Feb. 19, 1935. W. A. BARRELL 1,991,366

ASBESTOS FACED DRIER FELT

Filed Feb. 13, 1933

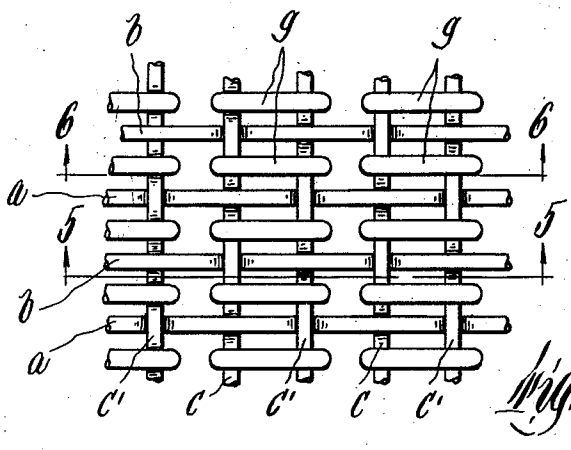


Fig. 3.

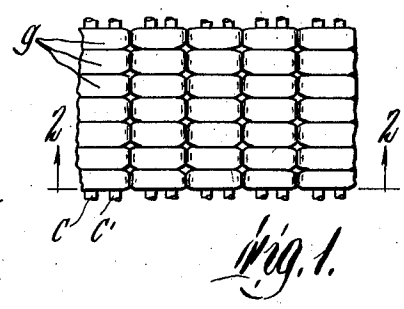


Fig. 1.

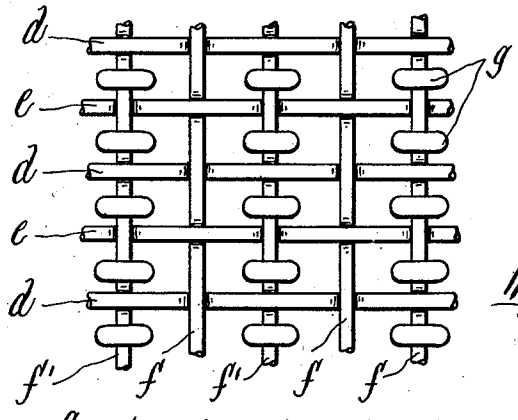


Fig. 4.

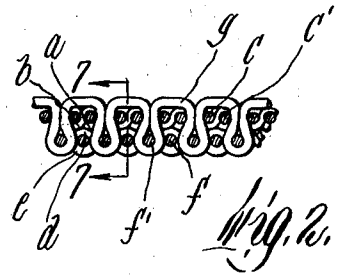


Fig. 2.

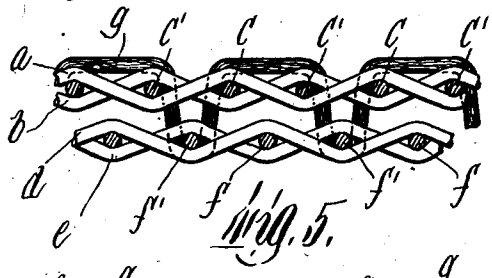


Fig. 5.

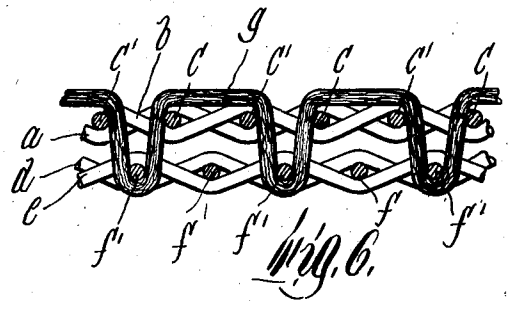


Fig. 6.

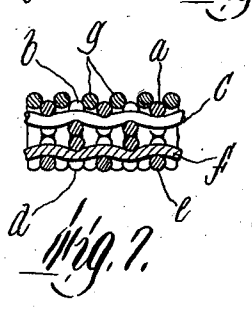


Fig. 7.

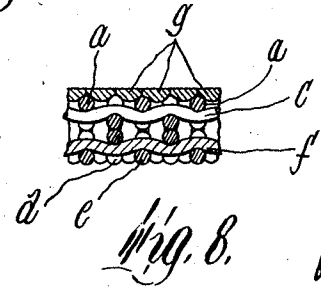


Fig. 8.

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

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ASBESTOS FACED DRIER FELT

William A. Barrell, North Andover, Mass.

Application February 13, 1933, Serial No. 656,445

11 Claims. (Cl. 139—410)

This invention relates to drier felts of the type used with paper machines to hold the wet newly formed web of paper in contact with steam heated drying drums to and from, and partly around, which the paper passes, and to assist in propelling the paper in unison with the peripheral speed of such drums. More particularly it relates to felts of this type which contain asbestos in their construction as a protection to the structural elements of vegetable or animal origin in the felt, against the destructive effects of heat emitted from the drying drums with moisture from the wet paper, and of repeated transitions between wet and dry conditions.

The great majority of drier felts used at the present day with paper driers are of woven construction composed entirely of cotton strands. Attempts have been made to introduce felts made partly of asbestos yarns so located as to bring the asbestos between the paper and the non-mineral elements of the felt. Such asbestos faced felts have heretofore been made of two or more woven plies in which all the structural elements, including both warp and filling, of the face ply, (the ply which runs next to the paper), are asbestos yarns. The asbestos faced felts of the prior art, while possessing the desired heat protection for the parts made of cotton or other vegetable or animal fibers, have on the other hand a number of undesirable or objectionable characteristics, including the following:—

(1) Their large content of asbestos greatly increases their weight. When it is remembered that the drier felts for some machines have a width of as much as 300 inches, and a length of more than 250 yards, and that the majority are 160 inches or more in width, and in the neighborhood of 100 yards in length, and weigh 1500 pounds or more, it will be appreciated that a substantial increase in weight is a serious and objectionable item on account of the increased tensile stress due to the extra weight, the cost of shipment, etc. Also the substitution of asbestos for cotton adds to the cost of manufacture in proportion to the content of asbestos.

(2) Asbestos yarns have substantially less tensile strength than yarns made of cotton and other vegetable fibers. In those used for drier felt manufacture the asbestos fibers are generally combined with strands of other materials arranged as cores around which the asbestos fibers are wrapped, or as binder strands surrounding a collection of asbestos fibers. But such reinforcing strands are necessarily small, and correspondingly weak; wherefore the tensile strength of the felt necessary to draw it around and past the drying drums and guide rollers, and to sustain its weight between guide rollers, but more particularly to bear the strain of the seam by which the ends are joined together, (which is the weakest part of the felt), is provided almost entirely by the back ply of vegetable fiber construction.

(3) Asbestos strands are highly absorptive of moisture, due presumably to capillary action between and among their fibers; and are much more absorptive than the tightly twisted cotton strands of the usual felt. While this absorptive tendency is useful for initially drawing water from wet paper when the felt is dry, it also opposes release of the contained water when the felt is saturated. In order that the paper may be dry enough when delivered from the drier, much of the water content in the felts must be dried out also as they approach the delivery end, which requires expenditure of heat additional to that needed for drying the paper. It has been found that, in general, a higher pressure of steam in the drums, consequently a larger consumption of fuel, is needed to drive the moisture from asbestos felts than is required with all-cotton felts after they have been run long enough to become wet.

(4) Asbestos yarns are difficult to weave satisfactorily, due to the fact that the rubbing together of the warp yarns with changing of the shed in weaving causes them to chafe; that is, the surface fibers "fluff off", as the saying is, and bunches of loose fluff adhere to the face of the felt or become entangled in the weave and, unless laboriously removed, are subsequently transferred into the paper. If the paper is afterwards used for printing, this asbestos causes poor printing. If care and attention are paid to prevent such chafing and fluffing, the speed of weaving is retarded and the cost of manufacture is increased.

The particular object of the present invention has been to produce an asbestos faced drier felt which, while possessing all the protective advantage of its content of asbestos, at the same time wholly or largely avoids the drawbacks above mentioned, and possesses other new and useful characteristics. In other words, my object has been to provide substantially complete heat protection for the non-asbestos structural strands of the felt; to relieve the asbestos strands of all tension and provide an adequate number of strong structural strands in both plies to provide necessary tensile strength; to bring the proportional weight of asbestos in the felt, and particularly

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that in the protective facing, to a minimum; to avoid chafing of the asbestos strands and fluffing off of loose fiber therefrom in course of weaving; to reduce the liability of the felt to stretch in length and become narrower in width with use; and to provide means for effecting a freer and more rapid dispersion and escape of moisture from the asbestos facing. The manner in which these objects are accomplished, and the particulars in which the invention consists, are explained and set forth in connection with the following detailed description of a specific drier felt in which the new characteristics of the invention are contained.

Referring to the illustrative drawing furnished herewith,—

Fig. 1 is a plan view of the felt embodying the invention, shown on an enlarged scale;

Fig. 2 is a sectional view of the same on line 2—2 of Fig. 1, looking in the direction of the arrows, the plane of section being parallel to the warp;

Figs. 3–6 inclusive are diagrams showing the particulars of the weave, with the strands separated for clearness; Fig. 3 showing the face of the fabric, Fig. 4 the back, and Figs. 5 and 6 being sections on the lines 5—5 and 6—6 respectively of Fig. 3;

Fig. 7 is a cross sectional view taken on line 7—7 of Fig. 2;

Fig. 8 is a view similar to Fig. 7 showing the result of an optional procedure which consists in flattening the asbestos strands.

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

The felt chosen for present illustration is of two-ply woven construction in which all the structural strands of both plies are cotton yarns, and the asbestos content is provided in the form of yarns parallel to the structural warp strands which are interwoven with the filling of both plies and provide binding means as well as a facing. The reference letters *a* and *b* designate alternate strands of the warp, and the letters *c* and *c'* designate alternate picks of the filling, of the face ply. These strands are interwoven in a plain weave with the strands or ends *a* of the warp passing over the filling strands *c*; while the warp strands or ends *b* pass under the filling strands *c* and over the strands *c'* and under the filling strands *c'*. Similarly the back ply is of plain woven construction composed of warp strands or ends *d* and *e* in repeated alternation, and filling strands *f*, *f'*.

The asbestos strands are designated *g*, *g*. Preferably they are as numerous as all the ends in each of the body warps *a*, *b* and *c*, *d*. That is, in the specific construction now being described there are sixteen ends in each body warp per inch of width of the felt, (that is, eight each of the warps strands *a*, *b*, *c* and *d*), and sixteen ends *g* of asbestos warp, and the latter are arranged in repeated and continuous alternation with the strands of each body warp. Thus there is an asbestos strand between each two body warp strands of each ply, and on each side of every body warp strand. The asbestos strands are laid over a group of picks, preferably two, as the picks *c* and *c'* of the face ply, then passed under and around a single pick *f'* of the back ply, then up and over the next two picks *c* and *c'* of the face ply, under the next pick *f'* of the back ply, skipping the intermediate pick *f*; and so on throughout the entire length of the felt. Thus the asbestos strands overlie all the filling strands of the face ply, but embrace only every other one of the picks in the back ply; the intermediate picks *f* of this ply being interwoven only with the structural warp strands.

It is to be understood that while the construction thus described is preferred both as to the number of strands in the felt and the proportion and arrangement of asbestos strands to structural warp and filling strands, I am not limited in these particulars, but may make various modifications as to any or all of them within the scope of the protection which I claim.

In the process of weaving the felt of the structure above described, all the asbestos strands are controlled by the same harness so that they are carried up and down in unison to opposite sides of the shuttle path. Adjacent asbestos strands are therefore not moved in relatively opposite directions, as is done with the structural or body warp of the fabric, and so do not chafe against one another. Such rubbing of asbestos and cotton strands together as occurs when the asbestos strands are displaced to form the binder loops does not cause objectionable chafing and fluffing off of asbestos fibers. This is a factor of the invention for which I claim protection. However, it is not the only factor; and may be omitted without prejudice to the protection claimed for other factors. For instance, I may wish to forego this advantage in favor of an arrangement of asbestos strands such that the locking loops of alternate strands pass around the filling picks *f* of the back ply while those of the intermediate asbestos strands pass around the picks *f'*. Where the asbestos strands pass around the filling strands of the face ply they form shoulders solidly locked into the face ply, and the arrangement of such shoulders on alternate warp yarns between the shoulders of other strands is of advantage for some purposes. I reserve the right to utilize such advantage if desired.

In referring to the strands *g* as being made of asbestos, I have not intended to state or imply that they must necessarily be wholly and exclusively of asbestos fiber. I propose to use for these strands any yarns which contain a sufficient content of other fibers or strands, however arranged, or any other binding material, to hold the asbestos fibers together sufficiently to permit weaving in the manner described, while having at the same time a great enough quantity and proportional content of asbestos, to give adequate protection to the vegetable fiber strands against burning. The term "asbestos strand" and similar terms used in the claims are therefore to be construed accordingly.

The body warp strands *a*, *b*, *d* and *e* are maintained in the course of weaving under tension, preferably a tension approximating that to which they will be subjected in the running of the felt in a paper drier; but the asbestos strands are put under only enough tension to make them lie smoothly and without slack in the fabric. The manner of weaving, according to which the asbestos strands are held up while two picks of filling are placed and beaten up in the face ply, and the shed of the body warp is changed between them, causes the asbestos strands to be laid mainly on top of the body warp strands, because the latter are flattened out somewhat in passing over the filling strands, leaving insufficient room between them to receive the asbestos strands. But in the back of the felt, the binder strands are passed around a single pick of the filling and then raised simultaneously with half

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of the body warp strands, that is, the warp strands which pass around the same pick with the binder strands, so that they are laid on the filling beside, and on both sides of, each of the above specified warp strands. The result is substantially as shown in Fig. 7.

As an optional measure, the asbestos strands on the face of the felt may be flattened, either in course of weaving or afterwards, to produce a superior surface finish as shown in Fig. 8; but this is not essential because the asbestos strands give sufficient protection to the body structure of the face ply without flattening, and they become more or less flattened in use.

The structural service performed by the asbestos strands in the felt is only that of binders to prevent separation between the face and back plies. They are subjected to no appreciable tension in performing this function, owing to their large number and the fact that the forces tending to separate the plies are small at the most. No tensile stress whatever is applied to them lengthwise of the felt; such stress being sustained wholly and entirely by the body warps. The protection which the asbestos strands give to the body warp strands of the face ply increases the useful life of those warp strands, while the face ply and asbestos together give additional protection to the back ply. Thus the warp strands of the face ply are enabled to carry their share of the load approximately as long as those of the back ply, the life of which is determined by the rotting effect of repeated wetting and drying, and of chemicals absorbed from the paper. Therefore by the total number of warp strands in both plies, (that is, strands of a given size per inch of width of the felt), need be only as many as have been required in the back ply alone of the two-ply all-cotton felt. The cotton structural elements, and not the asbestos strands, hold the seam by which the ends of the felt are joined together.

The loops of the asbestos strands which pass through the back ply serve as conductors of moisture absorbed from the paper, leading such moisture to the contiguous cotton strands of both plies and to the outer air. At the same time the back ply is made open and porous by reason of the spacing between the warp strands *d, d* and *e, e* across those picks which are not embraced by the asbestos loops. Such porosity facilitates direct escape of water vapor from the paper into the outer air.

Notwithstanding the relatively small number and wide spacing of the body warp strands in each ply of the felt, there is no greater tendency of the felt to stretch in service as compared with two ply cotton felts having more warp ends of the same size per inch of width, because of the loops of the asbestos strands which pass down between the body warp strands (between each two warp strands, or in other words, at both sides of each warp strand, in the preferred construction) at frequent intervals in the length of the felt. The factor which causes stretching of a felt in service is the partial straightening under tension of the bends in the warp strands where they pass around the filling strands, which occurs to the extent permitted by compression and bending of the filling under the shearing stresses imposed by the warp strands. Such bending or crimping of the filling as then occurs draws in the width of the felt a distance governed by the number of warp strands and the depth of offset of the filling. In my felt the construction enables a part of the stretch which would occur in service to be obviated in the weaving.

The protection due to the asbestos facing of my felt is obtained with a small proportional content of asbestos. Analysis of a felt of the specific construction herein described shows an average total weight of 21.9 grains per square inch, of which the asbestos strands collectively weigh 9 grains, or 41.1% of the total weight. Approximately 60% of the length of the asbestos strands is taken up in the loops which pass through the weave, leaving only about 40% of the asbestos in or on the face of the felt. Thus the proportional part of the weight contained in the protective asbestos face is approximately 16½%. I believe that I am the first to produce an asbestos faced felt with a substantially complete covering of asbestos, in which the asbestos content is less than 50% of the total weight. I claim protection for this feature generically as an important new step in the art and without limitation, in its broadest scope, to the specific means here disclosed for securing the asbestos facing to the body portion of the felt.

In describing the body structure of my new felt as being made of cotton strands or yarns, I have not intended to imply the limitation of my protection to cotton exclusively for the material of the body structure or any part of it. I may use strands of any other suitable material for either the body warp, or the filling, or both, of either or both plies. Suitable materials for this purpose are those which have adequate strength and pliability for the purpose, including not only materials which have been heretofore used in drier felt manufacture, but others which may by test and experience be hereafter found satisfactory. Strands of such other suitable materials may be combined with cotton strands or with one another in producing an asbestos faced felt according to this invention.

It is to be understood that the scope of my claimed protection embraces the drier felt in all uses which it is adapted to serve.

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

1. An asbestos-faced drier felt for paper machines comprising two complete plies each constructed of interwoven body warp and filling strands, combined with asbestos binder warp strands interlocked with filling strands of both plies and disposed so as to cover substantially the entire outer face of one of said plies; the total content of asbestos in the felt being contained in said binder strands.

2. An asbestos faced drier felt having two complete plies constructed of interwoven body warp and filling strands of vegetable fiber, and including asbestos strands extending over and substantially covering the outer face of one of said plies and being interlocked at intervals with structural strands of the other ply.

3. A drier felt for paper machines comprising a face ply and a single back ply each constructed of interwoven non-mineral warp and filling strands, combined with asbestos strands extending side by side on the outer face of said face ply in parallel with the warp strands thereof over all the filling strands of said ply, said asbestos strands being formed with loops passing between pairs of adjacent filling strands at non-consecutive intervals in the length of the felt, through the back ply and around non-adjacent filling strands of said back ply.

4. A drier felt for paper machines comprising

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a face ply and a single back ply each constructed of interwoven warp and filling strands, combined with asbestos strands extending side by side on the outer face of said face ply in parallel with the warp strands thereof over all the filling strands of said ply, said asbestos strands being formed with loops passing between each second and third filling strand in repeated alternation and around every second filling strand of the back ply.

5. A drier felt for paper machines comprising a face ply and a single back ply each constructed of interwoven warp and filling strands, combined with asbestos strands extending side by side on the outer face of said face ply in parallel with the warp strands thereof and in number equal to the entire number of said warp strands; said asbestos strands extending over all the filling strands of the face ply and having loops, less numerous than said filling strands passing between and flanking each of the warp strands of both plies and at intervals between adjacent filling strands of the face ply around non-adjacent filling strands of the back ply.

6. A drier felt for paper machines comprising a face ply and a single back ply each constructed of interwoven warp and filling strands, combined with asbestos strands parallel with the warp strands of the face ply, each passing over two filling strands of the face ply, under one filling strand of the back ply, then over the next two filling strands of the face ply, under a third filling strand of the back ply; and so on in repeated alternation.

7. A drier felt for paper machines comprising a face ply and a back ply each constructed of interwoven non-mineral warp and filling strands, combined with asbestos strands lying mainly outside of the warp strands on the outer face of the face ply, and having securing means binding them in the structure of the felt.

8. A drier felt for paper machines comprising a face ply and a single back ply each constructed of interwoven non-mineral warp and filling strands, combined with asbestos strands passing over groups of filling strands in the face ply mainly outside of the warp strands which overlie the same picks of filling, and having loops passing through the felt and around filling strands of the back ply beside warp strands of that ply.

9. A drier felt for paper machines comprising a face ply and a back ply each constructed of interwoven non-mineral warp and filling strands, combined with asbestos strands extending side by side on the outer face of said face ply in parallel with the warp strands thereof, each passing over all the filling strands of said ply, and being formed with loops passing between adjacent filling strands at non-consecutive intervals in the length of the felt, through the back ply and around non-adjacent filling strands of said back ply; the intermediate filling strands of the back ply being clear of asbestos strands except in so far as they touch the outer sides of such loops.

10. An asbestos-faced drier felt for paper machines comprising face and back plies each constructed of interwoven non-mineral body warp and filling strands, and asbestos binder strands interwoven with the filling strands of both plies; passing alternately over a group of filling strands in the face ply outside of the body warp strands which overlie the same filling strands, and under a single filling strand of the back ply in such manner and being flattened to produce a substantially smooth surface on the outer face of the face ply.

11. The method of making a drier felt with an asbestos face which consists in providing asbestos strands as a binder warp in alternation with non-asbestos strands forming body warps of two plies, interweaving a filling with said body warps, and shifting all the strands of the asbestos warp by means of a single harness so as to place them alternately around a group of picks of the filling in one ply and around a single pick of the filling in the other ply with such tension as to lay the asbestos strands outside of the body warp strands on the face of the felt and beside the warp strands on the picks of filling which they embrace in the back of the felt.

WILLIAM A. BARRELL.