12) and before said transfer fabric (111) receives said web (60).
6. The apparatus according to Claim 5, wherein said foreshortening means (75) further comprises a transfer nip formed either between said transfer fabric (111) and said papermaking fabric (20) or between said transfer fabric (111) and said first press surface (11).
7. A process for making a foreshortened paper web, said process comprising the steps of:
 - (a) providing a first press surface (11) and a second press surface (12) juxtaposed with the first press surface (11) to form a press nip therebetween, the first and second press surfaces moving in a machine direction at a first velocity.;

- (b) providing a fluid-permeable papermaking fabric (20) having a web-side (20a) and a backside (20b) opposite to said web-side (20a);
- (c) providing a web of wet cellulosic fibers (60);
- (d) disposing said web (60) on said web-side (20a) of said papermaking fabric (20);
- (e) interposing said web (60) and said papermaking fabric (20) between said first and second press surfaces (11, 12);
- (f) pressing said first and second press surfaces (11, 12) towards each other to impress said papermaking fabric (20) into said web (60), thereby densifying at least selected portions (61) of said web, said first press surface (11) contacting said web, and said second press surface (12) contacting said papermaking fabric (60);
- (g) creating a temperature differential between said first press surface (11) and said second press surface (12), thereby moving water from said web (60) into said papermaking fabric (20);
- (h) releasing said web (60) from the pressure between said first and second press surfaces (11, 12); and
- (i) foreshortening said web (60) to form said foreshortened paper web, said process being characterized in that in said step (a) of providing said press surfaces each of said first and second press surfaces (11, 12) comprises an endless band, in said step (e) of interposing said web (60) between said first and second press surfaces (11, 12) said first press surface (11) is parallel to said second press surface (12), said step (i) of foreshortening is performed immediately after said web (60) is released from the pressure between said first and second press surfaces (11, 12), and wherein said process is conducted without the use of a Yankee dryer.

8. The process according to Claim 7, wherein said step (i) of foreshortening comprises creping said web (60) off said first press surface with a doctor blade (73).

9. The process according to Claim 7, wherein said step (i) of foreshortening comprises transferring said web (60) from said papermaking fabric (20) to a transfer fabric (111) moving at a second velocity less than said first velocity.
10. The process according to Claims 7, 8, and 9, wherein said web of cellulosic fibers (60) comprises fluid-latent indigenous polymers.