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Patience

[11] **3,837,344**

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[54] **LAPAROTOMY SPONGES**

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[52] **U.S. Cl.** **128/296**

[51] **Int. Cl.** **A61f 13/00**

[58] **Field of Search** 128/284, 286, 287, 296

[56] **References Cited**

UNITED STATES PATENTS

2,081,370	5/1937	Secrist	128/296
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3,491,802	1/1970	Mortensen et al.	128/296
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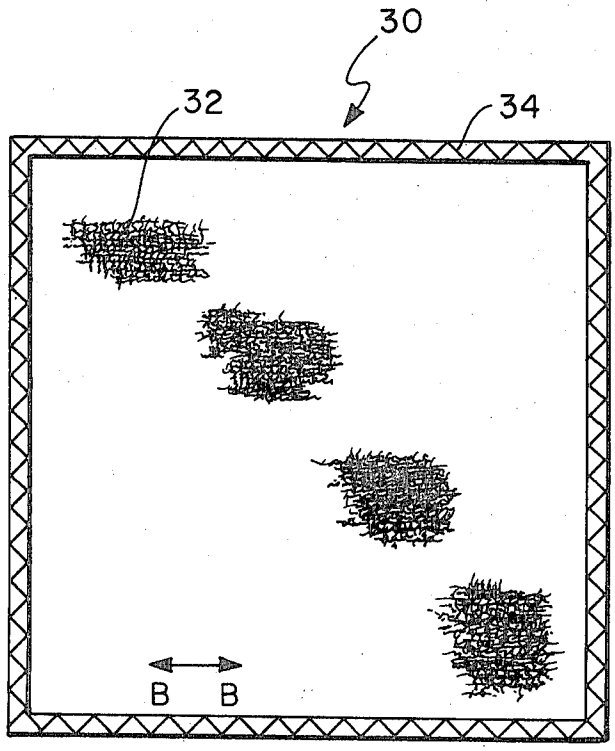
[57] **ABSTRACT**

A laparotomy sponge is formed from a multiplicity of plies of open-meshed bleached absorbent gauze of a cover factor of not greater than 3.5, wherein the yarns of each ply are kinked, convoluted, and twisted into interengagement with the adjacent plies of gauze. The plies are thereby held together in relatively non-displaceable relationship, and the sponge has increased loft and elasticity.

3 Claims, 4 Drawing Figures



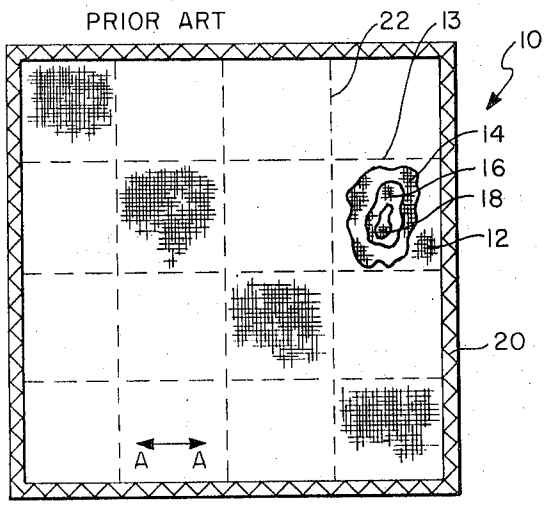


FIG. 1

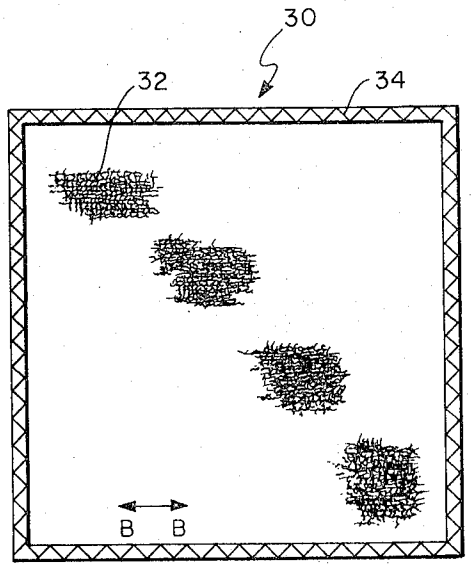


FIG. 2

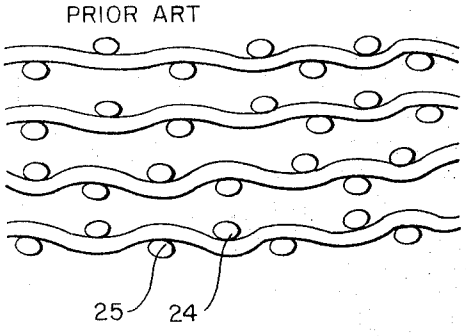


FIG. 3

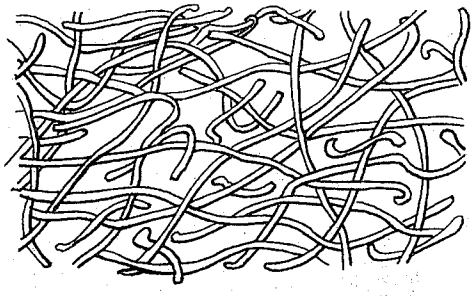


FIG. 4

LAPAROTOMY SPONGES

This invention relates to soft, conformable woven gauze dressings known as laparotomy sponges or abdominal packs. More particularly it relates to a process for producing packs of enhanced atraumatic properties by a more economical process than conventional packs.

BACKGROUND OF THE INVENTION

This invention is concerned with surgical laparotomy sponges commonly referred to as ABD packs, or abdominal packs. ABD packs are often used in surgical procedures involving the opening of the abdominal wall by surgical incision whereby body organs and delicate membranes and tissues are exposed. These delicate body members when exposed to the air are subject to radically different environmental conditions than are normally encountered in the moist warmth of the body. It is considered good surgical procedure, therefore, to simulate an environment more nearly approaching the natural environment by using ABD packs moistened with warm saline solution. Such moistened packs are inserted into the cavity to protect and isolate those interior body organs and tissues not directly involved from accidental impact and environmental hazards of the immediate operative area. In the operative area itself ABD packs, either dry or only slightly moistened, are used to sponge and soak up any surplus body fluid present.

ABD packs have evolved over many years of surgical practice. Presently used ABD packs are an attempt to retain both the advantages of thin, flexible single layers and the absorptive cushioning and insulating properties of thicker padlike structures. As a result, the ABD pack has traditionally been formed of multiple layers of low-count gauzelike material which are unified by a sewing operation along fairly widely separated lines extending longitudinally or transversely, or in the case of packs of appreciable size, in both directions. Unification has universally been accomplished by lines of machine stitching whether the pack is formed of separated layers or, as is more common, by folding a single width of fabric. Such unification of the multiple layers of the pack has been necessary to minimize the possibility of the separate plies of gauze shifting in position with respect to each other, with the formation of undesirable and possibly trauma-inducing folds and wrinkles, either during use or during laundering and reclaiming. Although hitherto regarded as essential, such cross-stitching is a substantial element in the cost of producing conventional abdominal packs.

Packs of this sort, made from bleached absorbent gauze, have a relatively harsh hand, and are not considered suitable for application to delicate body organs without pretreatment. Therefore, it is an almost universal hospital practice to launder such packs before their initial use, to soften the pack and render it less traumatic. This laundering procedure introduces pills of fiber onto the surface of the pack, which necessitates a combing operation for pill removal to avoid the danger of fibrous pills or lint becoming detached from the pack, being left in the body, and giving rise to a foreign body reaction. The processing of conventional packs before their initial use, therefore, is a tedious and expensive process, complicated by the necessity of individually wrapping and sterilizing the packs prior to

their introduction into the operating room. Packs made in accordance with this invention may be prepackaged as wrapped, single and sterilized units, ready for use.

It is with improvements in the manufacture of abdominal packs made from woven gauze that the present invention is concerned.

It is an object of the present invention to provide an improved process for the manufacture of abdominal packs.

It is a further object of the invention to provide a woven abdominal pack of enhanced bulk and softness, comparable in hand with a washed gauze pack, and not requiring laundering before use.

An additional object of the invention is to provide a woven abdominal pack comprising a plurality of layers of open-meshed gauze in which the individual layers of gauze are interengaged in relatively non-displaceable relation to each other without the use of cross-stitching to hold the layers together.

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

FIG. 1 is a front elevation of a conventional woven gauze prior art abdominal pack.

FIG. 2 is a similar elevation of the pack of the present invention.

FIG. 3 is a cross-section of the prior art pack of FIG. 1 along the line A—A.

FIG. 4 is a cross-sectional view of the pack of FIG. 2 along the line B—B.

DESCRIPTION OF THE INVENTION

In carrying out the process of this invention, a multiplicity of layers of bleached, absorbent, low-count gauze are plied together, and while in plied and superimposed condition are subjected to strong agitation in a water bath, preferably hot, and the plied assembly is then slack dried, without any substantial warpwise or fillingwise tension. By the agitation process, both the warp yarns and the filling yarns are kinked, bent, and convoluted into a three-dimensional spatial configuration, as distinct from the planar configuration of the individual layers of untreated gauze, and the assembly shrinks at least 10 percent in warp and filling. The convolutions and kinks induced into the yarns of one gauze layer are thus caused to penetrate into the meshes of the adjacent gauze layer or layers, so that the finished slack-dried multilayered assembly behaves as a thick, soft, unitary piece of fabric, strongly resistant to attempts to delaminate or separate one treated gauze layer from another.

In selecting a suitable gauze fabric for the process of this invention, care must be exercised to provide a proper size of interstices between yarns to allow the kinking and convoluting yarns to be converted into a three-dimensional configuration in which they penetrate, in random and irregular fashion, into the interstices of the adjacent layer of gauze, becoming enmeshed and interlocked therewith. One measure of the space available to a yarn to depart, under stress, from its normal linear path is expressed by the so-called "cover factor" of the fabric, which indicates the ratio of space in a fabric occupied by yarns to the space occupied by the spaces between the yarns. Cover factor may thus be regarded as a measure of the degree of openness of a fabric — i.e., an indication of the portion of a fabric area occupied by solid yarns versus the portion occupied by open spaces between the yarns.

Mathematically, cover factor is the count or number of yarns in an inch of fabric layer divided by the square root of the size of the yarns in that layer, size being expressed in the cotton system (number of hanks of yarn, 840 yards long, in a pound of yarn).

Since the warp (end) count and the filling (pick) count usually are different, and since different size warp and filling yarns are usually employed in a fabric, the warp and filling cover factors in any woven fabric structure are usually different. An arithmetical average of the warp and filling cover factors is an index of the openness of a fabric.

As representative of a class of tightly woven fabrics, a common woven duck fabric has a 52 × 49 count, with 18's 2-ply yarns in warp and filling. The warp cover factor is 17: the filling cover factor 16. Fabrics with an average cover factor of 13 or higher are regarded as tight or closely-woven fabrics.

Diaper fabrics are in an intermediate class, with cover factors of around 7, 8, or 9. Neither diaper fabrics nor closely-woven fabrics are suitable for use as abdominal packs, due to their relative impenetrability and to the fact that when wet such fabrics tend to become relatively firm, and do not conform to the contours of body cavities and body organs.

It has been found that novel, inexpensive, and functional addominal packs can be constructed according to this invention by employing plies of open-mesh fabric wherein the average of the warp and filling cover factors is not greater than about 3.5. Such packs are soft and conformable and are capable of delivering adequate amounts of warm saline solution and of absorbing into their inner structure the viscous body fluids when they are used for sponging purposes.

As suitable fabrics for use in this invention, bleached absorbent gauze is selected which comprises yarns from 20's to 60's yarn size, with the 30's to 40's range being preferred, and with a thread count of 8 × 8 to about 18 × 12, with 14 × 8 or 14 × 10 being preferred.

A preferred process for stabilizing a multi-ply open-meshed array of bleached absorbent gauze may be derived from the process set forth in Secrist U.S. Pat. No. 2,081,370, which describes a hot water bulking treatment of single-layer open-meshed fabrics. In the process of the present invention, a multi-ply array of bleached absorbent gauze, such a 6 superimposed layers of 14 × 8 gauze, is fed to a hot water bath where it is subjected to agitation to shrink and bulk up the assembly, after which the multi-ply assembly is removed from the bath and dried without tension.

The single-layered fabric of U.S. Pat. No. 2,081,370 is characterized by the presence in the fabric of a multiplicity of crunodal loops, where yarns curve up or down out of the plane of the fabric, form a complete loop, and then continue their path in their original direction. Such loops are substantially lacking in the product of this invention, presumably due to inter-ply interference with complete yarn freedom to rearrange itself. Instead, the yarns in each ply of fabric are thrown into a series of bends, kinks, and convolutions rising out of the fabric plane and entangling and enmeshing with the perturbations in the yarn structures of the adjacent layer of fabric. The result is a unitary, coherent multilayered fabric which can be manipulated, sewn, and generally handled by conventional processing without the need of sewing or otherwise securing the layers together.

Referring to the drawings, FIG. **1** represents a conventional prior art abdominal pack **10** of open-meshed gauze, four superimposed gauze layers, **12, 14, 16,** and **18,** being shown. Unless special provision is made, the individual layers of gauze have a tendency to slide on each other and form objectionable folds and wrinkles, especially when laundered. A common method of counteracting this slippage tendency is to provide the pack with sets of cross-stitching **22** and **13,** spaced 3 or 4 inches apart, so that the layers of the pack are secured in a set of squares or rectangles. As mentioned above, such a sewing operation is an expensive part of the process of producing abdominal packs.

FIG. **3** is a cross-sectional view of the cut edge of the pack of FIG. **1** along the line A—A. The filling yarns **24** and warp yarns **25** are arranged in a plain weave, but each layer of fabric stands individually apart from each other layer, and the plies of fabric, unless otherwise secured, can be separated from each other by a slight lifting effort.

FIG. **2** is a front elevation of a typical abdominal pack **30** of this invention, wherein the warp and filling yarns **32** are seen to follow a tortuous and cursive path. This is seen more clearly in FIG. **4,** which is a cross-sectional view of the pack of FIG. **2** along the line B—B. It is characteristic of the packs of this invention that the various layers of the pack are held together in relatively non-displaceable relationship by the interpenetration of the yarns of one layer into the interstices between the yarns of the adjacent layer or layers. Therefore, in FIG. **4,** no attempt is made to distinguish between warp yarns and filling yarns, since it is practically impossible in examining such a cross-section to tell the original orientation of any single yarn, or even to which layer in the fabric it belongs, without careful microscopic dissection.

In forming the packs of this invention, a suitable number of plies of bleached absorbent gauze, such as the six plies of 14 × 8 gauze mentioned above, are made to enmesh and cohere strongly to each other by the above-described process. This is done in continuous fashion, so that the result is a roll of soft and lofty multi-ply gauze which can be cut and sewn as a unitary fabric. From this, in conventional manner but avoiding tension as far as practical, the proper size of pack is cut: typical pack sizes are 12 × 12 inches, 8 × 36, and 18 × 8.

As an index of the degree of inter-ply adhesion in the packs of this invention, a six-layered pack was prepared from 14 × 10 gauze, with 30's warp and 40's filling, with the layers intermeshed as set forth above. A 6-inch long strip of six-ply gauze, 2 inches wide, was cut from the pack. One inch was removed from the top three layers of gauze at one end, and from the bottom three layers at the other end. The strip was suspended vertically with the upper edge clamped. A force of over **40** grams had to be applied to the lower edge of the strip to separate the plies of the strip in the 4-inch overlap zone. When this was repeated with a conventional pack, either the plies fell apart merely on being suspended, or a force of only three or four grams would cause the plies of the strip to separate.

Pieces of yarn separate readily from the cut edges of open mesh low count fabrics, and their presence of course is very undesirable in a sponge or pack intended

for use inside a body cavity. Pieces of yarn are not digested or assimilated by body fluids, but instead the human system treats such yarns as foreign bodies, and attempts to encapsulate them, leading to pain and irritation, or more severe symptoms, in the patient. It has been the universal practice, therefore, to fold in the raw cut edges of a multi-layered abdominal pack, and to overstitch the folded-in edges securely, to prevent raveling, or to secure the thread ends in the cut edges by the application of a soft polymeric sealant. Such edge securement, **20** in FIG. 1 and **34** in FIG. **2,** is conventional.

It is also common practice in many varities of abdominal pack to provide a radiopaque telltale, sewn into or affixed to the pack, and a loop of tape attached to one corner of the pack. This loop is left projecting from the body cavity during surgery, to provide a ready check on the count of packs in use. Either or both of these refinements may be incorporated into the packs of this invention, and being conventional they are not shown.

OTHER EMBODIMENTS

An especially economical pack may be produced in accordance with this invention if a three-layered gauze construction, of, say, 14 × 8 or 14 × 10 count, is woven as a unit. For convenience in handling and subsequent processing, the three layers may be tied together at intervals by interweaving the yarns of one layer with the other layers, as set forth in U.S. Patent Application Ser. No. 250,238, filed May 4, 1972. The three-layered structure is boiled and bleached in conventional manner, and then, in the bleached absorbent state, is subjected to the process of U.S. Pat. No. 2,081,370, which softens the gauze and causes the plies to interengage with each other as set forth above.

The gauze is then folded laterally on itself, forming a six-layered assembly which is cut to length, and which needs to be sewn only along three edges, since the fold edge does not require protective edge-stitching to guard against the escape of cut threads.

In addition to being more economical to manufacture than packs which rely on cross-stitching to secure the plies together, the packs of this invention have properties of loft, softness, and elasticity which make them especially acceptable to the surgeon. A pack comprising six layers of untreated bleached absorbent 14 × 8 gauze had a thickness of 0.030 inches, measured on an Ames gauge Type 382 with a foot 1.5 inches in diameter. A similar six ply fabric processed according to this invention yielded a pack that measured 0.070 inches in thickness. When the necessary corrections for gauze shrinkage are made, it is found that the apparent density (grams per unit of volume) of the lofty packs of this invention is approximately half of the density of conventional packs. In the example immediately above, the apparent density of the conventional pack was 0.124 grams per cubic centimeter, and of the pack processed according to this invention, 0.066 grams. It is preferred that packs produced in accordance with this invention have an apparent density, as measured above, of not more than 0.08 grams per cubic centimeter.

Additionally, the bulking operation carried out on the multi-ply gauze assembly results in a lengthwise and widthwise contraction of 10 percent to 20 percent or so, which is reflected in the elasticity and conformability of the final pack. This elasticity, together with enhanced loft, imparts to the pack a soft resilience which is not afforded by conventional adbominal packs hitherto available. It is preferred that packs produced according to this invention be characterized by a ready elongation of at least 10 percent in both warp and filling, with substantially immediate and complete recovery therefrom.

Having thus described my invention, I claim:

1. A soft, elastic, bulky, absorbent laparotomy sponge which comprises a multiplicity of superimposed plies of open-meshed gauze,

the individual warp and filling yarns of each ply of gauze being kinked, twisted and convoluted out of the normal two-dimensional plane of gauze fabrics,

the kinks and convolutions of the yarns in each individual ply of gauze being enmeshed with and embedded into the kinks and convolutions of the yarns in each adjacent ply of gauze,

the multiple plies of gauze thus being secured in relatively non-displacable relation to each other as a unitary, coherent fabric having an apparent density of not over 0.08 grams per cubic centimeter, and said plies having means sealing said fabric against thread end loss.

2. The product according to claim **1** in which the sponge has a ready elongation of at least 10 percent in both warp and filling, with substantially complete and immediate recovery therefrom.

3. The process of producing a soft, elastic, bulky absorbent laparotomy sponge which compries:

plying together a multiplicity of layers of open-meshed bleached absorbent gauze, said open-meshed gauze having an average cover factor not greater than 3.5;

subjecting the thus-formed plied array of gauze to violent agitation in a water bath;

inducing kinks, bends and convolutions in the individual warp and filling yarns of each layer of gauze, thereby causing the interpenetration of the yarns of one layer into the interstices between the yarns of the adjacent layer or layers so as to produce a unitary, coherent fabric;

removing said unitary, coherent fabric from said water bath and drying said fabric without tension;

cutting said fabric into the shape of a laparotomy sponge;

and sealing the cut edges of said fabric against thread end loss.

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