

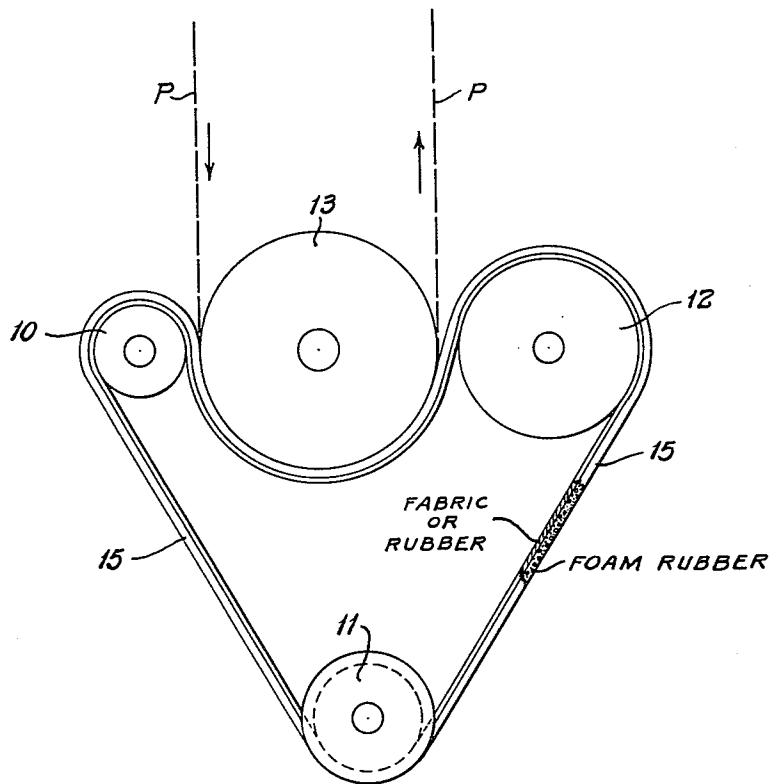
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W. C. DABROSKI ETAL

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APPARATUS FOR TREATING PAPER WEBS

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INVENTOR.

WINIFRED CHRISTINA DABROSKI
BENJAMIN FRANK HERR
BY

Morgan, Finnegan, Durham & Pine
ATTORNEYS.

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APPARATUS FOR TREATING PAPER WEBS

Winifred Christina Dabroski and Benjamin Frank Herr,
Brunswick, N.J., assignors to Johnson & Johnson, a
corporation of New Jersey

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1 Claim. (Cl. 162-361)

This invention relates to novel apparatus and methods for increasing the extensibility of paper webs in a continuous manner.

In recent years a number of methods and apparatus have been developed for increasing the extensibility of paper webs. In U.S. Cluett Patent No. 2,624,245, there are disclosed a method and apparatus for increasing the extensibility of a paper web in the longitudinal direction. In the Cluett process, a compressive force is applied parallel to the face surfaces of a paper web in a direction lengthwise thereof, while simultaneously there is applied a force perpendicular to said face surfaces. This causes the fibers of said web to be compressively distorted, crowded and pushed together between the face surfaces of the web within and throughout the body of the web in a direction parallel to said face surfaces lengthwise of the web. Paper treated in the aforementioned manner is stretchable in a longitudinal direction.

In copending application Serial No. 680,146, filed August 26, 1957, by Isaac R. Dunlap, now abandoned, there are disclosed methods and apparatus for increasing the extensibility of a paper web in the lateral direction or in both the lateral and longitudinal directions. In the aforementioned Dunlap methods, a compressive force or forces are applied parallel to the face surfaces of a paper web in a direction crosswise or in directions crosswise and lengthwise thereof, while simultaneously there is applied a force perpendicular to said face surfaces.

By the Dunlap methods, fibers of the web are caused to be compressively distorted, crowded and pushed together between the face surfaces of the web within and throughout the body of the web in a direction parallel to said face surfaces crosswise or crosswise and lengthwise of the web. Papers treated in accordance with the aforementioned Dunlap methods are stretchable in the lateral or lateral and longitudinal directions.

In the above-mentioned prior Cluett and Dunlap methods, the paper web that is passed to the compressing machine is usually in a wet condition to make the paper fibers more pliable and to reduce the resistance of the paper web to contraction. The time required to soak the paper web to reduce its resistance to contraction, of course, varies depending upon the paper to be compressed and may be as short as minutes and as long as hours. Prior to this invention, paper webs conditioned in the aforementioned manner, prior to being passed to the compressing machine, had to be treated so as to control the water content of the paper web. The water content of the paper web is an important consideration because it is not possible to materially increase the density or to decrease the volume of the web if the web is highly saturated with water. For a paper web to be compressed effectively, it must have an adequate number of voids. The voids permit increased compression of the web and thus increased extensibility. While some water will gradually be removed from the web, as it is compressed in the machine, so as to produce some voids, the excess of the water in a thoroughly wet paper web, heretofore, had to be removed by suitable means before the web entered the compressing machine to critically control the water content of the web passed to the compressing machine. Removal of said excess of water from said web prior to passing it to the compressing machine in the

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aforementioned manner, provided a web having a large number of voids which, as indicated above, permits increased compression of the web when subjected to the compression operation.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the steps, methods, combinations and improvements pointed out in the appended claim.

The invention consists in the novel steps, methods, combinations and improvements herein shown and described.

It is an object of this invention to provide novel apparatus and methods for increasing the extensibility of a paper web in a continuous manner by a compression operation whereby it is not necessary to critically control the water content of a wet paper web to be subjected to a compression operation. A further object of this invention is to provide novel apparatus and methods for increasing the extensibility of a paper web in a continuous manner by a compression operation in which a greater amount of water may be removed from a wet paper web during the compression operation than has heretofore been possible.

The accompanying drawing is a diagrammatic side elevation of one embodiment of apparatus of this invention.

The apparatus by which the objects of this invention may be realized comprises a deformable, porous endless belt system which, when contacted by an "appreciably wet paper web" fed in a direction lengthwise thereof causes simultaneously: (1) a substantial amount of water to be squeezed out of said web which passes into the pores of the belt system and is absorbed by or passes through said belt leaving the web with a large number of voids, and a "substantially reduced water content," and (2) a compressive force to be applied to the web parallel to the face surfaces thereof. By the term "appreciably wet paper web," as used herein, is meant that the web contains water in an amount at least 50% by weight of the dry weight of the web. The term "substantially reduced water content" as used herein means the water in the web after compression is not greater than 35% by weight of the dry weight of the web. The aforementioned compressive force may be applied in a direction lengthwise, crosswise, or lengthwise and crosswise. Means are provided for simultaneously applying a pressure perpendicular to said face surface while the compressive force is applied thereto, whereby fibers between the face surfaces of said web are compressively distorted, crowded and pushed together between the face surfaces of the web within and throughout the body of the web in a direction parallel to said surfaces.

As indicated hereinbefore, by the present invention, it is not necessary to critically control the water content of the wet paper web fed to the compressing mechanism. Thus, webs which have been conditioned to a substantially saturated state by soaking in water may be passed to the compressing mechanism without any special preliminary treatment to remove water.

In order to explain the invention even further, reference is now made to the accompanying drawing which illustrates one embodiment of the invention useful in increasing the extensibility of a paper web by a compression operation wherein, contrary to prior apparatus, it is not necessary to critically control the water content of the wet paper subjected to the compression operation. The embodiment illustrated in the drawing relates to apparatus for increasing the extensibility of a paper web in a direction longitudinal of the web. More particularly, the apparatus comprises rolls 10, 11 and 12, heat driven roll 13 and a thick, deformable porous belt having a contract-

able surface layer, preferably of foam rubber. Roll 10 and roll 13 are adjustably movable toward or from each other so as to properly nip the belt 15 between them where the belt passes from the roll 10 to roll 13, and roll 12 being spaced away from 13 sufficiently to give the porous belt a short straight run from roll 13 to roll 12. As the belt passes from roll 10 to roll 13, the outer surface of the foam belt which is convexly curved on roll 10 becomes concavely curved on roll 13 and, accordingly, shortens.

The aforescribed apparatus may be used for compressing a paper web in a direction longitudinal of the web, even if it is soaking wet, in a continuous manner. The wet paper web P is fed in a direction lengthwise thereof between the foam belt 15 and roll 13 where the shortening of the belt surface is taking place. The pressure exerted on the paper web as it is passed between belt 15 and roll 13 causes water to be squeezed out of the web wet into the pores of the foam belt leaving a web having a number of voids whereby the web is readily compressible. The desired compressive force which is applied to the face surfaces of the web in a direction lengthwise thereof, is produced by expanding belt 15 in a lengthwise direction by means of roll 10, and subsequently permitting longitudinal contraction of the belt when the paper web is passed between belt 15 and low friction roll 13. Simultaneously, there is applied a pressure perpendicular to the face surfaces of the web. This is accomplished by means of the pressure applied to the web as it passes between the nip formed by rollers 10 and 13.

The above-described forces on the web causes the fibers of the web to be compressively distorted, crowded and pushed together between the face surfaces of the web within and throughout the body in a direction parallel to said face surfaces. In the particular embodiment shown, the fibers are compressively distorted, crowded and pushed together in a direction lengthwise of the web. It should be understood, however, that the principles of this invention are applicable to other modifications or embodiments whereby a paper web is compressed in such a manner that the fibers are compressively distorted, crowded and pushed together between said face surfaces within and throughout the body of the web in a direction parallel to said face surface but in a direction other than longitudinal of the web such, for example, as crosswise and longitudinal of the web or crosswise of the web.

For example, in the embodiment shown in the drawing, if a crown roll is substituted for the roll 10 shown, a wet paper web passed through such embodiment will be compressed both longitudinally and laterally in a continuous manner rather than just longitudinally as is the case employing the embodiment shown in the drawing. Paper webs passed through the apparatus shown in the accompanying drawing are stretchable mainly in the machine direction. Paper webs passed through the above referred to modification employing a crown roll would be stretchable in both the machine and cross-machine directions.

Appreciable wet paper webs treated in accordance with this invention not only provide paper webs which have improved stretchability, but improved delamination resistances (resistance to splitting into plies) as well. Also, unified sheets formed from such paper webs exhibit an improved delamination resistance compared to unified sheets formed from the same raw paper and impregnated in the same manner except that the paper web has not been compressed.

The following are examples of appreciably wet paper webs which are treated in accordance with the methods and by the apparatus of this invention. Unless otherwise indicated, the parts given are by weight. It should be understood that the examples are merely for the purpose of illustrating the invention, but the invention should not be considered limited thereto. It should be pointed out that the wet paper webs fed to the compressing apparatus

contain water in an amount of about 100% by weight of the weight of the dry paper web, which is contrary to heretofore methods wherein the water in the web to be compressed was critically controlled so as not to exceed about 35% by weight of the dry paper web.

Example 1

A wet flat kraft paper web (about 100% by weight of water of the dry weight of paper) of 30 lbs. basis weight (24 x 36 x 480) was compressed to 85% of its original length by passing said web through the apparatus shown in the accompanying drawing in a manner described hereinbefore in detail. The compressed web showed a 20% improvement in elongation in the longitudinal direction.

The above-described compressed sheet was impregnated (32.6% impregnation on a dry weight basis), with a conventional water-based impregnant of the following formulation:

	Parts by wt.
Butadiene-acrylonitrile (70:30)-----	74.0
Butadiene-styrene (50:50)-----	23.5
Phenolic curing resin (Durez)-----	2.0
Ethylene diamine tetra acetic acid-----	0.5

When tested for delamination resistance, the impregnated sheet showed a delamination resistance of 42 oz. An identical raw paper sheet (non-compressed) impregnated to the same extent with the same impregnant showed a delamination resistance of only 12 ounces.

Example 2

A wet kraft paper web (about 100% by weight of water of the dry weight of paper) of 27 lbs. basis weight (24 x 36 x 480) was compressed to 85% of its original length by passing said web through the apparatus shown in the accompanying drawing in a manner described hereinbefore in detail. The compressed web showed an 18% improvement in elongation in the longitudinal direction.

The above described compressed sheet was impregnated (17% impregnation on a dry weight basis) with a conventional water-based impregnant of the following formulation:

	Parts by wt.
Butadiene-acrylonitrile (70:30)-----	74.0
Butadiene-styrene (50:50)-----	23.5
Phenolic curing resin (Durez)-----	2.0
Ethylene diamine tetra acetic acid-----	0.5

When tested for delamination resistance, the impregnated sheet showed a delamination resistance of 40 oz. An identical raw paper sheet (non-compressed) impregnated to the same extent with the same impregnant showed a delamination resistance of only 29 ounces.

The invention in its broader aspects is not limited to the specific steps, methods, combinations and improvements described but departures may be made therefrom within the scope of the accompanying claim without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

In a paper web compacting and extensibilizing apparatus comprising longitudinally movable and continuous, deformable rubber belt means having one surface adapted to contact and compact a wet paper web; means for expanding said belt surface along a portion of its travel and then permitting contraction of said surface; and pressure means for applying pressure to the wet paper web perpendicular to its face surfaces and holding the web in contact with the compacting surface of said belt from a point where the compacting surface is expanded to a point where it is contracted; the improvement wherein the rubber belt, including the compacting surface thereof, is of foam rubber and capable of holding a substantial percentage of water and the belt surface opposite to its compacting surface is reinforced; whereby a substantial

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amount of water is removed from the wet paper web and passed into the pores of said belt when pressure is applied to the web while it is in contact with the compacting surface of said belt, and fibers between the face surfaces of said web are compressively distorted, crowded and pushed together between the face surfaces of the web within and throughout the body of the web in a direction parallel to said face surfaces of the web as the belt contracts while in contact with the web.

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