April 21, 1959 T. HINDLE ET AL 2,882,933

LONG WEARING PAPERMAKERS' DRYER-FELT

Filed July 26, 1955 2 Sheets-Sheet 1

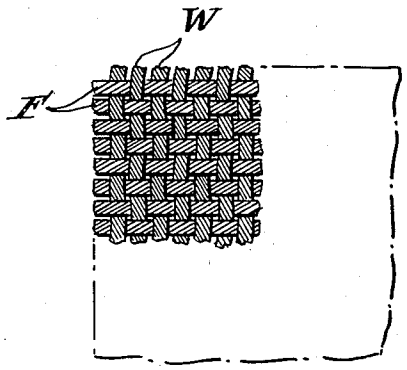


Fig. 1

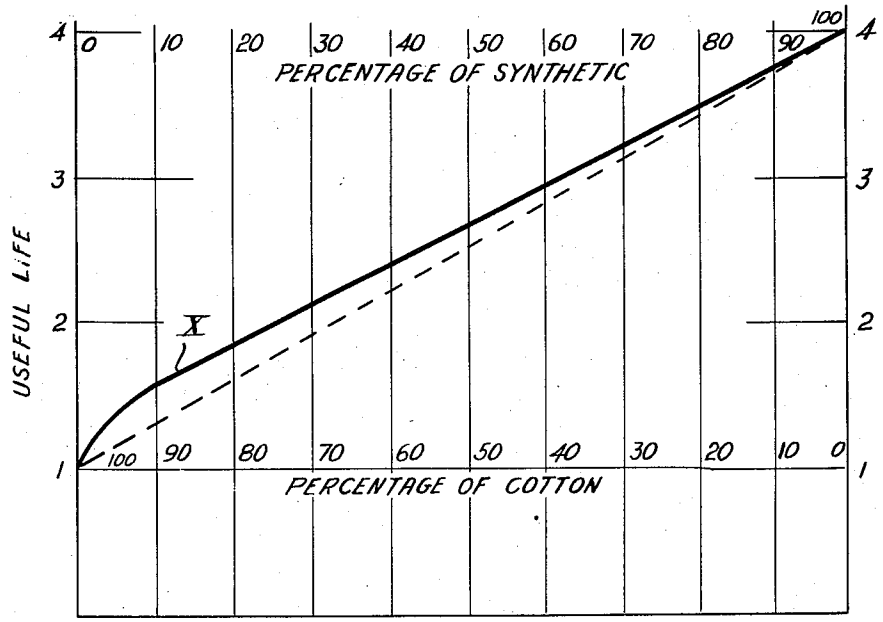


Fig. 5

Inventors
Thomas Hindle
Edward H. Hall
by Robert Cushman & Grover
Attys

April 21, 1959 T. HINDLE ET AL 2,882,933

LONG WEARING PAPERMAKERS' DRYER-FELT

Filed July 26, 1955 2 Sheets-Sheet 2

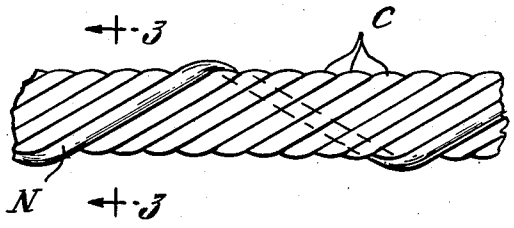


Fig. 2

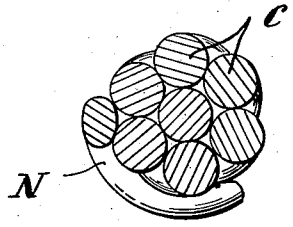


Fig. 3

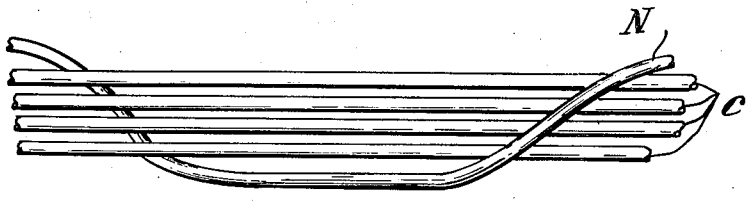


Fig. 4

United States Patent Office

2,882,933

Patented Apr. 21, 1959

2,882,933

LONG WEARING PAPERMAKERS' DRYER-FELT

Thomas Hindle, Blackburn, England, and Edward H. Hall, Fitchburg, Mass.

Application July 26, 1955, Serial No. 524,410

13 Claims. (Cl. 139—426)

This invention relates to papermakers' dryer-felts. In papermaking, dryer-felts in the form of endless woven bands are used to carry the sheet or web of paper in close contact with the drying cylinders of the paper-machine. Although such dryer-felts, being composed of cotton or other cellulosic material or a mixture thereof with asbestos, are not subjected to any form of milling, and are therefore not felts in the technical sense of the term, they have, by common usage, become universally known as "dryer-felts."

Such dryer-felts are subject to severe mechanical stresses due to reverse bending around the drying cylinders and intermediate felt rolls, which latter are usually driven by the felts. They are also subject to abrasion and to heat combined with the action of certain acids which are absorbed by the dryer-felt in a cumulative manner.

Dryer-felts are commonly woven from cotton or combinations of cotton and asbestos yarns. Cotton has excellent drying properties, but has the disadvantage that its strength is lost under the combined action of acids and heat. Asbestos has pronounced resistance to heat, and in this respect is preferable to cotton, but since the asbestos fibre is very short, yarns produced from pure asbestos have very little tensile strengh. For that reason, asbestos yarns usually contain a certain proportion of cotton or rayon fibre mixed with the asbestos fibre, and usually have a core of cotton or rayon yarn to provide additional strength.

Because of their great tensile strength and superior resistance to abrasive action and to destructive chemical action, yarns of certain synthetic fibres have been suggested as a substitute for cotton or the other natural fibres commonly employed in the manufacture of dryer-felts, and experiment has shown that a felt woven from such yarns alone has a useful life as much as four times that of the customary cotton felt. However, the high cost of synthetic yarns spun from staple length synthetic fibres has precluded their use for this purpose, except in certain specific locations, for example, in the margins of the dryer-felt. On the other hand, pure filament yarns, although cheaper than the spun yarns, have certain inherent characteristics which make it impractical to use them alone in the manufacture of a dryer-felt.

The present invention has for its object the production of a commercially practical dryer-felt having a substantially longer life than that of the customary cotton or asbestos felt.

As the result of extended experiment and practical test under paper mill conditions, we have discovered that by a proper combination of synthetic filament yarn with cotton or with cotton and asbestos, it is possible to obtain many of the advantages of the synthetic material, as compared with pure cotton, in an acceptable felt whose cost is low enough to make it commercially practical. More specifically, we have discovered that if conventional smooth-surfaced filament nylon, for example, be combined with cotton, so that the nylon constitutes from 6% to 14% of the whole by weight, to form a yarn

wherein the cotton constitutes a core about which the nylon is wound to form an open helix, and this composite strand be employed for both warp and filler in weaving a dryer-felt according to customary procedure, the resultant felt has a useful life which is approximately 50% greater than that of a felt of similar weave consisting of cotton yarn alone. However, these experiments show that if the synthetic material be increased beyond 14% of the whole, by weight, the corresponding added length of useful life of the felt is so relatively slight as to more than be counterbalanced by the corresponding increased cost of the material employed.

Other and further objects and advantages of the invention will be pointed out in the following more detailed description and by reference to the accompanying drawings, wherein

Fig. 1 is a fragmentary plan view illustrating diagrammatically a piece of papermakers' dryer-felt made in accordance with the present invention;

Fig. 2 is a fragmentary view to a very large scale, diagrammatically illustrative of the construction of one of the composite warp or weft strands employed in weaving the fabric of Fig. 1;

Fig. 3 is a diagrammatic transverse section on the line 3—3 of Fig. 2 but to larger scale;

Fig. 4 is a large-scale diagrammatic view showing a piece of one of the composite warp or weft strands untwisted until the core yarns are paralell, and showing the synthetic filament yarn as it then appears; and

Fig. 5 is a diagram graphically illustrative of the beneficial effects of the present invention as respects increased useful life of the dryer-felt.

Referring to the drawings, Fig. 1 represents a piece of dryer-felt embodying the present invention and comprising the warps W and wefts F, it being understood that the warps and wefts are interwoven to provide a multi-ply fabric in accordance with any customary weaving procedure in the manufacture of dryer-felts. It is also to be understood that the warps and wefts are alike in respect to the ratio of filamentous synthetic and cotton contained therein, although it is immaterial whether the twist of the warps be of the same or of a different hand from that of the wefts. As usual in the manufacture of dryer-felts, each warp or weft comprises a plurality of cotton yarns plied together, but in accordance with the present invention one or two yarns of filamentous synthetic, for example, nylon, is or are wound about the plied cotton yarns. The term "filamentous synthetic" as herein employed is intended to designate a strand consisting of conventional smooth-surfaced filaments of a man-made fibre produced for example, by extrusion, and is to be distinguished from a strand made by chopping up or otherwise dividing extruded filaments and thereafter forming the short sections into yarns by spinning. Among the synthetics which have been found to provide the desired characteristics in the dryer-felt in accordance with the present invention are nylon, which is a polyamide resin made by the polymerization of a hexamethylenediamine salt of adipic acid; Orlon, which is made principally from polyacrylonitrile and which is made and sold commercially by E. I. du Pont de Nemours & Company, this material having high resistance to acids and to degradation by sunlight; and Dacron, which is made by the condensation of dimethyl terephthalate and ethylene glycol, and which is made and sold commercially by E. I. du Pont de Nemours & Company; these several synthetics being within that group of synthetics commonly referred to as of the high tenacity type.

In accordance with the present invention, the number and size of the cotton yarns which are plied together in making the core of the warp or weft strand may be

varied as desired, according to the type of cotton employed, or with respect to the particular requirements of the mill in which the felt is to be used, but in accordance with the present invention, the winding of filamentous synthetic should constitute from 6% to 14% and preferably 10% of the total weight of the felt which is to be woven.

As shown graphically in Fig. 5, wherein the ordinates represent useful life of the felt and the abscissa represent the ratio of synthetic to cotton, the average normal life of a plain cotton felt of customary construction is indicated by the numeral **1**. If, in manufacturing a felt, a filamentous synthetic, for example nylon yarn be substituted for some of the usual cotton yarns in making the warps and wefts, the useful life of the felt is thereby prolonged, but for some unknown reason the increase in useful life resultant from increase in the percentage of synthetic is not according to a straight line ratio, such as might be expected and which is indicated by the dotted line **1—4**, but as the synthetic is substituted for cotton, the useful life of the resultant felt rises very sharply and at a much higher rate than the rate of increase of the synthetic-cotton ratio, as shown by the curved portion of the solid line **1—4**. This abnormal increase in useful life is such that by a substitution of 10% of filamentous synthetic for an equal amount of cotton, the useful life of the felt is increased by approximately 50% or more. However, after the synthetic reaches 14%, by weight, of the whole, further increase in the percentage of synthetic does not show any similar abnormal increase in the useful life of the felt, but beyond 14% of synthetic, increase in useful life is approximately in a straight line ratio to the increase in percentage of synthetic, as indicated by the solid line X—4.

The cost of filamentous synthetic is so much greater than the cost of cotton that increase in the amount of synthetic beyond 14% is substantially balanced by the increased cost of the felt, so that for practical purposes 14% of synthetic in a felt, wherein the balance is cotton, represents the upper useful substitution of synthetic for cotton, and as will be seen by inspection of Fig. 5, this 14% synthetic represents an increase of useful life of the felt of approximately 60%. However, the abnormal rate of increase is most manifest up to 10% synthetic, and it is at present considered that 10% synthetic represents the best practice as respects prolonged life as balanced against increased cost.

In the drawings (Figs. 2, 3, and 4) a composite strand such as is used in the practice of the present invention, and which may be a warp or weft strand, is illustrated, the views being diagrammatic.

In preparing the composite warp strands W or the composite weft strands F (Fig. 1) according to the present invention, cotton yarns C (Figs. 2, 3 and 4) of the selected size and in the desired number are twisted together to form a plied strand. While so twisting the cotton yarns together, one or more filamentous synthetic nylon strands are delivered to the twisting point at substantially zero tension, while concurrently the cotton yarns are delivered at a positive tension, the difference between these tensions being such that in the completed composite strand the synthetic yarn tends to lie on the surface, thus forming in the one twisting operation an open-coiled helix or spiral winding exposed at the surface of the bundle of plied cotton yarns which form the core of the strand. Obviously the synthetic yarn could be wrapped about the cotton core as a separate operation if desired. Because the synthetic yarn has a much higher tensile strength than the cotton yarn, offers greater resistance to abrasion, is less easily damaged by chemical action, and is exposed at the surface of the bundle of cotton yarns forming the core, it provides added strength to resist tension and flexing, and protects the cotton core yarns from the effects of abrasion and chemical action, and thus, although these windings of synthetic yarn form

but a small percentage of the entire felt, nevertheless the synthetic yarn applied as above described adds very substantially to the useful life of the felt, as above pointed out and illustrated in Fig. 5 of the drawings.

Not only does the substitution of a relatively small amount of synthetic yarn for a similar amount of cotton add materially to the useful life of a felt which is otherwise of pure cotton, but a generally similar increase in useful life may be given to a so-called "asbestos felt" in accordance with the present invention by the addition thereto of a small percentage of filamentous synthetic yarn. Usually an asbestos felt is of multi-ply construction comprising a backing ply or plies of pure cotton, yarn, and a facing ply or plies of asbestos yarn, the latter usually containing a certain proportion of cotton or rayon fibres mixed with the asbestos fibre before the spinning process, and usually having a core of cotton or rayon yarn to provide additional strength. In accordance with the present invention, the warps and wefts which form the backing of the asbestos felt may be made in the manner above described by plying cotton yarns and winding a filamentous synthetic strand about the bundle constituted by the plied cotton yarns, the synthetic strand and cotton being in proportions such that the percentage of synthetic falls within the range from 6% to 14% by weight, but preferably being 10% synthetic.

In making the composite yarn for warp or weft as above noted, and merely by way of example 10s/7 cotton yarns may be plied together and wound with one or more filamentous synthetic yarns, the latter being of such denier that the completed yarn will contain the synthetic in the percentage, by weight, above described. Merely by way of a further example, 7s/5 cotton yarn may likewise be plied together and wound with one or more synthetic filamentous yarns of such denier as to produce the above desired percentage. In forming the composite strand, any desired twist may be employed, for instance, the composite strand may have seven turns per inch, either in the **Z** or **S** direction, it being understood, however, that these specific examples are merely by way of illustration and not in any sense designed to indicate limitations upon the invention.

It is further to be understood that any and all modifications which fall within the terms of the appended claims are to be considered as within the scope of the invention.

We claim:

1. A papermakers' dryer felt wherein, throughout its entire width, both warps and wefts comprise cores consisting of plied cotton yarns and exposed helical windings of abrasion resistant filamentous synthetic material which ride on the cotton cores, the synthetic material constituting from 6% to 14% of the whole felt by weight.

2. A papermakers' dryer felt comprising cotton and from 6% to 14% by weight of a filamentous synthetic material which is abrasion resistant and of high flexural endurance, each of the warps and each of the wefts having a core consisting of plied cotton yarns and an external winding comprising a plurality of spaced helices of the filamentous synthetic material which ride on the bundles of cotton yarns.

3. A woven papermakers' dryer felt which has a useful life approximating 50% greater than that of a similarly constructed felt consisting of cotton alone, said felt comprising cotton and approximately 10% by weight of a filamentous synthetic material which is strong and abrasion resistant, the felt consisting of interwoven warps and wefts, each warp and each weft comprising a core consisting of plied cotton yarns, the filamentous synthetic material being so associated with the cotton cores as to form an exposed helical winding which embraces and rides on the latter.

4. A papermakers' dryer felt wherein warps and wefts are interwoven in customary manner, each of the warps

and each of the wefts comprising a core of cotton and an external open-coiled helical winding of filamentous nylon, the nylon constituting from 6% to 14% by weight of the felt.

5. A papermakers' dryer felt wherein warp and weft strands are interwoven in customary manner to form a multi-ply fabric, certain of the constituent strands which appear at the face of the fabric comprising asbestos fibre, and others of the constituent strands, which constitute the back of the fabric, each comprising plied cotton yarns and a yarn of a strong, abrasion resistant filamentous synthetic, the cotton yarns forming the core of the strand and the filamentous synthetic yarn forming an open-spired helical winding exposed at the surface of the core, and riding on the latter, the filamentous synthetic material so employed constituting approximately 10% by weight of the felt.

6. A papermakers' dryer felt, according to claim 1, wherein the filamentous synthetic material is of the high tenacity type.

7. A papermakers' dryer felt, according to claim 1, wherein the synthetic material is filamentous nylon.

8. A papermakers' dryer felt, according to claim 1, wherein the synthetic material is filamentous Dacron.

9. A papermakers' dryer felt, according to claim 1, wherein the synthetic material is filamentous Orlon.

10. A multi-ply papermakers' dryer felt wherein warp strands and weft strands are interwoven to form a multi-ply fabric, certain of the constituent strands, which appear in the face ply of the fabric, comprising asbestos fibers, and others of the constituent strands which are in the rear ply of the fabric each comprising plied cotton yarns and filamentous nylon, the cotton yarns forming the core of each such strand, and the nylon yarn forming an open-spired helical winding exposed at the outer surface of the core and riding on the latter, the nylon so employed constituting approximately 10% by weight of the fabric.

11. A papermakers' dryer felt which comprises warp and weft strands which are so interwoven as to form a textile fabric structurally suitable for use as a dryer felt, each of the strands so employed comprising a core consisting of a plurality of cotton yarns twisted together, said

core being embraced by at least one winding of filamentous synthetic yarn which lies on the surface of the cotton core in the form of an open-coiled helix, the total amount of synthetic filamentous material comprised in the felt constituting from 6% to 14% by weight of the felt.

12. A papermakers' dryer felt consisting of interwoven warp and weft strands of non-felting fibrous material, certain at least of the constituent strands each having a plied core whose constituent yarns consist of fibre of natural origin, the core being embraced by at least one protective winding of filamentous smooth-surfaced synthetic yarn of the high tenacity type disposed to form an open-coiled helix coaxial with the core, said helix riding upon the core with its turns exposed at the outside of the core, the total amount of filamentous synthetic so employed in the felt constituting from 6% to 14% of the total weight of the felt.

13. A papermakers' dryer felt consisting of interwoven warp and weft strands wherein each of the warp and weft strands has a core consisting solely of cotton yarn, said core being embraced by a winding of filamentous, smooth-surfaced yarn of a synthetic of the high tenacity type which forms an open-coiled helix coaxial with and riding upon the core, the synthetic yarn constituting from 6% to 14% of the total weight of the felt.

References Cited in the file of this patent

UNITED STATES PATENTS

2,098,993	Barrell	Nov. 16, 1937
2,115,658	Whittier	Apr. 26, 1938
2,168,928	Barrell	Aug. 8, 1939
2,423,828	Chagnon	July 15, 1947
2,449,595	Ellis	Sept. 21, 1948
2,506,667	Hall	May 9, 1950
2,540,874	Geddings	Feb. 6, 1951
2,552,210	Parker	May 8, 1951
2,575,753	Foster	Nov. 20, 1951

FOREIGN PATENTS

472,893	Canada	Apr. 17, 1951
710,078	Great Britain	June 9, 1954