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Chesky et al.

[11] 3,837,338

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[54] **CONFORMABLE NONWOVEN BANDAGE**

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[52] **U.S. Cl.** **128/156,** 26/18.6, 161/169

[51] **Int. Cl.** **A61l 15/00**

[58] **Field of Search** 128/156, 155, 82; 26/18.6; 161/169

[56] **References Cited**

UNITED STATES PATENTS

2,528,793	11/1950	Secrist	128/156 X
2,625,733	1/1953	Secrist	128/156 X
2,765,513	10/1956	Walton	26/18.6
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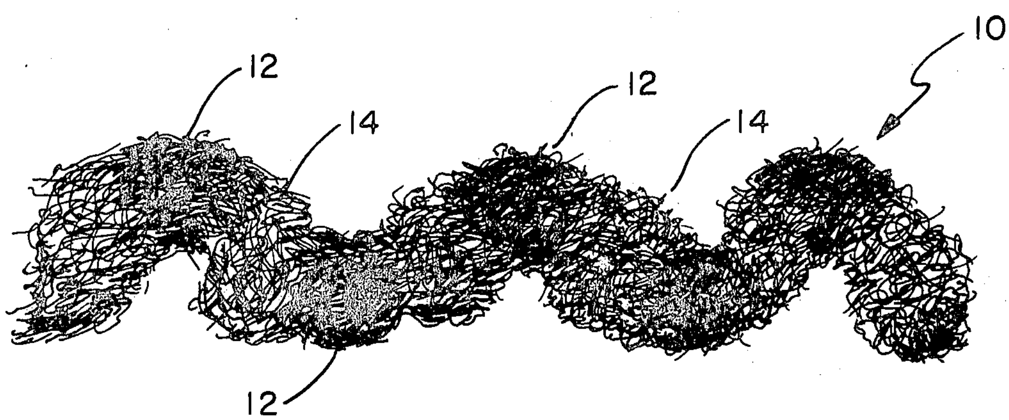
[57] **ABSTRACT**

A felted cellulosic nonwoven fabric, in which the fibers have substantial freedom of movement relative to each other, is mechanically compacted into a series of undulations, to yield a bandage material that does not decrease in width when elongated by 10% or more.

3 Claims, 4 Drawing Figures



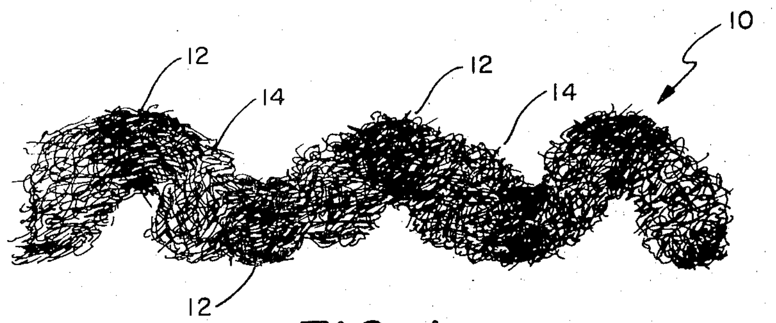


FIG. 1

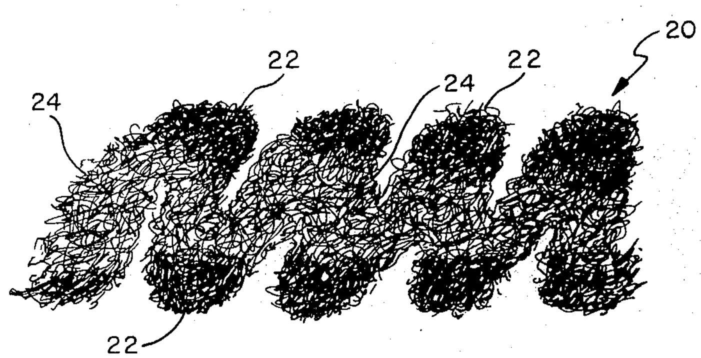


FIG. 2

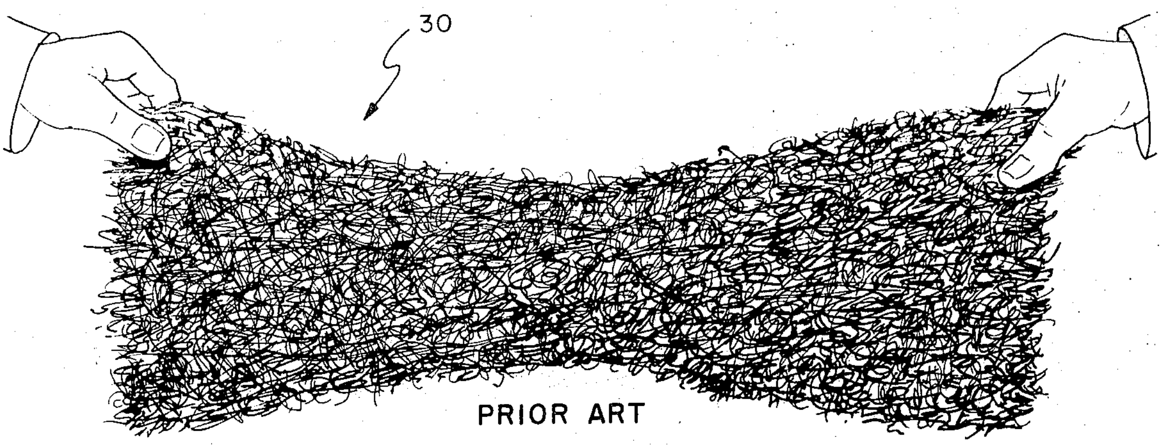


FIG. 3

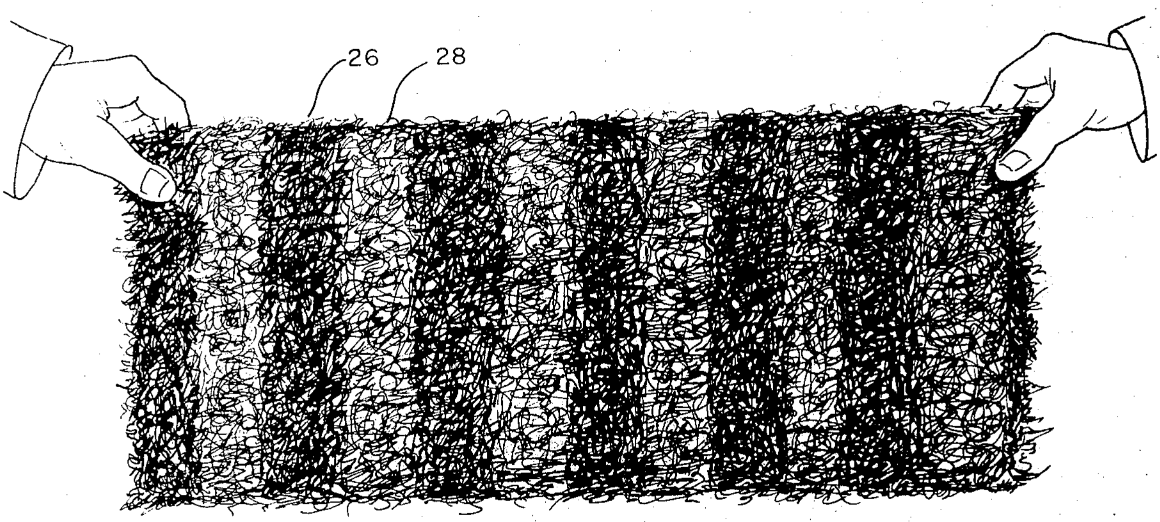


FIG. 4

CONFORMABLE NONWOVEN BANDAGE

This invention relates to a nonwoven bandaging material. More particularly it relates to a bandaging material which has enhanced elongation and conformability, of advantageous use in applications such as cast padding in orthopedic surgery.

FIELD OF THE INVENTION

A variety of bandaging materials is presently being used in orthopedics and allied arts as padding under rigid supports such as plaster casts, splints, and braces, and as padding under elastic bandages, elastic stockings and the like for the correction or amelioration of circulatory disturbances such as phlebitis or varicosities.

A satisfactory bandage of this type should be elastic and conformable, to provde support; it should be non-constricting, even under pronounced swelling and should not shrink during the alternating sorption and desorption of moisture; it should be strong enough wet or dry to resist rupture during application and use; it should not readily bunch or wrinkle; it should absorb and retain perspiration, promoting healthy tissue; it should have a high air porosity, to permit unhampered circulation of air; and it should be soft and non-irritating.

PRIOR ART

Available prior art devices are deficient in one or more of the desirable criteria set forth above. Sheet wadding, the oldest historically-used cast padding, is relatively non-absorbent. has low dry and wet strength, and is held together by a starch coating which offers a fertile breeding ground for micro-organisms, especially when damp. Various proposed alternatives to sheet wadding are objectionable on other grounds. One available material, described in U.S. Pat. No. 2,625,733, is widely used in orthopedic work, consisting as it does of a binder-free cotton felt, in which the fibers are held together by mechanical engagement. It does, however, have a tendency to pucker, wrinkle, or fold over unless special care is exercised during it application. In order to obviate this difficulty, the surgeon frequently will apply tension to the bandage which is sufficient to cause rupture. Additionally, tension applied to a felt-like bandage of this type causes a narrowing of the width of the bandage, called "necking in", which decreases the area-covering power of the material. This behavior is especially apparent when the bandage is applied to body members in which an abrupt directional change is encountered, as in bandaging a lower extremity. The necking-in is accompanied by an increase of up to 50% in the thickness of the bandage, which is undesirable in that it may give rise to ridges and potential pressure points on or along the bandage edges.

It is an object of this invention to provide an improved bandaging material suitable for orthopedic use. It is a further object of the invention to provide a crimped orthopedic bandage of entangled and interlaced cellulosic fibers, said bandage being exceptionally soft and being capable of 10% or more elongation without an appreciable narrowing in width.

Other objects of the invention will be apparent from the following description and drawings in which:

FIG. 1 is a front elevation of the edge of a bandage material made according to this invention.

FIG. 2 is a similar view of another embodiment of the invention.

FIG. 3 is a representation of a prior art bandage material under tension.

FIG. 4 is a similar view of the product of this invention under tension.

SUMMARY OF THE INVENTION

As a starting material for the product of this invention, there is employed a nonwoven fabric comprising cellulosic fibers which are frictionally interlocked into a felt-like structure by artificially-induced kinks, twists, bends, and curls, as described in U.S. Pat. Nos. 2,528,792 and 2,625,733, of common assignee. The material described in the latter patent has found use as an orthopedic bandage, due to its clean, absorbent, porous nature, and its property of clinging to itself.

Such material does, however, fall short of being ideal, on three counts. Although it is recoverably elongatable, in contrast to the commonly-employed sheet wadding, such bandage material as currently available elongates only about 25% before breaking. Stretching orthopedic bandage material is inevitably met with the result of the need for adjusting to the constantly varying contours of body members. As set forth above, stretching under tension causes a substantial necking-in, or decrease in width, of such bandage material, as illustrated by the behavior of the prior art bandage **30** in FIG. **3.** And finally, stretching bandage material of this nature causes an increase in thickness.

The reason seems to lie in the fact that in the prior art material the fibers are interlocked into a fabric of uniform density, with any force applied to one group of fibers being translated into a coactive effect on all of the rest of the fibers, which are relatively free to move. The behavior of the material under stress, therefor, resembles the behavior of an elastomeric plastic strip — i.e., there is a narrowing of the material at a point intermediate the ends.

It has now been found that this type of necking-in, with consequent increased thickness, can be obviated if the base fabric of U.S. Pat. No. 2,625,733 is rearranged into a fabric in which the fibers are aggrevated into a set of transverse wave-like undulations, marked by transverse ribs of more densely compacted fibers at the peaks and valleys of the undulations, and more extensible, less compacted areas of fibers on the slopes of the undulations.

In this manner, a sort of reservoir of elasticity is provided by the uncompacted fibrous areas, **28** in FIG. **4,** which shows a bandage of this invention under tension, comparable to the tensed prior art bandage of FIG. **3.** The compacted fibrous ribs **26,** however, are made up of fibers which have been brought into closer approximation, and which are not so readily displaced from their position by applied stress. The ribs **26,** therefor, have the net effect of holding the bandage out to width during extension, the elastic capacity of the bandage as a whole being satisfied by the ability of the uncompacted areas **28** to stretch and recover.

It is essential, for behavior of this sort, that the fibers comprising the starting material be held together principally by mechanical engagement, so that they have a relatively high degree of freedom of movement with respect to each other. In this manner, fibers can be displaced from the normally uniform density of the sheet, to be aggregated into alternating bands of high density and low density. The apparent density (weight per unit volume of fabric) in the compacted, relatively inextensible rib sections may be as much as twice the apparent density of the uncompacted, readily extensible sections. The apparent thickness of the bandage, however, does not vary appreciably from point to point, the density increase in the rib sections being effected by an actual physical translation of fibers from the extensible sections.

As processes for rearranging the fibers of cellulosic felts of the nature set forth in U.S. Pat. No. 2,625,733, a mechanical creping or crimping action is exerted on the fabric, as described in U.S. Pat. Nos. 2,765,513, 2,765,514, or 3,655,474. Although primarily designed for imparting a micropleating action to fabric materials and paper, these processes have been found to have an unexpected advantage in producing the product of this invention, in that the freedom of movement of the fibers in the base material allows individual fibers to be displaced from their entangled positions and to be rearranged into zones of alternating high and low density. The degree of compacting, and the permanence thereof, is enhanced by carrying out the process in the absence of moisture, and at temperatures of 200° F or higher.

A typical bandage material made by subjecting the nonwoven fabric of U.S. Pat. No. 2,625,733 to the compacting process described in U.S. Pat. No. 2,765,513 is shown at **10** in FIG. **1.** The normally flat and planar arrangement of the fibers has been rearranged into a series of sine-like waves and troughs, consisting of alternating ribs of high density **12** separated by zones of low density **14.**

FIG. **2** represents another embodiment of the invention, in that the bandage material **20** has been rearranged into a somewhat different wave-like configuration, but still consisting of alternating high-density ribs **22** and low-density zones **24.** The behavior of either type of material under 10% to 20% elongation is shown in FIG. **4.**

As base material for compacting, the base fabric range may be from 40 to 120 grams per square yard, with the 50 to 80 gram range being especially preferred. The number of convolutions per linear inch, determined by the machine settings in known manner, may vary from eight to 16, with the 11 to 14 per inch range preferred. The linear shrinkage during compaction may vary from 10% to 30 or 40%. Due perhaps to the attenuation of fibers effected in the noncompacted, extensible zones, a decrease of about 25% may be expected in the machine direction tensile strength, related to the decrease in weight of the fabric in the extensible areas.

The elongation at break of bandage material processed according to this invention is markedly enhanced over the elongation at break of the untreated nonwoven fabric, being between 50% and 70% compared with 20% to 25% in bandage material compacted by 12% – 20%. This is accompanied by an increased conformability and ready adaptation to form a smooth, wrinkle-free covering over wrists, ankles, knees, and the like. Unlike the base material, the compacted bandage had a thickness of 40 mils both originally and after 20% extension and release, as measured on an Ames gauge Type 382 with 1.5 inch diameter foot. Even higher elongations at break characterize material subjected to greater degrees of compaction.

The behavior of the bandage material under tension is remarkable and unexpected. A three-inch wide strip of uncompacted nonwoven fabric, stressed to 10% elongation, narrowed in its central portion to 2.6 inches, a loss of 13%, and showed a loss in width of 17% when subjected to 20% elongation, after which it broke. The same nonwoven fabric, compacted according to this invention, to a frequency of 11.5 convolutions per inch, with a convolution amplitude of 0.05 inches, actually gained slightly in width at 10% elongation, showed a loss of only 6% at 20% elongation, and at 40% elongation was still wider than the untreated base material was at 10% elongation. Since tensions applied in orthopedic bandaging are often sufficient to stretch the bandage material by 10% to 20%, the increased conformability and covering power of the bandage of this invention will be readily apparent.

Having thus described our invention, we claim:

1. A conformable nonwoven bandage material which comprises:

a strip of felt-like nonwoven fabric characterized by the property of displaying substantially no decrease in width where elongated by 10% comprising cellulosic fibers held together principally by frictional engagement derived fron kinks, bends, twists, and curls induced into said fibers,

said fabric being arranged in a repeating series of wave-like undulations substantially throughout its length,

said undulations running across the width of said strip,

and said undulations comprising a set of high density, compacted transverse ribs marking the peaks and valleys of said undulations,

the side slopes of said undulations comprising areas of lower fiber density and greater extensibility than the fibers in said ribs.

2. The bandage material of claim **1** characterized by a weight of between 50 and 80 grams per square yard and between 11 and 14 undulations per inch.

3. The bandage material of claim **1** characterized by an elongation at break of at least 50%.

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