

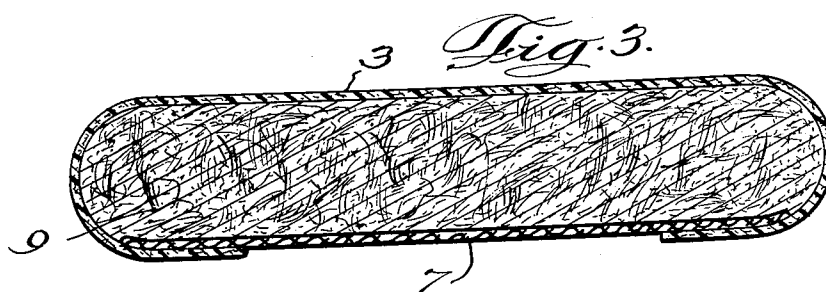
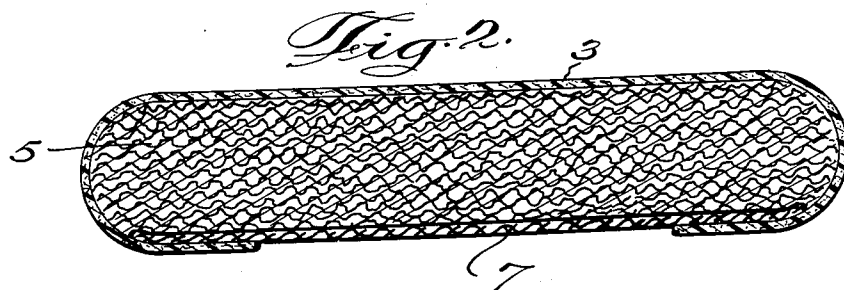
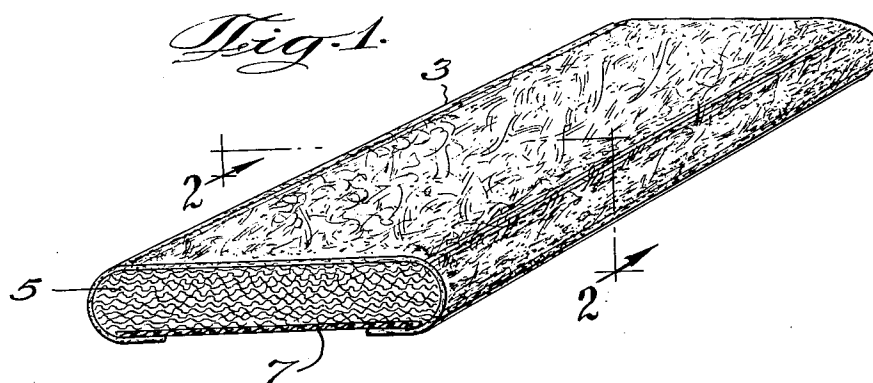
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CELLULOSIC PRODUCT

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CELLULOSIC PRODUCT

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This invention relates generally to improvements in absorbent non-adherent bandages particularly adapted for surgical or menstrual use.

It is the primary object of the invention to provide an absorbent bandage with an improved highly porous wrapper the body-contacting surface of which remains non-adherent during use.

It is an additional object to provide an absorbent non-adherent bandage which will withstand high temperature sterilization without adverse effect on the non-adherent or absorbent properties thereof.

These and various other objects will become readily apparent from the following description and accompanying drawings. The embodiments shown in the drawings are for purposes of illustrating those forms of the invention which are presently preferred. It is understood, however, that the invention is not limited to the precise arrangements and embodiments shown therein.

In the drawings:

FIG. 1 is a perspective view of an absorbent pad embodying some of the features of the invention.

FIG. 2 is a section taken through line II-II of FIG. 1.

FIG. 3 is a sectional view of another embodiment of an absorbent pad similar to the pad of FIG. 1.

FIG. 4 is still another embodiment illustrating a non-adherent surgical dressing material.

While surgical bandages must be constructed of highly absorbent material capable of accepting and retaining drainage during the normal healing process, it is highly desirable that the bandage wrapper remain non-adherent during use to permit easy removal or replacement without detriment to the cicatrix forming over the wound.

When an absorbent bandage wrapped with conventional porous fibrous material is placed in direct contact with an open wound, the wound exudate, in saturating the wrapper material normally coagulates in situ to form an undesired adhesive bond between the wound and the bandage.

The invention therefore is directed to the employment of an improved fibrous wrapper which insures rapid fluid penetration therethrough into a highly absorbent core material without retention of a sufficient quantity of fluid within the fibrous wrapper material itself to effect an undesirable adhesive bond with the wound. Exudate is drawn almost instantaneously through the porous non-absorbent top sheet or wrapper of the dressing to an underlying absorbent element wherein substantially all of the fluid is absorbed. The resulting absence of body fluid coagulation around the fibers of the porous top sheet permits bandage removal without disturbance to the healing tissue of the protected wound. In cases where the exudate coagulates between the bandage and the wound because they are not in intimate contact, no adhesive bond develops because of the hydrophobic nature of the individual fibers. The invention thus permits the use of fibrous materials as bandage wrappers, with the attendant advantages thereof, but without the above-stated disadvantages which heretofore has limited the use of most fibrous materials for this purpose.

Absorbent bandages having non-fibrous top sheets, such as the fenestrated plastic films now in general use where non-adherency is desired, may adhere to the wound if either the size of the openings are excessive or if the ratio of open area to closed area is excessive. Limitations with

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respect to the relative openness of the bandage wrapper have been overcome due to the particular microporous structure of normally hydrophobic fibrous material used as a wrapper in this invention in place of old macroporous materials.

FIGS. 1 and 2 show a top sheet 3 comprising a permeable non-woven web of bonded synthetic hydrophobic fibers of a type hereinafter described. Directly beneath top sheet 3 is a highly absorbent material which may consist of a plurality of absorbent creped cellulose wadding sheets 5. Beneath the absorbent material is a gauze web 7. In the construction as shown in FIG. 1, top sheet 3 partially encircles absorbent material 5, in face-to-face engagement therewith, marginal portions of sheet 3 being folded about absorbent material 5 sufficiently to overlap marginal portions of gauze 7 with the overlapped portions being bonded together, such as by being heat-sealed one to the other, to maintain the elements in unitary assembly. To obtain a maximum rate of absorbency, it is desirable for the top sheet 3 to be thermally bonded to absorbent material 5 over the entire area of interfacial contact therewith. A lesser, but satisfactory, degree of efficiency may be obtained, however, when thermal bonding is confined to the overlapped areas between top sheet 3 and gauze 7. In place of the gauze 7, other webs of sufficient strength such as non-woven scrim, wet strength paper, felts, synthetic films, non-woven webs and the like may be used. Alternately, top sheet 3 may encircle the entire absorbent element and preferably be bonded along the bandage edge making the bandage usable from either side.

FIG. 3 illustrates in cross-section another variation of an absorbent bandage which is similar in all respects to FIG. 2 except that the absorbent material 9 shown here is "fluff," a mass of heterogeneously arranged short absorbent cellulosic fibers commonly used in absorbent pads such as sanitary napkins.

FIG. 4 illustrates still another embodiment of a non-adherent absorbent bandage. In this embodiment the non-woven top sheet 3 is thermally bonded over its entire contacting area with a felted self-sustaining absorbent web 12. One material suitable for the latter use is an absorbent non-woven material made by combining cotton and/or rayon fibers with thermoplastic fibers and is sold under the trademark "Webriil" by Kendall Mills. The "Webriil" material is available in various thicknesses and weights. The surface sheet 3 may also be folded over the edge of the absorbent web 12 and bonded on the underside as shown at 10.

Other absorbent materials suitable for use as absorbent sheets are absorbent cotton and cellulose sponge. The combination of the non-absorbent top sheet and a single ply of absorbent cellulose wadding also results in a satisfactory wrapper material. It has been found that a lamination consisting of a fibrous non-absorbent synthetic sheet in combination with one or more plies of conventional absorbent sheets will give the non-absorbent sheet some characteristics of an absorbent sheet in its ability to attract fluids, yet the non-absorbent portion will not be wetted by the absorbed fluid.

The improved characteristics of the bandage wrapper material taught herein are dependent in part on the physical relationship between the top sheet and the absorbent element. In general, the bandage structure consists of a non-absorbent essentially inert thin top sheet or wrapper of extremely high porosity in combination with a suitable absorbent element. The fluid-penetrable non-absorbent wrapper effectively separates the absorbent element from the fluid generating source in a manner to avoid the above-mentioned adherence between the wrapper material and contiguous areas of the body.

Fibrous non-woven wrapper 3 consists essentially of synthetic hydrophobic fibers which are normally non-

bonding, i.e., have no tendency to felt or interlock into a self-sustaining sheet, and fibrous synthetic binder particles which are of a chemical composition compatible with the fibers and serve as the bonding medium. The fibers used in making this non-woven sheet are normally from ¼ inch to ½ inch in length, but longer fibers may be used, although they are not as easily handled in forming the sheet. Fibers of low denier are preferable, with deniers of 0.5 to 6 being most suitable for use. Generally, the lower the denier of the fibers used in the top sheet, the thinner is the non-woven web produced from an equivalent amount of fibers, the greater is the number of microporous openings, and the more rapid is the rate of fluid strike-through.

The non-woven sheet may be formed by deposition out of a fluid medium onto a foraminous screen. The preferred fluid medium is water with papermaking techniques being used to form the sheet.

Synthetic fibers found useful in making the top sheet include those derived from polyesters, polyamides, polyacrylates, polyvinylchloride, polyethylene, polyacrylonitrile, tetrafluoroethylene, and vinylidene chloride. Polyester fibers, such as polyethylene terephthalate of the type called "Dacron" and supplied by E. I. du Pont de Nemours, and polyamides such as nylon, are especially suitable.

The above-named non-bonding fibers do not form self-sustaining sheets when subjected to ordinary paper-making techniques as do the natural cellulosic fibers usually employed in traditional papermaking methods. As a result, some type of supplementary bonding material, such as natural or synthetic adhesives, resins, elastomers, or a small percentage of natural fibers, is necessary to bind the fibers together when fabricating a self-supporting web.

The recent development of binder particles similar in chemical composition to the non-bonding fibers themselves has eliminated the need for traditional binders and their inherent disadvantages in forming fibrous sheets. These binder particles are dispersed among the synthetic fibers, and sheets are subsequently formed from the dispersion. Microscopic examination of the binder particles, which are much smaller in size than the non-bonding fibers with which they are interspersed, indicate the particles to be somewhat filmy and highly frazzled or fibrillated. The non-bonding fibers with which they are intermixed have a smooth outer surface with no tendency to fibrillate, which accounts for their lack of felting ability. If an attempt is made to form a sheet with non-bonding fibers when no binder particles are present, it is impossible to produce a self-sustaining sheet. With the introduction of the new binder particles it is possible to form sheets from non-bonding fibers satisfactorily on papermaking equipment. The particles are mixed with non-binding fibers, usually in aqueous suspension, and become entangled with the fibers during the forming process, improving the waterleaf strength of the webs sufficiently to allow further handling and processing.

Binder particles are used which normally have a chemical composition of a type related to that of the non-bonding fibers with which they are interspersed, although totally unrelated materials may be used. The difference in chemical design is often slight but functionally useful. For example, the particles may be designed to have a lower melting point than the staple fibers of related chemical composition with which they are mixed, and when a formed sheet, such as one made with polyethylene terephthalate fibers, is heated to sufficiently high temperature, about 350° F. to 400° F., these particles will melt and bond the synthetic fibers at their points of intersection. The temperatures required for fusing the binder particles are designed to be high enough to melt the binder particles yet are long enough to prevent the synthetic fibers themselves from melting and losing their fibrous identity.

Thermally bonded fibrous webs made in this manner have unusually high wet and dry strength. The binder particles while in aqueous dispersion, are attracted to the points of fiber intersection where they are ultimately fused.

Thus, the fusion does not block interstitial openings and there is no loss in the potential porosity of the finished non-woven fibrous web. The relatively low melting point of the binder particles, mentioned above, also enables the fibrous webs containing these particles to be thermally bonded without destroying the fibrous nature of the webs.

The binder particles are special materials manufactured by E. I. du Pont de Nemours and presently called "Fibrids." These consist of small funicular and/or foliated particles, i.e. miniature fibers or leaf-like foils, of various synthetic polymers and preferably are non-uniform in structure, form, and dimension. Although the binder particles are non-uniform they are of such a nature that one dimension is considerably greater than the others. The smallest dimension usually does not exceed an average of about 10 microns, while the largest dimension does not exceed an average of about 100 microns. The binder particles normally are sufficiently small to pass through a wire screen of about 10 mesh and sufficiently large so that 90% of the particles will be retained on a wire screen of about 200 mesh, although larger sizes may also be useful. The particles can be characterized further in that they have a Canadian standard freeness value of between about 90 and 850 when they are in aqueous suspension.

These binder particles have the unusual property of being able to hold fibrous sheets together by means of mechanical entanglement in much the same manner as do natural cellulosic pulps. This unexpected ability permits sheets to be formed from these particles which are unusually strong in wet felted condition in comparison to other water-formed synthetic sheets. This property of producing strong wet sheets is not adversely affected by the presence of other synthetic or natural fibers. In fact, minor amounts of these binder particles in admixture with otherwise non-binding fibers, permit sheets to be formed from these latter fibers on conventional papermaking machines which heretofore was difficult or impossible.

Binder particles may be made from almost any synthetic polymer. One method of forming the particles is by subjecting the polymer to a cutting and beating action at the time when the polymer is freshly formed and has not been completely solidified into its new state. A preferred method for preparing binder particles consists in introducing a solution of the polymer into a non-solvent of the polymer and subjecting the mixture to the cutting and beating action while the polymer is being precipitated from solution.

Polymers which have been found especially suitable as the binder particles used in preparing the top sheet of the absorbent bandage of this invention include polyesters such as polyethylene terephthalate and copolymers of ethylene terephthalate and ethylene isophthalate, and polyamides such as polyhexamethylene adipamides, polyethylene sebacamides, polymethylene bis-(p-cyclohexylene) adipamide, and their copolymers with caprolactam, such as a copolyamide of polyhexamethylene adipamide and polycaprolactam. Other polymers which have been used include polymers and copolymers of acrylonitrile such as those formed from acrylonitrile and methyl acrylate or vinyl chloride; polyacrylic and polymethacrylic esters such as methyl polymethacrylates; polyvinylchlorides and copolymers of vinyl chloride with vinyl esters, acrylonitrile, vinylidene chloride and the like; polyvinylidene chloride; polyhydrocarbons such as polystyrene and polyethylene; chlorosulphonated polyethylene; polychlorotrifluoroethylene; polyvinyl alcohol; partially hydrolyzed vinyl-polyesters; polyurethanes; polyureas; polythioesters; polysulphonamides; polysulphones; polyoxymethylene; and many others.

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Best results usually are obtained when binder particles are used with fibers of a related chemical composition. However, intermixing of dissimilar particles and fibers also results in useful materials. For example, the binder particles made from polyamides have been found to be excellent binders for most types of fibers. Binder particles of polyesters on the other hand appeared to be more selective and were found to be more efficient in binding polyester fibers than for binding other fibers. Thus, polyamide binder particles are useful as the binder material for normally non-binding polyamide fibers, such as the various nylons to form non-woven polyamide fiber sheets, as well as for bonding other synthetic fibers such as the polyacrylonitrile fibers known as Du Pont's "Orlon." Polyester binder particles on the other hand are most useful with other polyesters, such as Du Pont's "Dacron" polyethylene and terephthalate fibers.

In forming suitable webs as the top sheet for our absorbent pad, the binder particles may be used in quantities from as low as 1 part to about 45 parts per 100 parts of fiber. Optimum sheet characteristics are developed when 30 to 45 parts of binder particles per 100 parts of fiber are used. After the sheets have been formed it is necessary to heat treat them in order to fuse the binder particle fibrils around the fiber intersection areas and develop the bonded strength of the non-woven web. This heat fusing may be effected in several ways, such as by hot calendering, passing the sheet over heated drying cylinders, or using radiant heat or hot air in drying tunnels. For use with bandages, it is preferred that the heat-treatment be carried out with as little pressing as possible consistent with retaining the soft cosmetic feel of the fibrous sheet.

The fibrous synthetic sheet thus obtained is then used as the wrapper for absorbent bandages as further described herein. The following examples teach suitable dressings incorporating the concept and found satisfactory in clinical tests.

Example I

Bandages of the construction shown in FIG. 1 were assembled for use in clinical testing. The top sheet 3 consisted of a waterlaid non-woven web made up of 75 percent by weight of polyethylene terephthalate (Dacron) staple fibers of 1/4 inch average length and 1.5 denier, and 25 percent by weight of polyester binder particles consisting of a copolymer of 74 percent ethyleneterephthalate and 26 percent ethyleneisophthalate. After being formed on a paper machine, the web was thermally bonded by passing it through a drying oven with an air temperature of between 400-425° F. The sheet had a basis weight of 8 pounds per 24" x 36"—500 ream and a caliper of 3.5 mils. The absorbent material 5 consisted of 25 plies of absorbent bleached cellulose wadding, each ply having a basis weight of 5.5 pounds per 3000 square foot ream, and a supporting ply of gauze 7. The top sheet was folded over and around the longitudinal edges of the absorbent pad partially extending over the underlying gauze, and heat sealed along the area of contact with the gauze.

The bandages thus assembled were sterilized in an autoclave at 250° F. for 15 minutes and then applied to surgical wounds. When removed, for redressing, none of the bandages adhered to the wounds, and healing had progressed satisfactorily. The fibrous structure of the wrapper provided a rapid wicking action, drawing in the fluid which reached its surface and spreading it out over the absorbent element to utilize effectively the latter's absorptive capacity, without appearing to wet the surface of the wrapper itself.

Example II

Bandages of the type illustrated in FIG. 4 were made up for use in clinical testing. The top sheet was similar to that of Example I. It was thermally bonded to

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"Webril" absorbent material over the entire area of mutual contact. The bandages were sterilized as in Example I and similarly applied to surgical wounds. Absorption of excess fluid exuding from the wound was found to be essentially complete. None of the bandages adhered to the wound area when removed, and healing of all wounds was noted to be progressing satisfactorily.

Example III

Bandages were assembled as in Example I except that the top sheet consisted of a non-woven web made up of 70% by weight of 1.5 denier nylon staple fibers of 1/4 inch average length and 30% by weight of polyamide binder particles consisting of a polymer containing 20% of polyhexamethylene adipamide and 80% of polycapromamide. The formed sheet was thermally bonded by heating to about 400° F. and had a basis weight of 8 pounds per 24" x 36"—500 ream and a caliper of 3.5 mils. The dressings were clinically tested and found to possess good non-adherent qualities.

Although the discussion herein has been directed mainly to the use of the bandages of this invention as a non-adherent dressing for surgical wounds, it is readily seen that the absorbent material may be easily adapted to other uses such as for sanitary pads, disposable diapers, hospital incontinent pads, and in similar sanitary and hygienic uses where absorbent materials are required.

We claim:

1. A non-adherent absorbent dressing comprising a fluid permeable non-absorbent web and an absorbent element in intimate association therewith, said web comprising a water-formed non-woven fibrous structure of normally non-bonding hydrophobic synthetic fibers united to each other only at their intersections by fuse synthetic binder particles, the smallest dimension of said particles averaging about 10 microns and less and the largest dimension of said particles averaging not more than about 100 microns, the fusion temperature of said binder particles being sufficiently less than the melting point of said fibers to bond the fibers at their points of intersection while preserving the fibrous nature of said web with no loss in porosity thereof, said web being attached to said absorbent element in areas of common interfacial contact between said fused synthetic binder particles and said element.

2. The absorbent dressing of claim 1 in which the absorbent element comprises absorbent cellulosic fibers.

3. The absorbent dressing of claim 1 in which the absorbent element comprises cellulose wadding.

4. The absorbent dressing of claim 1 in which the fibers consist of polyethylene terephthalate and the binder particles consist of a copolymer of ethylene terephthalate and ethylene isophthalate.

5. The absorbent dressing of claim 1 in which the fibers consist of nylon and the binder particles consist of a copolymer of polyhexamethylene adipamide and polycapromamide.

6. The absorbent dressing of claim 1 in which the ratio of binder particles to fibers in the web is about 25 to 45 parts by weight of particles per 100 parts by weight of fiber.

References Cited in the file of this patent

UNITED STATES PATENTS

65	2,649,859	Hermanson et al. -----	Aug. 25, 1953
	2,695,025	Andrews -----	Nov. 23, 1954
	2,788,003	Morin -----	Apr. 9, 1957
	2,783,474	Campagna et al. -----	Mar. 5, 1957
	2,833,283	Spahr et al. -----	May 6, 1958
70	2,864,362	Hermanson et al. -----	Dec. 16, 1958
	2,896,618	Schaefer -----	July 28, 1959
	2,905,176	Davidson -----	Sept. 22, 1959

FOREIGN PATENTS

204,413	Australia -----	Nov. 23, 1956
---------	-----------------	---------------