United States Patent

[11] 3,585,998

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[54] **DISPOSABLE DIAPER WITH RUPTURABLE CAPSULES**
2 Claims, 6 Drawing Figs.

[52] U.S. Cl. 128/284, 128/287
[51] Int. Cl. A61f 13/16
[50] Field of Search ..... 128/156, 260, 261, 268, 284—285, 287, 290, 296; 424/16, 19, 28

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ABSTRACT: This invention is directed to disposable baby diapers and baby diaper liners, viz., disposable baby diaper components containing encapsulated baby oil.

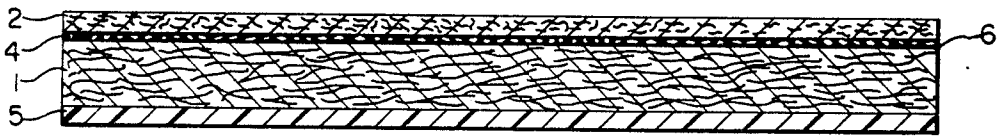


FIG. 1

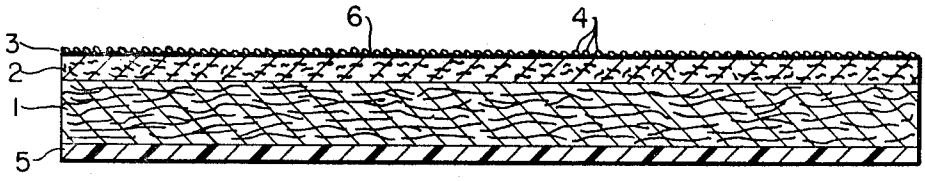


FIG. 2

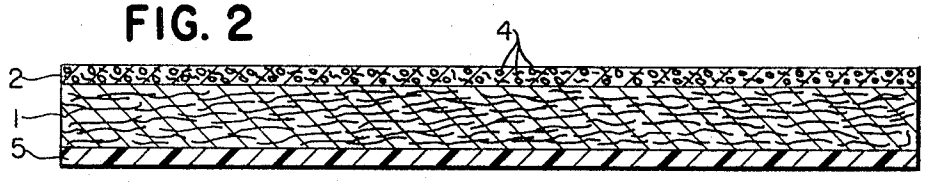


FIG. 3

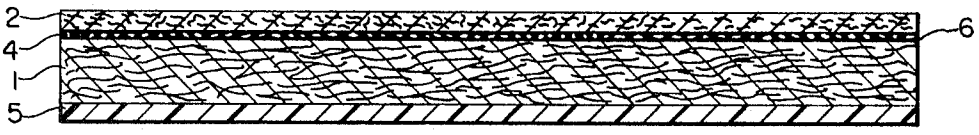


FIG. 4

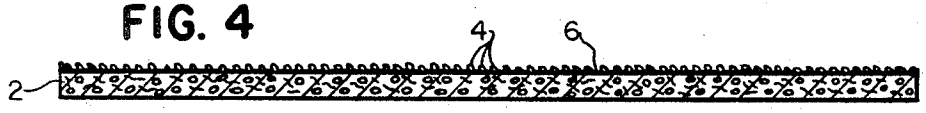


FIG. 5

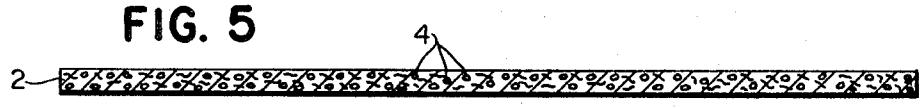
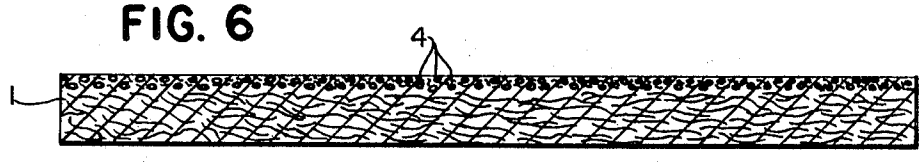


FIG. 6



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DISPOSABLE DIAPER WITH RUPTURABLE CAPSULES

For some time it has been considered desirable to incorporate baby oil into disposable fibrous, esp., absorbent paper, baby diapers. While some conventional prior art absorbent paper baby diapers can be provided with minor amounts of solids, e.g., disinfectants, deodorants, etc.; it has been difficult to incorporate liquids into such baby products. The reason for this is that the liquid tends to be degraded upon exposure to the atmosphere; and when liquid baby oil is incorporated as a liquid onto these porous paper diapers, the oil frequently spoils not only resulting in discoloration but also generating unpleasant odors in such paper diapers. Another objection to direct liquid incorporation is that it tends to restrict the porosity and softness of the baby diaper and make it oily and unpleasant rather than porous and fluffy. Consequently, no satisfactory way has been arrived at prior to the present invention to actually incorporate liquid baby oil formulations into disposable porous absorbent paper diapers.

The present invention incorporates encapsulated liquid baby oil formulations into or coated onto the absorbent, porous, fibrous disposable diapers or diaper liners and in large part overcomes the previously mentioned prior art problems. The baby oil, being encapsulated with a readily pressure rupturable cell wall material, is provided in a condition whereby it is protected from the degradative influences of air until the time it is desired to be used. Consequently, the encapsulated baby oil formulations when incorporated on and/or into the absorbent fibrous, e.g., paper, diapers are present in a condition having a much longer shelf life. Each individual capsule constitutes a generally spherically shaped container having an external phase, viz., cell wall material, and a liquid internal phase, viz., baby oil formulation. Moreover, since the capsules do not significantly alter the soft and porous structure of the paper absorbent diaper core, the overall porosity of the disposable paper diaper is not deleteriously altered from that of articles containing no encapsulated baby oil.

Six typical diaper or diaper liner structures embodying the present invention will be discussed below in conjunction with FIGS. 1 to 6 of the accompanying drawings.

FIGS. 1 to 6 of the drawings are cross-sectional views of various disposable diaper and diaper liner structures incorporating the present invention.

In FIG. 1 there is shown a disposable paper diaper comprised of a centrally located disposable porous, absorbent paper or other fibrous core 1 having moisture-permeable, woven or nonwoven fibrous interior liner 2 (closest liner to the baby's skin) on the outer surface which are located a layer 3 of an array of profusion of pressure-rupturable capsules 4 containing baby oil formulation. An optional moisture-impermeable exterior liner 5 can be used to retain most of the moisture in the core section. A flexible coating binder 6, which is optional, e.g., polyethylene, polyvinyl chloride, etc., can be present to aid in adhering the capsules to the upper portion of the interior liner and providing a partial retaining matrix therefor.

FIG. 2 depicts a similar diaper but wherein the baby oil-containing capsules are located predominantly within the matrix provided by the interior liner, e.g., by inclusion of the capsules on a uniform distribution basis during formation of said liner. The diaper structure of FIG. 2 possesses an additional advantage over that of FIG. 1, viz., it virtually eliminates any source of local irritation due to capsule chaff (broken pieces of capsule cell wall) due to the fact that said chaff is substantially softened and retained by the interior liner which serves as a retaining matrix.

Alternative ways to accomplish this are shown in FIGS. 3 and 6. In FIG. 3 the capsules are located between the interior liner (optional) and the core section with the interior liner protecting against capsule chaff irritation. In the structure of FIG. 6 the baby oil-containing capsules 4 are located predominantly within the upper region of the core 1, e.g., by addition

of the capsules during formation of the upper portion of the core section, e.g., using the basic procedure of South African Pat. No. 63/231. Hence the upper core region acts as a capsule chaff softening and retaining matrix in a manner very similar to interior liner 2 shown in FIG. 2. The capsule-containing core structures as shown in FIG. 6 can be used with or without interior and/or exterior liners.

FIG. 4 illustrates a disposable diaper liner having the same basic capsule-interior liner arrangement as in FIG. 1. Such disposable liners are usually used in conjunction with conventional cloth diapers being located on the inside (next to the baby's skin). FIG. 5 illustrates an alternative disposable liner having the same structure as interior liner 2 in FIG. 2. The variations of FIGS. 2, 3, 5 and 6 are useful for babies with overly tender skin.

The individual capsules are in effect individual generally spherically shaped containers which can vary in size (diameter) from about 5 to about 300 microns. Usually, however, the capsules range in size from about 5 to 200+ microns and more usually from about 10 to about 100 microns. The thickness of the capsule cell wall can range from about 0.1 to about 100 microns, but usually ranges from about 0.3 to about 20 microns. Each individual capsule is comprised of an external phase (cell wall) and an internal phase (baby oil formulation). Clusters or aggregates of capsules can also be used and these clusters or aggregates can have diameters ranging from about 50 to 1,500 microns, usually from about 100 to about 1,500 microns and more usually from about 150 to 1,200 microns. Both the capsules and capsule clusters (or aggregates) are dry to the touch (until broken) as the baby oil is contained within the capsule cell walls. The capsules can contain a liquid pay load, viz., a weight concentration of liquid baby oil formulation, ranging anywhere from about 50 to about 99 weight percent. Usually, however, the liquid baby oil pay load ranges from about 60 to 95 percent and more usually from about 70 to about 95 percent based on total capsule weight (viz., liquid baby oil formulation plus capsule cell wall).

The "baby oil" which constitutes the internal phase of the capsules, usually is comprised of a water-white (colorless) mineral oil which is comprised chiefly of paraffins, refined lanolin with or without perfume(s), deodorant(s), silicone oil(s), disinfectant(s), and other adjuvant materials. The oil and lanolin are characteristically always present in such baby oil formulations with the perfume(s), silicone oil(s), disinfectant(s), and deodorant(s) being optional components thereof. In place of a mineral oil base, other conventional oils, lubricants or emollients can be used, e.g., isopropyl myristate. A typical baby oil formulation suitable for use in accordance with this invention can contain the following component materials in the below noted weight concentrations.

Component	Concentration [1]
Mineral oil (or other lubricant or emollient)	83–99
Lanolin (or ester thereof)	1–10
Perfume(s) or deodorant(s)	0–0.1
Silicone oil(s)	0–5
Disinfectant(s)	0–1
Preservative(s)	0–1

[1] Weight percent based on total baby oil formulation.

The concentration of baby oil capsules, expressed as weight percent capsules, based on total weight of capsules plus disposable absorbent diaper component, will vary widely, e.g., from about 1 to about 80 weight percent, depending upon the particular structure being prepared. Thus, for example, when making baby diaper liners, e.g., for use with cloth diapers, the capsule concentration can range from 1 to 50 weight percent, but more usually ranges from 20 to 45 weight percent. On the other hand, when making the structures wherein the encapsulated baby oil is incorporated onto or into the absorbent disposable porous paper baby diaper cores; the encapsulated baby oil concentration can range from about 10 to 80 weight

percent, and more usually from about 20 to 45 percent, based on total weight of capsules plus core.

These conventional baby oil formulations can be encapsulated in accordance with a wide variety of encapsulation procedures, such as, for example as indicated in U.S. Pat. Nos. 2,800,457 and 2,800,458, the disclosure of which is incorporated herein by reference. While these encapsulation procedures are chemical in nature, it should be understood that both chemical and mechanical encapsulation procedures can be employed to encapsulate the baby oil formulations in accordance with this invention. A comprehensive discussion of detailed encapsulation procedures which can be used to encapsulate the baby oil to produce the size capsules noted hereinabove can be found in "Microencapsulation" by Anderson et al. (Harvard MBA Candidate's Report), published by Management Reports, Boston, Mass. (1963), the disclosure of which is also incorporated herein by reference.

In similar manner a wide variety of external phase (cell wall) materials can be used to encapsulate the above-mentioned and other conventional baby oil formulations. Suitable exemplary encapsulating materials which can be used in accordance with the invention include, but are not limited to: gelatin and gum arabic; polyethylene; ethyl cellulose; polyvinyl alcohol; polyvinylidene chloride; urea-formaldehyde and other aminoplast condensates; phenol-formaldehyde and other phenolic condensates; etc. The use of gelatin-gum arabic material is frequently preferable, especially in structures of the type shown in FIGS. 1 and 4, as it has less tendency to irritate a baby's tender skin, e.g., as when the capsules are in substantially direct contact therewith.

One typical procedure which can be employed to encapsulate conventional baby oil formulations employs gelatin-gum arabic as the capsule cell wall material. The procedure for forming the capsules is as follows: aqueous solutions of 11 percent by weight gum arabic and 11 percent by weight high bloom strength pigskin gelatin are prepared and held at 55° C. The liquid baby oil formulation is emulsified with the gelatin solution and additional water to give 10—40 microns droplets. This emulsion is added to the gum arabic solution with additional warm water so that the aqueous phase contains 1.2 to 2.2 weight percent gelatin and 1.2 to 2.2 weight percent gum arabic and the weight ratio of oil to gelatin and gum arabic combined is from 1:1 to 20:1. The slurry is cooled with good agitation from above 40° C. to below 25° C. at a rate not greater than 0.1° C./minute.

A wide variety of absorbent, porous paper or other cellulosic fibrous stock materials can be used to constitute the absorbent paper core upon which or into which the encapsulated baby oil capsules are incorporated. The two essential features which must be present in such absorbent porous paper cores is that they must be nonirritating with respect to the baby's skin, and they must absorb a sufficient amount of fluid, e.g., between about 15 and 20 fluid ounces, so that they will be satisfactory for use. Usually these materials are considered disposable. Also natural or synthetic organic fibrous materials can be used alone or in conjunction with cellulosic fibers.

Conventional disposable baby diapers usually contain an absorbent layer(s) of intermingled wood pulp fibers prepared by depositing the fibers in the form of a sliver on a facing or collecting web and then cutting the web and the sliver at spaced intervals to provide diaper pads of a predetermined length. Usually, the wood pulp fibers in the pad are stabilized in some way to prevent them from becoming dislocated in the pad in use and in handling. Suitable absorbent porous paper cores which can be employed in accordance with this invention are those referred to in U.S. Pat. No. 3,065,751.

Such diapers contain a thin, water-permeable facing (liner) sheet covering the interior side of the diaper, viz., the side which is to contact the baby's skin in use, and a thin (usually moisture-impermeable) backing sheet covering the exterior side of the diaper, remote from the baby's skin, with the porous, highly absorbent paper core (pad) being located between the interior and exterior facing (liner) sheets. Usually, the core pad itself ranges in thickness from about 25 to 100 mils and has a bulk density between about 25 and 50 grains per cubic inch and a Gurley stiffness of less than about 20 milligrams per grain of weight. In general, any cellulose tissue assemblage having a basis weight of about 8 to 10 lbs. per ream (five hundred 24 inches × 36 inches sheets) or multi-ply composite of a plurality of tissues for greater absorption can be employed in accordance with this invention as the porous, absorbent disposable diaper core section.

The moisture-permeable interior diaper liner can be a nonwoven fabric produced according to the procedures indicated in U.S. Pat. Nos. 2,039,312, or 2,788,003, or 2,705,688, the disclosure of which is also incorporated herein by reference. In certain cases, it is desirable to prepare both the interior facing sheet and the backing sheet of the same material, but in such cases usually the backing sheet is provided with a moisture-impermeable coating or layer. Also, both the interior liner and exterior backing sheets can be prepared from soft tissue paper, such as a 13-pound tissue, having a weight of 13 lbs. per ream (four hundred 24 inches × 36 inches sheets). The disposable core can likewise be faced interiorly and/or exteriorly with the thin, but strong nonwoven top sheet described in U.S. Pat. No. 2,039,312. Other woven and nonwoven materials can be used for the interior and exterior liners as well be apparent to those skilled in the art.

The capsules can be incorporated into the disposable diapers or diaper liners by a variety of procedures including the four procedures described hereinbelow:

A. The capsule aqueous slurry containing the encapsulated liquid baby oil formulation can be continuously roll-coated onto a portion of or the entire surface of the fibrous paper or nonwoven fabric used to form the diaper liner, or the diaper core for the disposable diaper. This procedure is suitable for applying a rather high concentration of small diameter capsules.

B. The capsule slurry can be sprayed onto the paper or fabric substrate which is subsequently air or oven dried. This procedure is suitable for applying a light to medium concentration of small to medium size capsules.

C. The capsule slurry can be mixed with the paper or other fibrous slurry prior to formation of the paper web or nonwoven fabric substrate, e.g., in accordance with the procedure of South African Pat. No. 63/231. This method is suitable for incorporating a light to heavy concentration of small to medium capsules. The capsules are entrapped within the matrix of the web structures (as a filler therein) during formation of the web.

D. The capsule slurry can be sprayed onto the wood pulp fibers used to form the disposable diaper core either during or after mat formation. This procedure is suitable for applying a light to heavy concentration of small to large size capsules.

In all four procedures a flexible binder can be used in conjunction with the capsules. Such a binder is not required, however, because the slight tackiness of wet capsule cell walls, e.g., gelatin capsules, usually provides sufficient adherency. The first two procedures, A and B, result in a surface coating of capsules which can be applied to either one or both sides of the paper or nonwoven fabric diaper core or liner substrate. The capsule-containing paper or nonwoven fabric resulting from the first three techniques, A, B, and C can be used as a diaper liner for nondisposable diapers, as a liner for disposable diapers, or, in the case of a multi-ply construction, as a core material for disposable diapers. The mat of wood pulp fibers containing capsules in and/or on the matrix resulting from the fourth procedure, D, is most suitable for use as disposable diaper cores. Other deposition procedures for incorporating the capsules onto or into the fibrous diaper core or liner portions will be apparent to those skilled in the art.

The invention will be illustrated in greater detail by the examples which follow. However, it should be understood that the present invention in its broadest aspects is not necessarily limited to these specific baby oil formulations, encapsulation

procedures; capsule cell wall materials; capsule diameters; liquid pay load; capsule incorporation procedures; capsule cluster diameters; paper stock; liner and facing sheet materials; and concentration of materials and preparation procedures set forth in the examples below:

EXAMPLES 1 THROUGH 4

This example illustrates preparation of a baby diaper liner having encapsulated baby oil coated on the upper, interior surface thereof. 250 milliliters of Johnson's Baby Oil, which is comprised of 1 to 5 weight percent lanolin in mineral oil, 250 milliliters of warm distilled water and 180 milliliters of a warm, 11 percent, by weight, solution of high bloom strength gelatin were mixed in a Waring Blender. Ten to 40 micron droplets were formed immediately. This suspension was then added to a 2-liter beaker containing 550 milliliters of warm distilled water and 180 milliliters of a warm 11 percent by weight solution of spray dried gum arabic. The mixture was stirred with a 4 inch turbine agitator turning at high speed. Then 0.7 milliliters of a 20 percent by weight sodium hydroxide solution was added thereto. The temperature was then allowed to drop, without application of heating or cooling, from 40° C. to 28° C. in 2 hours. Capsule cell wall formation on the droplets occurred at about 30° C. At 28° C. capsule cell wall formation was essentially completed and the capsule slurry was chilled to 7° C. by application of an ice bath. The chilled capsule slurry was sprayed onto Johnson & Johnson "Chix" disposable baby diaper liner tissues with a hand atomizer and the sprayed tissues were allowed to air dry over night. Each 10 inch × 14 inch tissue weighed approximately 1.9 grams (dry weight) and approximately 0.5 grams of dried capsules per tissue were deposited by spraying in the manner indicated above. Under 100-power magnification, the capsules appeared as 600 to 1,000 micron aggregates or clusters of individual capsules having individual diameters ranging from approximately 10 to 40 microns. Capsule cell wall thickness ranged from approximately 0.5 to 2 microns. The liquid pay load was approximately 85 weight percent based on total of internal phase (baby oil formulation) plus external phase (cell wall material). The above procedure is demonstrative of capsule incorporation used to prepare the structures shown in FIGS. **1**, **2**, and **4**. In the case of the FIG. **1** structure, the interior liner containing the baby oil capsules coated thereon is layed up on the diaper core **1** with or without an intermediate adhesive. Exterior liner **5** can be joined to the core in conventional manner. In the case of FIG. **3** structure, the procedure of Example **1** is repeated except that the baby oil capsules are deposited onto core **1** (rather than the interior liner). The liner **2** is then applied with or without binder **6**.

As noted previously the capsules are readily rupturable by pressure. Slight to moderate pressures will suffice to break most capsules. Of course, the amount of pressure to break the capsule cell walls depends primarily upon capsule cell wall thickness, cell wall material, etc. Usually it is desirable to break a portion of the capsules prior to placing the capsule-containing diaper on the baby to release the baby oil. This can be accomplished readily by use of conventional household items, e.g., rolling pin, hand iron (unheated), etc. Also the baby's weight will usually break a good portion of the capsules. As noted above it is also within the purview of this invention to deposit the capsules on a portion of the diaper, viz., coat the capsules in a predetermined pattern corresponding generally to that portion of the baby's anatomy where the application of oil is most desired.

What we claim is:

1. A disposable baby diaper comprising a centrally located absorbent, porous, fibrous core section; a moisture-impermeable exterior liner positioned on one side thereof; and a moisture-permeable interior liner positioned on the other side thereof, said interior liner having on its inner surface an array of generally spherically shaped, pressure-rupturable capsules ranging in size from about 5 to 300 microns and containing from about 50 to about 99 weight percent liquid baby oil, based on total capsule weight.

2. A disposable baby diaper comprising a centrally located absorbent, porous, fibrous core section; a moisture-impermeable exterior liner positioned on one side thereof; and a moisture-permeable interior liner positioned on the other side thereof, said interior liner comprised of a fibrous matrix containing an array of pressure-rupturable, generally spherically shaped capsules uniformly distributed and retained therein, said capsules ranging in size from about 5 to about 300 microns and containing from about 50 to about 99 weight percent liquid baby oil, based on total capsule weight.