

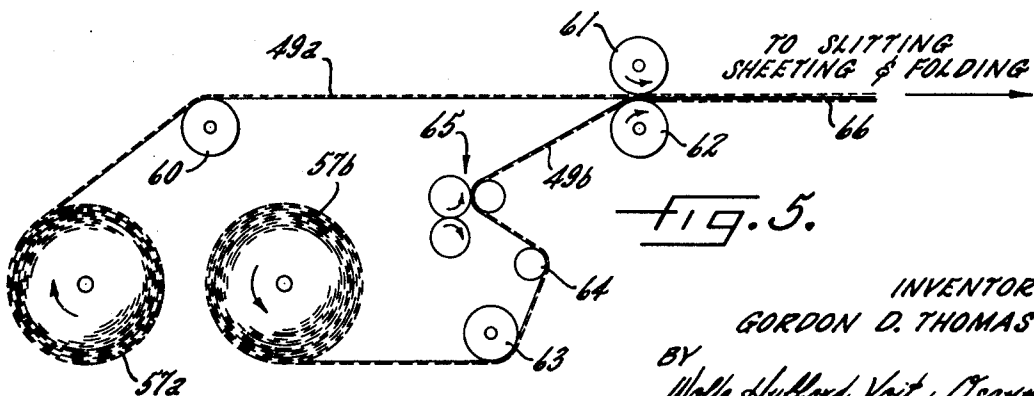
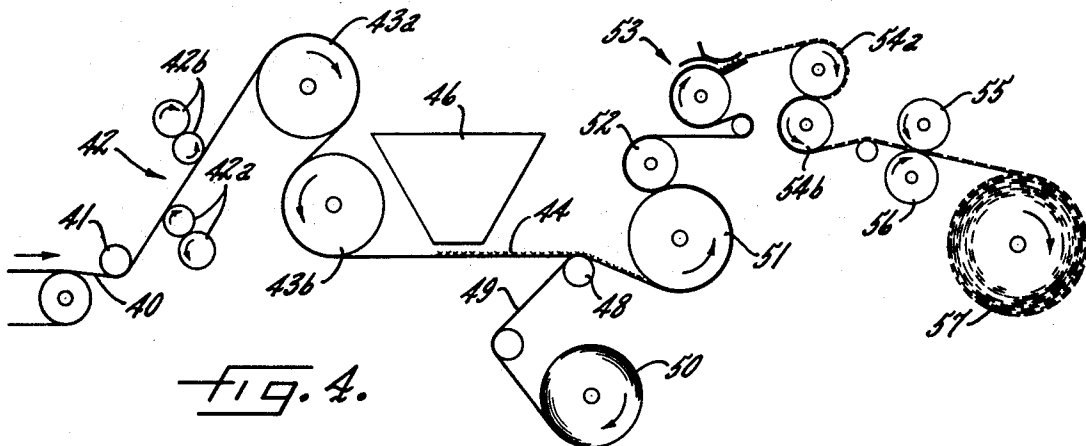
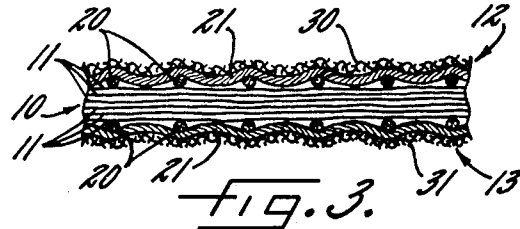
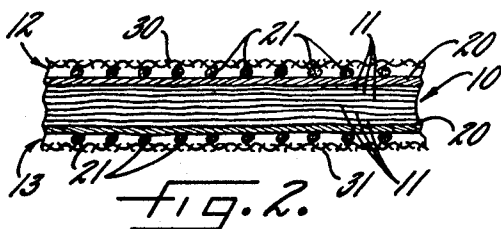
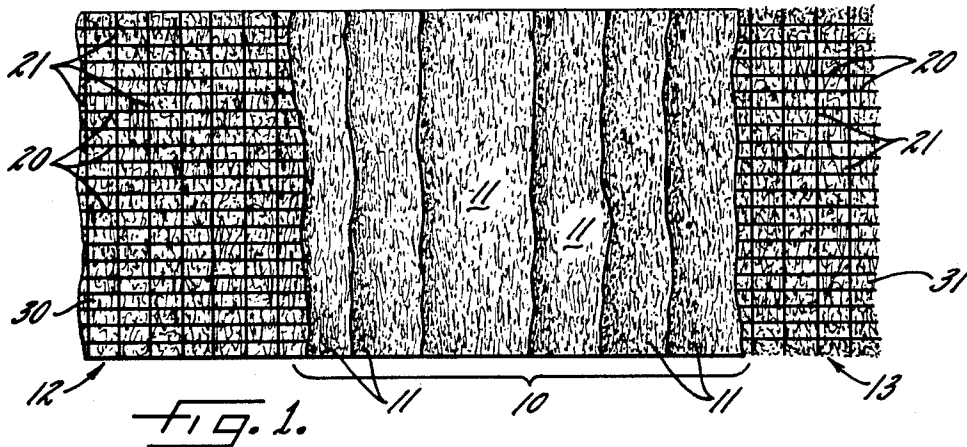
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3,709,764

HEAVY-DUTY WIPE AND METHOD FOR PRODUCING SAME

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1

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## HEAVY-DUTY WIPE AND METHOD FOR PRODUCING SAME

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U.S. Cl. 156—177

9 Claims

### ABSTRACT OF THE DISCLOSURE

An improved heavy-duty wipe made of non-woven materials, and a method of producing the same. The wipe includes a central layer of multi-ply cellulosic tissue, a web or sheet of open-mesh non-woven crossed threads on each side of the central layer, and a thin applique of fine fibrous material bonded to the outer surface of each crossed-thread web. The central layer of multi-ply cellulosic tissue is bonded to both the warp threads and fill threads on the warp thread side of each of the two webs of non-woven material, and the fibrous appliques are bonded to the fill thread sides of each web.

This application is a divisional of my copending application Ser. No. 788,987, filed Dec. 23, 1968, now Pat. No. 3,616,133.

### DESCRIPTION OF THE INVENTION

The present invention relates generally to heavy-duty wipes and, more particularly, to an improved heavy-duty wipe made of non-woven materials, and a method of producing the same.

It is a primary object of the present invention to provide an improved heavy-duty wipe having superior strength, abrasion resistance, and softness properties combined with adequate bulk and absorbency. A more particular object of the invention is to provide such an improved heavy-duty wipe having improved resistance to grinning and thread pick off, a desirable soft feel, and relatively high absorbency rate and capacity.

Another object of the invention is to provide an improved heavy-duty wipe of the type described above which can be efficiently manufactured at high production rates and at a relatively low cost.

A further object of the invention is to provide a method of producing an improved heavy-duty wipe of the foregoing type.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a schematic plan view of a heavy-duty wipe embodying the invention, with sections of successive layers of the wipe material removed to reveal underlying layers;

FIG. 2 is a schematic side elevation of the heavy-duty wipe shown in FIG. 1 on an enlarged scale;

FIG. 3 is a schematic end elevation of the heavy-duty wipe shown in FIG. 1 on an enlarged scale;

FIG. 4 is a schematic representation of a process for producing one half of the heavy-duty wipe shown in FIGS. 1 through 3 in accordance with the invention; and

FIG. 5 is a schematic representation of a process for laminating two layers of material prepared by the process of FIG. 4 to produce the heavy-duty wipe shown in FIGS. 1 through 3 in accordance with the invention.

While the invention is susceptible of various modifications and alternative forms, certain specific embodiments thereof have been shown by way of example in the drawings which will be described in detail herein. It should be

2

understood, however, that it is not intended to limit the invention to the particular forms disclosed but, on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention.

Referring now more particularly to the accompanying drawings, the invention is embodied in a wipe represented in FIGS. 1 and 2, and including a flat central layer 10 of absorbent material formed of a multiplicity of plies 11 of creped cellulosic tissue, and layers 12 and 13 of non-woven fabric on the opposite faces of the flat central layer 10. In order to provide a wipe with superior absorbency characteristics, the multi-ply tissue layer 10 in the illustrative embodiment comprises four plies of creped tissue having a stretch per ply of about 15 to 75%, preferably 25 to 30%, and a dry, uncreped basis weight of from about 4 to about 13 pounds per 2,880 sq. ft., preferably about 7 to 8 pounds per 2,880 sq. ft. In the particular embodiment illustrated, the two plies 11 of cellulosic tissue adjacent each fabric layer 12 or 13 are bonded to each other and to the adjacent fabric layer by means of adhesive that is originally applied to only the fabric layer, but it will be understood that a greater number of tissue plies may be used and interbonded by adhesive applied to a sufficient area of adjacent surfaces of the multiple plies to hold the plies together during use. In the latter case, the adhesive will normally be applied in a discontinuous pattern so that the desired interbonding is achieved with a minimum of adhesive and without reducing the flexibility of the multi-ply layer 10. In any event, the particular adhesive employed should always be insoluble in oil and any other liquids that might be absorbed in the wipe during use.

As can be seen in FIGS. 1 and 2, each of the two layers 12 and 13 of non-woven fabric comprises a set of spaced warp threads 20 which extend in the longitudinal or machine direction, and a set of fill threads 21 which extend across the warp threads in the transverse direction. Since the fabric is non-woven, the fill threads 21 are all on the same side of the warp threads 20, with the two sets of threads disposed in face-to-face relation to each other and adhesively bonded together where the threads of one set cross the threads of the other set. Non-woven fabrics of this type are well known in the art, and may be made by any of several different known methods and apparatus, one example of which is described in U.S. Pat. No. 2,841,202 to H. W. Hirschy. The threads in each of the two cross-laid sets normally run parallel to each other and are uniformly spaced, but the fabric may be formed with the threads following non-parallel or irregular patterns if desired, as long as one set of threads is disposed entirely on one side of the other set. It will be understood that the term "threads" is intended to include both monofilament and multifilament structures, although multifilament structures are generally preferred in non-woven fabrics.

It is critical in the present invention that the layers 12 and 13 of non-woven fabric have the warp threads 20, i.e., the machine direction threads, on the inner surfaces thereof, and the fill threads 21, i.e., the transverse threads, on the outer surfaces thereof. Because the warp threads are the machine direction threads, they are inherently tensioned more than the fill threads, which are the transverse direction threads. Consequently, when the non-woven fabric is disposed with the fill threads 21 on the outer surface thereof, the fill threads tend to sag between the warp threads 20 (see FIG. 3) and make more effective contact with the exposed portions of the central layer 10 of cellulosic tissue than would be possible with the warp threads disposed on the outer surface. Similarly, the fill threads 21 can be more effectively pressed down

between the warp threads 20 into intimate contact with the central layer 10 of cellulosic tissue, by means of a calendering operation for example. As a result, the final composite material is considerably less susceptible to thread pick-off than a material having the warp threads on the outside. This is an especially significant feature in a heavy-duty wipe, which is continually rubbed over rough surfaces and sharp corners which tend to pick or pull threads from the surface of the wipe during normal usage.

It is also critical that both the warp threads 20 and the fill threads 21 be coated with adhesive in the two layers 12 and 13 of non-woven fabric. By applying adhesive to both the warp and fill threads, the central layer 10 of cellulosic tissue is bonded to both sets of threads so that the resulting composite material is not subject to "grinning" when stressed in the transverse direction, i.e., the central layer 10 of cellulosic tissue, cannot slide over one set of threads and rupture due to the lack of an effective bond between the relatively strong threads and the relatively weak cellulosic tissue, as in the case when adhesive is applied to only one set of threads.

In accordance with a further aspect of the invention, thin appliques 30 and 31 of fine fibrous material are bonded to the outer surfaces of the layers 12 and 13 of non-woven fabric on the opposite faces of the central layer 10 of cellulosic tissue. Thus, in the illustrative embodiment, thin appliques 30 and 31 are applied to the outer surfaces of the two fabric layers 12 and 13, and the appliques are bonded to the fabric by means of the adhesive on both the warp and fill threads 20 and 21. The appliques 30 and 31 are well known per se in the art, and are preferably made of fine fibers of cotton or other natural or synthetic fibers deposited on the fabric layers 12 and 13 in a random manner. Most of the fibers engage and become bonded to one or more of the warp and fill threads of the fabric layers 12 and 13, but the fibers in the applique also become intertwined so that a fiber which does not engage a warp or fill thread is nevertheless anchored to the laminate via other fibers which are directly attached to the fabric layers. The fibrous appliques 30 and 31 are preferably formed directly on the fabric layers 12 and 13 before the fabric is laminated to the central layer 10 of cellulosic tissue, but if desired the appliques can be formed on the fabric after the lamination of the fabric layers to the cellulosic tissue, or the appliques may even be pre-formed and subsequently laminated to the non-woven fabric. If desired, relatively long fibers, such as 3/4-inch cut rayon staple, may be used to insure that each fiber contacts at least one of the threads in the cross-laid fabric and thereby provide improved resistance to linting.

It has been found that the particular combination of materials embodied in the composite laminate of FIGS. 1 and 2 is superbly suited for use as a heavy-duty wipe. Thus, the central layer 10 of cellulosic tissue provides a relatively high absorbent capacity, and is readily accessible via the relatively large openings in the fabric layers 12 and 13 and the thin fibrous appliques 30 and 31 so that the absorbency rate is also relatively high. The non-woven fabric layers on the outer surfaces of the cellulosic tissue provide the composite laminate with the relatively high tensile strength and abrasion resistance required in a heavy-duty wipe. In this connection, a relatively high thread count, e.g., 6 x 10 or 12 x 5 (number of warp threads per inch by number of fill threads per inch), is preferred to provide good abrasion resistance, and a denier in the range of about 30 to about 70 is preferred to provide adequate strength characteristics. From a cost-strength standpoint, a crossed-thread fabric made of 40 denier high tenacity nylon is especially preferred. Finally, the fibrous appliques 30 and 31 on the outer surfaces of the fabric layers provide the composite wipe with softness and enhance the absorbency of the wipe due to the relatively large pores in the appliques rapidly transporting

absorbed liquids to the smaller pores of the cellulosic tissue which retains the liquid. The relatively small pore structure of the cellulosic tissue retains absorbed liquids under compression, while the relatively large pores structure of the appliques provides a high absorbency rate and good oil film removal ability.

Several samples of the particular product illustrated in FIGS. 1-3, and made with the exemplary materials described above, were subjected to physical tests to determine the oil absorbency rate and the oil film removal characteristics. In the oil absorbency rate test, a 4-inch square specimen was placed on a wire screen, and 0.1 milliliter of white mineral oil at about 73° F. was discharged onto the specimen near the center thereof. The oil was discharged from a syringe held at an angle of about 30° from horizontal, and with the tip of the syringe in the liquid, nearly touching the specimen. The time was measured from the start of the liquid flow until the end point when the liquid was completely absorbed, as indicated by no further reflection of light from it when viewed at an angle. The oil film removal test was conducted by placing 1 milliliter of the same oil on a vitrolite (black glass) surface and spreading it out into a thin film within about a 12" circle. The wipe material was then used to remove the oil film, with the time being measured from the start of the wiping until the removal of the shine, or the development of a dull gloss. These tests were conducted on the illustrative product both with and without the cotton applique on the outer surfaces thereof, with the following results:

Property	No applique	Applique
Oil rate (seconds).....	6	3-4
Oil film removal (seconds).....	6	4-6

Further physical tests conducted on the same sample described above, with the cotton applique on the outer surfaces thereof, yielded the following results:

Physical test.....	Sample No.	
	1	2
Tensile strength:		
Dry:		
MD.....	5,018	4,933
CD.....	2,283	1,665
Wet:		
MD.....	4,050	4,683
CD.....	1,817	1,400
Grams/1" wide and stretch.....	40	32
Basic weight #/MSF.....	24.8	26.5
Product thickness (10-4 x 4).....	0.293	0.290

In FIGS. 4 and 5, there is illustrated a preferred method of forming the particular wipe shown in FIGS. 1-3. Thus, turning first to FIG. 4, a continuous fabric web 40 of open-mesh, non-woven crossed threads (corresponding to the layers 12 and 13 in the illustrative wipe of FIGS. 1-3) is passed under a guide roll 41 to an adhesive application station indicated generally 42. The station 42 includes a first pair of rolls 42a for applying adhesive to the warp thread side of the web 40, and a second pair of rolls 42b for applying adhesive to the fill thread side. The web 40 may be fed to the adhesive station 42 directly from the apparatus for making the crossed-thread fabric, or it may be unwound from a supply roll of previously manufactured fabric. The illustrative adhesive application station 42 includes two application rollers 42a and 42b, one on each side of the web, to insure uniform application of adhesive on both sides of the web. It can be seen that the applicators 42a and 42b apply an adhesive coating to both sets of the cross-laid threads, i.e., both the fill threads 20 and the warp threads 21.

While various adhesives may be employed, advantages reside in the use of plastisols which, as is well known, are colloidal dispersions of synthetic resins in a suitable organic ester plasticizer. While many adhesives of this nature are known, those found particularly useful for

5

incorporation in the product of this invention include vinyl chloride polymers, and copolymers of vinyl chloride with other vinyl resins, plasticized by organic phthalates, sebacates, or adipates. These combinations provide a fast curing plastisol adhesive characterized by relatively low viscosity, low migration tendencies, and minimum volatility. Such adhesives remain soft and flexible after curing, can be reactivated by the application of heat and pressure, such as by hot-calendering, and insure that the resultant laminated product retains the desired softness, and proper hand and feel. Although plastisols are preferred, polyvinyl resins per se, plasticized or unplasticized, such as polyvinyl acetate, and copolymers may also be used. Other flexible adhesives may also be used, including acrylic resins such as the alkyl acrylates, and butadiene resins such as butadiene-styrene and butadiene acrylonitriles.

From the applicator 42, the adhesive coated fabric web 40 is passed around a pair of heated steel rolls 43a and 43b for the purpose of curing and solidifying the adhesive. When using the preferred plastisol adhesives described above, the heated rolls 43a and 43b are typically maintained at a temperature of about 200° to 300° F. which is sufficient to set the plastisol adhesive.

For the purpose of applying an applique 44 (corresponding to the appliques 30 and 31 in the illustrative wipe of FIGS. 1-3) to the fabric web 40, the web is withdrawn from the heated roll 43b and passed under an air former 46 in a generally horizontal path. The air former 46 applies fine fibers, which may be natural or synthetic, to the traveling fabric web 40 by means of an air blast, gravity feed, or similar mechanism. For example, the air former may apply 4.0 to 5.0 grams per sq. yd. of fine fibers to the fabric web. As will be understood by those familiar with this art, the fine fibers tend to lightly film or bridge across the openings between the crossed threads of the fabric web.

For reasons described previously, it is important that the fibrous applique 44 be applied to the fill thread side of the fabric web 40, and thus the web must be oriented so that the fill threads are on the upper surface of the web 40 as it passes under the air former 46. After the fiber applique 44 has been applied to the fabric web 40, the web is passed over a guide roll 48 where a multi-ply layer 49 of cellulosic tissue (corresponding to half of the central layer 10 in the illustrative wipe of FIGS. 1-3) is unwound from a supply roll 50 and laminated to the underside of the fabric web. As explained previously, it is important that the cellulosic tissue 49 be laminated to the warp thread side of the fabric web 40. In order to form the specific wipe shown in FIGS. 1-3, the layer 49 of cellulosic tissue contains two plies, i.e., half the thickness of the ultimate central layer 10 in the final wipe.

In order to bond both the applique 44 and the tissue layer 49 to the fabric web 40, the laminate is passed around a heated steel roll 51, and then through the nip formed by the heated roll 51 and a nylon calender roll 52. The heat from the roll 51 reactivates the previously set adhesive on the fabric web 40, while the calendering operation presses the fill threads on the outer surface of the fabric web 40 down between the warp threads on the inner surface, and into intimate engagement with the tissue layer 49. When using the preferred plastisol adhesives described above, the steel roll 51 is heated to a temperature of about 320° to 350° F., to complete the curing of the adhesive and firmly bond the tissue layer 49 to the web 40. In order to prevent fiber pick-off on the nylon calender roll 52, the roll 52 should contact the tissue side of the web, while the metal roll 51 contacts the applique-fabric side of the web, as illustrated in FIG. 4.

From the calender roll 52, the bonded laminate is passed through a conventional hot microcreper 53 for the purpose of improving the softness and bulk of the wipe, and also imparting stretch with minimal strength loss.

6

With the exemplary materials mentioned above, the hot microcreping is preferably carried out at a temperature of about 250° to 300° F. so as to set the adhesive and provide the desired permanent crepe in the resulting product. The microcreper 53 is conventional equipment, and the operation thereof is well known to those familiar with this art.

In order to complete the solidification of the adhesive in the creped product withdrawn from the microcreper 52, the creped web is passed around a pair of cooling rolls 54a and 54b. This cooling step insures that any remaining tack in the adhesive is completely eliminated so that the laminate can be readily handled and wound on a storage roll, and subsequently unwound therefrom without sticking. In the illustrative process of FIG. 4, the laminate is pin embossed by passing it between a pin roll 55 and a brush roll 56 before winding it on the storage roll 57. The pin embossing, which again is carried out with conventional equipment well known to those skilled in the art, further improves the absorbency and softness of the final product.

In order to complete the formation of the composite wipe shown in FIGS. 1-3, two rolls 57a and 57b, both formed by the process illustrated in FIG. 4, are unwound and laminated as illustrated in FIG. 5. Thus, the laminate from roll 57a is unwound over a guide roll 60 and passed into the nip of a pair of calender rolls 61 and 62 with the cellulosic tissue layer 49a on the underside thereof. The laminate from the other roll 57b is passed around a pair of guide rolls 63 and 64, through an adhesive applicator 65, and then into a low pressure nip formed by rolls 61 and 62 with the cellulosic tissue layer 49b on the upper side thereof. The adhesive applied to the tissue side of the laminate from the roll 57b in the applicator 65, which is preferably a polyvinyl acetate adhesive, bonds the two face-to-face cellulosic tissue layers 49a and 49b together as the two laminates are pressed together by the calender rolls 61 and 62, thereby forming a final composite laminate 66 corresponding to the wipe shown in FIGS. 1-3. This laminate is then passed on to downstream equipment for performing the desired slitting, sheeting, and/or folding operations. The adhesive pattern printed on the tissue side of the laminate 49b by the adhesive applicator 65 is preferably applied in a discontinuous pattern, such as in a dot pattern by means of intaglio cell roll. As will be apparent to those skilled in this art, such a discontinuous adhesive pattern firmly bonds the two tissue layers without adversely affecting the absorbency and flexibility thereof.

While the invention has been described above with specific reference to certain particular embodiments, it will be understood that various modifications may be made within the spirit and scope of the invention. For example, the fine cotton appliques described above may be replaced by materials such as longer airlaid rayon fibers (approximately 0.75 inch), a drawn web of rayon, or a carded web for improved linting properties. Another possible modification is to dispose the cotton applique or other fibrous material between the warp thread side of the non-woven fabric and the central layer of cellulosic tissue, again for improved linting properties.

As can be seen from the foregoing detailed description, this invention provides an improved heavy-duty wipe having superior strength, abrasion resistance, and softness properties combined with adequate bulk and absorbency. More particularly, the wipe has improved resistance to grinning and thread pick-off, a desirable soft feel, and a relatively high absorbency rate and capacity. Furthermore, the wipe can be efficiently manufactured at high production rates and at a relatively low cost.

I claim as my invention:

1. A method of forming a laminated heavy-duty wipe comprising the steps of providing a web of non-woven fabric made of open-mesh cross-laid and bonded threads, said fabric including spaced warp threads extending in the

machine direction on one side of said fabric and spaced fill threads extending in the transverse direction on the other side of said fabric, said warp and fill threads being coated with adhesive, laminating a layer of absorbent material formed of a multiplicity of plies of creped cellulosic tissue to the warp thread side of said web of non-woven fabric and bonding said absorbent material to both the warp and fill threads, and bonding two layers of the resulting laminate together with the tissue layers facing each other to form a composite laminate with said tissue layers on the inside and said fabric webs on the outside.

2. A method of forming a laminated heavy-duty wipe as set forth in claim 1 wherein a thin applique of fine fibrous material is bonded to the fill thread side of said web of non-woven fabric.

3. A method of forming a laminated heavy-duty wipe as set forth in claim 2 wherein said applique comprises randomly oriented fine cotton fibers.

4. A method of forming a laminated heavy-duty wipe as set forth in claim 1 wherein said non-woven fabric has a thread count of at least five threads per inch in one direction and at least ten threads per inch in the other direction.

5. A method of forming a laminated heavy-duty wipe as set forth in claim 1, wherein said non-woven fabric is made of high tenacity nylon thread having a denier within the range of from about 30 to about 70.

6. A method of forming a laminated heavy-duty wipe as set forth in claim 1 wherein said cellulosic tissue has a stretch per ply of between about 15% and about 75% and a dry uncreped basis weight within the range of about 4 to about 13 pounds per 2,880 square feet.

7. A method of forming a laminated heavy-duty wipe comprising the steps of providing a web of open-mesh non-woven crossed threads including a set of spaced warp

threads extending in the machine direction and a set of fill threads extending in the transverse direction on one side of said warp threads and bonded thereto at the crossing points, both the warp threads and the fill threads being coated with adhesive, laminating a layer of absorbent material formed of two or more plies of cellulosic tissue to the warp thread side of said web and bonding said absorbent material to both the warp threads and the fill threads, and laminating two plies of the resulting web-tissue laminate together with the layers of tissue on the inside and the fabric web on the outside and bonding the two tissue layers together to form a composite laminate.

8. A method of forming a laminated heavy-duty wipe as set forth in claim 7 wherein a thin applique of fine fibrous material is deposited on the fill thread side of said fabric web and bonded both the warp threads and the fill threads.

9. A method of forming a laminated heavy-duty wipe as set forth in claim 7 wherein said applique is deposited on said fabric web prior to the lamination of said layer of absorbent material to said fabric web.

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