Aug. 8, 1939. W. A. BARRELL 2,168,928

SINGLE PLY ASBESTOS FACED DRIER FELT

Filed July 13, 1937

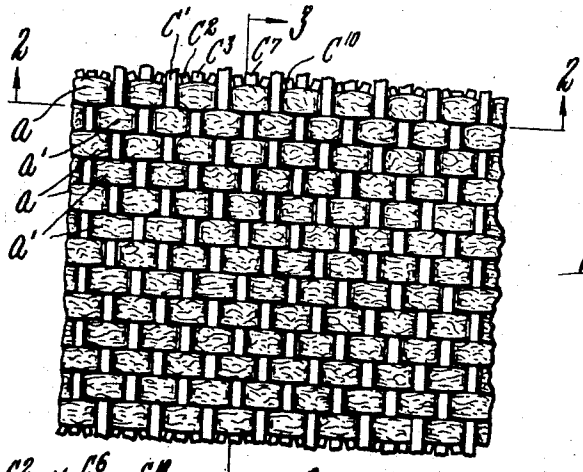


Fig. 1.

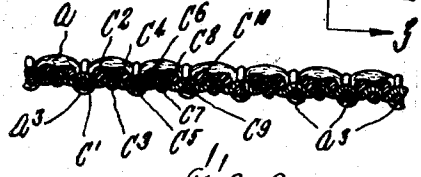


Fig. 2.

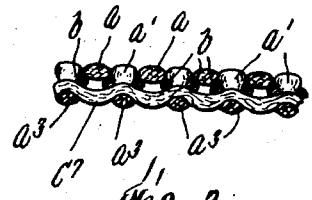


Fig. 3.

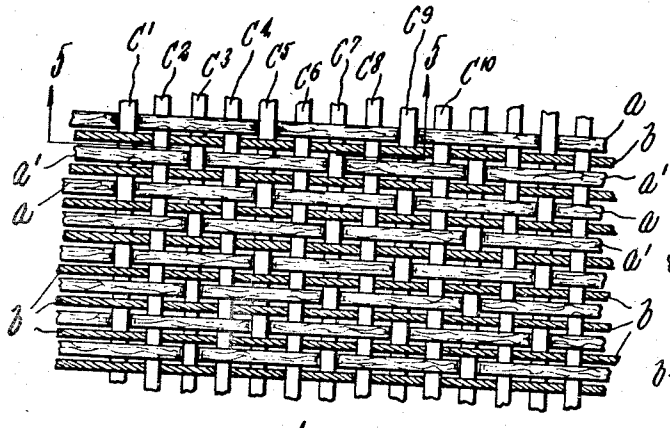


Fig. 4.

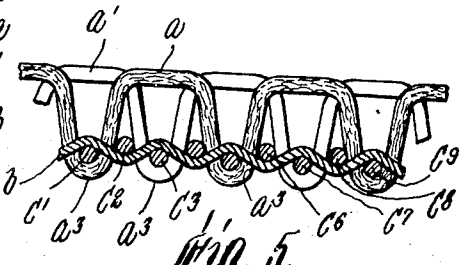


Fig. 5.

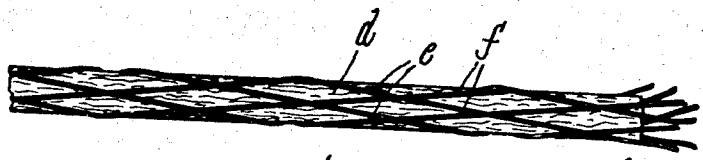


Fig. 6.

Inventor
William A. Barrell
by Wright, Brown, Quinby & Craig
Attys.

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SINGLE PLY ASBESTOS FACED DRIER FELT

William A. Barrell, North Andover, Mass., assignor to Lawrence Duck Company, Lawrence, Mass., a corporation of Massachusetts

Application July 13, 1937, Serial No. 153,309

10 Claims. (Cl. 139—383)

The present invention relates to drier felts for paper machines, i. e., the wide bands or carriers, by which newly made paper, containing all the water remaining after the paper has been passed through squeezing rolls, is conducted around a multiplicity of steam heated drums and is dried by evaporation. More particularly it relates to felts of this class, of woven construction, which contain a substantial content of asbestos fiber so disposed as to afford protection to any cotton or other non-asbestos strands which may be in the fabric from the destructive effects of the heat and moisture to which they are subjected, and to facilitate the discharge and escape of moisture from the paper through the felt.

It is well known that asbestos fiber is not well adapted for spinning, and that to produce drier felts containing asbestos and at the same time having sufficient tensile strength to withstand the stresses and strains to which they are subject in use, fibers or strands of other materials are needed. Asbestos moreover is much heavier than cotton, which is the material heretofore most commonly used for the manufacture of drier felts. Heretofore such so called asbestos drier felts as have appeared commercially on the market have been heavy and bulky, and run wet when operated at the normal speeds and with the normal temperatures employed when standard all cotton felts are used. "Running wet" means that the felt does not conduct and discharge or evaporate moisture absorbed from the paper rapidly enough to deliver the paper from the drier with the prescribed low content of moisture. In order then to bring the moisture content in the paper to the prescribed percentage, the machine must either be run slower, which reduces the production of finished paper, or steam at a higher temperature must be supplied to the drying drums, which causes increased expense for fuel.

My object has been to produce a thinner and lighter asbestos faced drier felt than those heretofore known, which is of sufficiently open construction to leave a multiplicity of minute openings through which water vapor can escape readily, and in which the content of asbestos is so disposed as to protect the non-asbestos strands and most effectively conduct water from the face to the back of the felt in wide surface exposure to the atmosphere; and at the same time to reduce greatly the tendency of the felt to elongate and narrow in width under tension, and eliminate liability of drawing together laterally, folding and wrinkling in use.

The product of the invention is a further step and improvement beyond the accomplishment of my recently granted Patent No. 1,991,366, entitled Asbestos faced drier felt, granted February 19, 1935, and my copending application having the same title, filed August 15, 1935, Serial No. 36,292, on which Patent No. 2,098,994 was granted November 16, 1937. As compared with the felts described in said patents, my present felt is substantially thinner and lighter in weight, and the asbestos is disposed more favorably for conduction and evaporation of moisture and to prevent clogging of the pores in the felt by detritus and other matters received from the paper. It contains a sufficiently of non-asbestos warp strands to give adequate tensile strength, and sufficiently numerous and closely spaced picks of filling to furnish all needed strength in the seam by which the ends of the felt are joined together in a paper drier.

A specific felt embodying the new invention is shown in the drawing, in which

Fig. 1 is a plan view showing as nearly as possible the actual appearance of the felt on an enlarged scale;

Fig. 2 is a section in the direction of the warp taken on line **2—2** of Fig. 1, and Fig. 3 a section across the warp on line **3—3** of Fig. 1; these figures showing in approximately correct proportions the locations and dispositions of the various strands relatively to one another;

Figs. 4 and 5 are diagrams showing the weave in extended order; of which Fig. 4 is a plan and Fig. 5 a section on line **5—5** of Fig. 4;

Fig. 6 is an elevation on a much enlarged scale of a fragment of the preferred character of composite yarn in which the asbestos content of the felt is contained.

Like reference characters designate the same parts wherever they occur in all the figures.

The textile structure of this felt consists of an asbestos warp disposed in two sets of strands *a* and *a'*, a warp *b* made of other material than asbestos, preferably cotton, of which the strands or ends have greater tensile strength, but are smaller in diameter and lighter in weight, than the asbestos warp strands, and an asbestos filling *c*, of which the picks are distinguished from one another by exponents for the purposes of this description, as will appear more particularly in the course of the further detailed description. In the particular embodiment of the invention here illustrated the warp *b* is of cotton, and it will be so called in the following description.

Each strand or end of the asbestos warp passes over three picks of filling and under one, in re-

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peated sequence; and the adjacent strands of that warp are staggered or alternated with each other in such fashion that the downward passing loops of each underlie the middle one of each group of three weft strands overpassed by the adjacent warp strands. That is, for instance, an asbestos warp strand, as a, passes under a pick of filling c', then over a group of three picks c^2, c^3, c^4, then under a pick c^5, then over a second group of three picks c^6, c^7, c^8, under a pick c^9; and so on in repeated series. The next asbestos warp strand a' passes over the picks of filling c' and c^2, under the pick c^3, over the next three picks c^4, c^5 and c^6, under the pick c^7, over the next three picks c^8, c^9, c^{10}; and so on; and the strands a and a' repeat in regular alternation across the width of the felt. The reference character a^3 designates the bends or loops of all these warp strands passing under the filling. Each weft strand, c^3, c^7, etc. under which the warp strands a' pass, is the middle one of the group c^2, c^3, c^4 and c^6, c^7, c^8, respectively, which is overpassed by the warp strands a; and each weft strand c^5, c^9, etc. under which the warp strands a pass, is the middle one of the groups c^4, c^5, c^6 and c^8, c^9, c^{10}, respectively, which are overpassed by the warp strands a'. The strands or ends of the cotton warp b lie in alternation with the asbestos warp strands, so that the order of these asbestos and cotton strands crosswise of the felt is as follows,—a, b, a', b, a, etc.; and all the cotton warp strands pass over every other pick of filling and beneath the intermediate picks in regular alternation. The picks over which the cotton warp strands pass are those designated as c', c^3, c^5, which are underpassed by the asbestos warp strands. This effect is obtained by the use, in weaving, of three harnesses, one of which controls all of the cotton warp strands and each of the other two controls half of the asbestos warp strands.

Although the cotton warp strands are harder than the asbestos strands, they are nevertheless soft enough, and small enough in diameter, to be pliable; and in weaving they are bent sharply enough around the weft strands over and under which they alternately pass, to partially embrace the latter. In other words, they are crimped, and the crimp is sufficient to provide grooves in which the weft strands lie and are confined. Although the tension to which the cotton warp is subjected in weaving, and in the subsequent use of the felt, has a tendency to straighten the bends, nevertheless the straightening effect is relatively slight and there is sufficient crimp to hold the weft strands in place under the pull of the seam by which the ends of the felt are sewed together. Resistance to slippage of the seam is as important as adequate tensile strength in other parts of the felt. The crimp of the cotton warp, in conjunction with the binding action of the asbestos warp strands, gives the necessary security against slippage of the weft strands at the seam.

Such displacement of the alternate weft strands toward the face and back of the felt as results from the absence of the oppositely disposed cotton warp strands characteristic of a two harness weave, is not sufficient to put the weft strands in separated planes. All of the weft strands are in nearly the same plane in that the inner sides or bounds of the strands c', c^3, c^5, etc. approximately overlap the plane tangent to the inner sides or bounds of the strands c^2, c^4, c^6, etc., and vice versa.

The lengths or stretches of the relatively large and soft asbestos warp yarns in the face of the felt largely, if not entirely, overlie the upper bends of the smaller and harder cotton strands, which are woven under a tension sufficient to draw them close against the filling strands. Hence these cotton warp strands are prevented from coming into direct contact with the wet paper and are shielded in large measure from the conducted and radiant heat issuing from the paper. Thus the burning and rotting effect, which is so pronounced in cotton strands running in contact with the paper being dried, is greatly retarded and the useful life of the felt correspondingly prolonged. At the same time the cotton warp strands keep the asbestos warp strands apart at the crossing points to the extent that, although flattened out on the face of the felt under pressure, they cannot spread out far enough to completely cover the face with asbestos and "glaze over". A defect which has been noted with felts containing a superabundance of asbestos fiber in the face is that the flattening and spreading of the asbestos masses, and the absorption among the asbestos fibers of chemical substances and detritus from the saturated spongy paper web, form a smooth and apparently glazed surface which strongly resists passage of water vapor from the paper. The construction here described prevents the development of such a continuous glazed surface and leaves a multitude of small openings scattered with substantial regularity throughout the entire area of the felt through which vapor can pass freely.

In the foregoing description I have referred to asbestos strands without qualification. This designation is not intended, nor is it to be construed, as meaning that the strands so characterized are made wholly or exclusively of asbestos fiber. As a matter of fact, other fibers are in practice combined with the asbestos fibers in a measure such as to make strands which, while being sufficiently soft and compressible, yet have sufficient tensile strength to hold together in weaving and to coperate with the cotton warp strands in confining the weft strands in the fabric. Preferably the tensile strength needed for this structural purpose is provided by distinct and separate strands or threads of other material, such as cotton, having greater tensile strength than loosely twisted strands of asbestos fiber.

I prefer to use for both the asbestos warp and filling, strands or yarns of the construction shown in my originally copending application Serial No. 89,514, filed July 8, 1936, for Asbestos textile yarn, on which Patent No. 2,098,995 was issued November 16, 1937. A fragment of such yarn is shown on a much enlarged scale in Fig. 6. It consists of a loosely twisted elongated mass d of asbestos fiber (with which some cotton fiber is preferably interspersed), and a confining cage of fine threads e and f, preferably of cotton, braided together around the asbestos body with wide meshes. The proportion of cotton fiber mixed with asbestos fiber is enough to hold the loosely twisted strand together while the cage is being braided around it, and in practice is in the order of 20%. The number of threads forming the confining cage is preferably the smallest capable of being successfully braided, i. e., eight, of which half extend in right hand helices and the other half in left hand helices around the asbestos mass. The braided threads constitute but a small proportion of the total mass

of the composite strand but they are sufficiently numerous and strong to give all the strength needed for successful weaving and to tie in the weft strands. Their helical lead is so long (there being approximately eight and a half crossings per inch of length of a strand approximating $\frac{1}{32}$ inch to $\frac{1}{16}$ inch in diameter) that the tension which is imposed on them in weaving has little effect to compress the asbestos or to elongate or draw out the strand. These confining threads also prevent the asbestos fibers of warp strands which rub against one another in changing the shed, from being disintegrated and torn loose. However, while I much prefer the strands of this construction for the felt herein described, nevertheless the invention in its generic aspects is not limited to the use of such strands exclusively, but includes any asbestos or composite strands of other constructions which are capable of being effectively combined in the herein described felt structure.

It will be understood from the foregoing description that within the meaning of the term "asbestos strands" as used in this specification I include all usable strands in which asbestos fibers are combined with other fibers or filaments or threads, as well as strands made of asbestos exclusively.

It is also to be understood that if desired I may use strands made of other fibers or materials than cotton in substitution for, and as equivalent to, the warp strands *b*, hereinbefore described as cotton strands. These warp strands *b* have greater tensile strength than strands made of asbestos or asbestos combined with other fibers or filaments, and they supply the major part of, or substantially the entire, tensile strength of the felt as a whole.

Describing in further detail the felt specifically illustrated herein, it contains ten ends of asbestos warp and ten ends of cotton warp per inch of width, and twenty picks of filling per inch of length; and the cotton warp strands are bent around the weft strands enough to form crimps which prevent the weft strands from slipping. This structure gives adequate tensile strength, adequate bulk and stiffness to prevent wrinkling and folding in service, and adequate strength in the seam joining the ends of the felt together. Its thickness averages .090'' and less, and its weight less than 26 ounces per unit of area measuring 22'' by 36''. The asbestos felts first put on the market were about .135'' thick and weighed about 42 ounces per unit of area. Such felts ran wet and were unsatisfactory. Subsequently asbestos felts of .115'' thickness were produced, and this is approximately the thickness of all asbestos felts on the market prior to the development of my inventions for which patent applications are now pending. But there are many situations in which felts of .115'' thickness do not run properly. My present invention satisfies the conditions for which the prior commercial asbestos felts are inadequate.

However, I may vary the number and dimensions of any of the component strands within the scope in which I claim protection. So also may the pattern of the asbestos warp and weft strands be varied within limits.

What I claim and desire to secure by Letters Patent is:

1. A drier felt of single ply construction consisting of interwoven substantially asbestos warp and weft strands, of which the warp strands are distributed substantially uniformly across the width of the felt and each warp strand passes over a group of successive weft strands in the face and under a single weft strand in the back of the felt, in repeated series, and the loops of adjacent asbestos warp strands passing to the back of the felt embrace respectvely different weft strands, and warp strands of other material and greater strength than the asbestos strands interspersed between the asbestos warp strands and all passing in parallel sinuous courses alternately over the same weft strands which are embraced by said loops and under the intermediate weft strands, with sufficient crimp to prevent displacement of the weft strands lengthwise of the warp.

2. A drier felt consisting of a non-asbestos warp, a filling of which all the picks are nearly in the same plane and alternate picks are overpassed while the intermediate picks are underpassed by all the strands of said warp, and a substantially asbestos warp of which the strands are distributed substantially uniformly across the width of the felt in alternation with strands of the non-asbestos warp and adjacent strands pass over respectively different groups of successive weft strands on the face, and under respectively different single weft strands at the back, of the felt, the loops of said asbestos warp strands which pass to the back of the felt being arranged to embrace the weft strands which are overpassed by the non-asbestos warp strands, forming therewith a single ply structure.

3. A drier felt consisting of a non-asbestos warp, a filling of which alternate picks are overpassed and the intermediate picks are underpassed by all the strands of said warp, and a substantially asbestos warp of which adjacent strands pass over respectively different groups of successive weft strands in the face, and under respectively different single weft strands at the back, of the felt, the picks which are underpassed by the non-asbestos warp being engaged with, and confined by, the latter and the overpassing asbestos warp strands exclusively in a single ply structure, and the loops of adjacent asbestos warp strands which pass to the back of the felt being separated from one another and flanked on both sides by non-asbestos warp strands.

4. A drier felt consisting of a non-asbestos warp, a filling, all the strands of said warp being arranged to pass over and under the same successive picks of the filling in parallel undulatory courses, and a substantially asbestos warp of which adjacent strands pass over respectively different groups of successive weft strands in the face, and under respectively different single weft strands at the back, of the felt, between strands of the non-asbestos warp, forming with the weft strands and the non-asbestos warp a single ply structure, those portions or stretches of the asbestos warp strands which overlie certain weft strands being arranged outside of and substantially covering those parts of the non-asbestos warp strands which overlie the same weft strands.

5. A drier felt constructed exclusively of weft strands all in substantially or nearly the same plane, a non-asbestos warp of which all the strands pass in parallel over and under adjacent weft strands, and asbestos warp strands woven with stretches overlying successive groups of weft strands in the face of the felt and having loops at intervals passing between strands of the non-asbestos warp and embracing intermediate weft strands which are overlaid by the first named

warp strands, forming in conjunction therewith a single ply structure.

6. A drier felt of which the entire construction consists of a single cotton warp, weft strands alternately overpassed and underpassed, respectively, by all the strands of said cotton warp, and an asbestos warp of which the strands lie in alternation with strands of the cotton warp, and each strand of the asbestos warp passes beneath a single weft strand which is overlaid by the cotton warp, and over a plurality of successive weft strands, in alternation; the asbestos warp cooperating with the cotton warp exclusively to confine the weft strands and providing elongated stretches in the face of the felt which substantially cover such face and protect the cotton warp from burning.

7. A single ply drier felt consisting exclusively of cotton warp strands and asbestos warp strands in alternation wth one another, and asbestos weft strands; the cotton warp strands all passing over and under the same successive weft strands, and each successive asbestos warp strand being passed over and under respectively different ones of the weft strands.

8. A drier felt as set forth in claim 7, in which the asbestos warp strands overlie groups of successive weft strands and underlie single weft strands between such groups.

9. A drier felt as set forth in claim 7, in which the asbestos warp strands overlie groups of successive weft strands and underlie single weft strands between such groups, and in which the wefts underlain by alternate asbestos warp strands are in the groups overlain by the intermediate asbestos warp strands.

10. A drier felt as set forth in claim 7, in which the cotton warp strands are deeply crimped and thereby substantially prevent displacement of the weft strands by the force exerted thereon by the seam joining the ends of the felt, when the felt is in use.

WILLIAM A. BARRELL.

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