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P. T. GATES
INDUSTRIAL AND PAPERMAKERS' FELT
AND METHOD OF PRODUCING THE SAME
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Fig. 1.

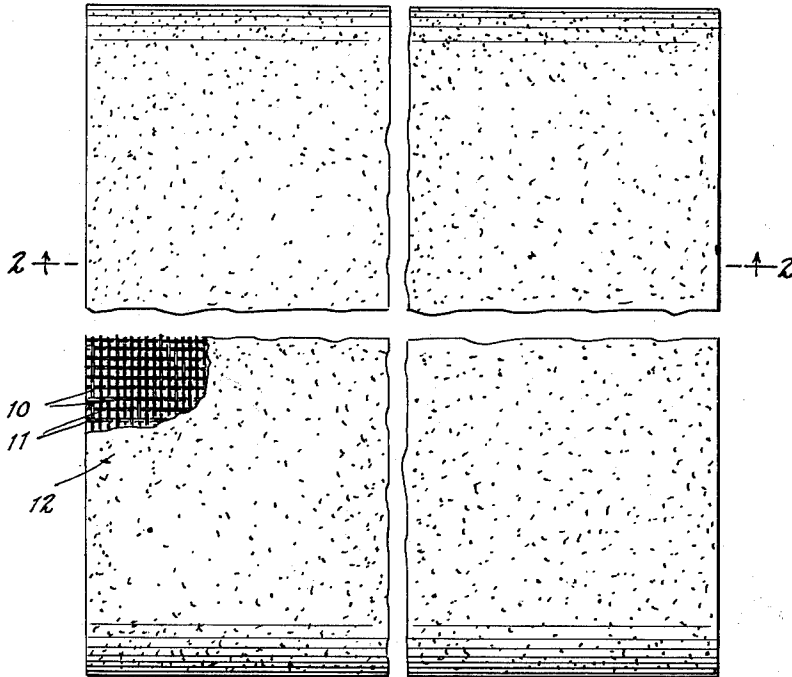


Fig. 2.

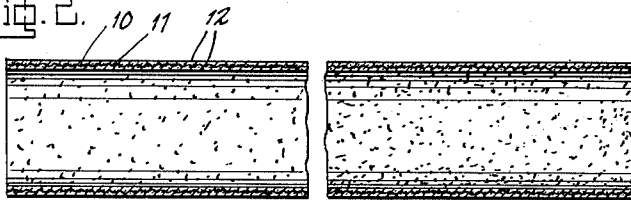
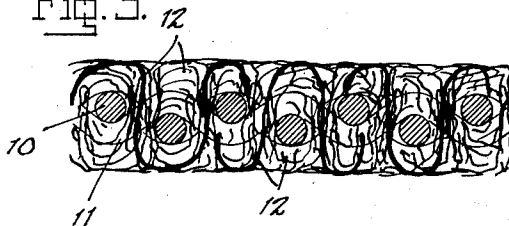


Fig. 3.



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INDUSTRIAL AND PAPERMAKERS' FELT AND
METHOD OF PRODUCING THE SAMEPercival T. Gates, Suffield, Conn., assignor to
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14 Claims. (Cl. 28—72.2)

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The present invention relates to industrial and paper makers' felts and method of producing the same, and is directed particularly to an improved felt for use in the manufacture of such paper machine products as pulp, paper, paperboard, asbestos cement products, millboard, gasketboard, asbestos paper and the like. Such felts are usually in the form of an endless belt, either produced in endless belt form or produced as a flat fabric which is thereafter joined together at its ends to form an endless belt, the belt being mounted in the paper making machine upon suitable rolls. Its principal functions are to impart a finish to the sheet of paper or other material carried on the felt, and to remove water from it by drainage of the water through the felt, this water removal being accomplished through the cooperation of press rolls, suction boxes, and the like. The paper makers' felt thus constitutes a mechanical part of the paper machine, and in such use is subjected to friction, abrasion, chemical deterioration, and deterioration due to bacterial molds, mildews, fungi, etc. Its structural and functional characteristics are therefore peculiarly related to the requirements of its use in paper machines, as distinguished from fabrics designed for other uses such as clothing, carpets, blankets, and the like.

The invention is concerned with paper makers' felts of the so-called needled type, as disclosed for instance, in the Reissue Patent No. 21,890, reissued August 26, 1941 to Patrick H. Walsh and Percival T. Gates for Industrial and Papermakers' Felts. Needled paper makers' felt consists of a woven base fabric having a nap surface produced by fleeces of fibre material needled into the base fabric, as distinguished from the type of felt, also used in paper manufacture, consisting of a woven fabric, usually wool, which is subjected to a fulling process to shrink and compact the fabric, and is then brushed or teazled to produce a napped surface.

Heretofore, needled felts have been constructed with the bats or pile fleeces composed of wool or other natural fibers in various blends, or of wools of various degrees of coarseness, these pile fleeces being needled into the base fabric from each side so as to completely cover the base fabric and prevent its coming to the surface of the felt. The principal object of the invention is to employ synthetic fiber material in the fleeces applied to the front and back of the felt, or to either the front or back, and to incorporate such fleeces in the felt by an interlocking of the fibers brought about by the needling process, as distinguished from certain

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known felts in which the synthetic fibers are combined with wool and spun into yarns, which in turn are woven into a felt fabric.

The synthetic fiber material best suited to carrying out the invention has a smooth and slippery surface, so that dirt and other foreign substances passing through the felt with the drainage water do not adhere to the fibers, as they do in the case of certain natural fibers, such as wool, which have a scaly surface and make the felt susceptible to "filling up" after a relatively short use in the paper machine, with consequent deterioration in the uniform quality of the products produced on the felt. Another desired characteristic of the synthetic fiber is that it should not have any appreciable "fulling" quality, as distinguished from certain natural fibers, such as wool, which continue to "full" while in use on the paper machine, with the result that the felts become progressively more dense, and in so doing tend to fill up with dirt and other foreign material. A further desired characteristic is that the synthetic fiber material be highly resistant to friction and abrasion, and to chemical deterioration and deterioration due to bacterial molds, mildews, fungi, etc.

A suitable synthetic fiber material having the desired characteristics for carrying out the invention is the polyamid known as nylon. Other suitable materials are synthetics such as rayon fiber, milk products like casein fiber, and glass fiber. It is proposed, according to the invention, to use synthetic fiber material, for instance nylon, either alone, or in any desired percentage combination with other synthetic fiber, or with natural fibers such as wool, cotton, ramie, hemp, asbestos, etc.

With the above and other objects in view, an embodiment of the invention is shown in the accompanying drawing, and this embodiment will be hereinafter more fully described with reference thereto and the invention will be finally pointed out in the claims.

In the drawings:

Fig. 1 is a plan view of a paper makers' felt in the form of an endless belt, according to the invention, a portion of the woven base being shown without fibers attached thereto.

Fig. 2 is a transverse sectional view along the line 2—2 of Fig. 1.

Fig. 3 is an enlarged transverse sectional view showing a portion of the felt, the pronouncedly heavy lines showing the characteristic interlocked position of certain of the synthetic fibers.

Referring to the drawings, the paper makers' felt, according to the illustrated exemplary em-

bodiment of the invention, is in the form of an endless belt comprising a woven base consisting of warp threads or cords 10 and weft threads or cords 11 and having a relatively open mesh. The woven base merely forms a support for the fibrous material needled into it and does not have its own fibers brushed into a nap, so that it is not subject to the abrasive action the surface of the felt is called upon to resist. It may be so designed, and constructed of such material as to give it maximum longitudinal and lateral tensile strength without having to build into it any abrasive resistance. This makes possible the use of relatively fine yarns of cotton or other suitable material, which impart a minimum of felt marking to the material being made on the felt.

The fibrous material 12 which makes up the front and back surfaces of the felt is secured thereto by needling, as will be hereinafter more fully pointed out, the needling process fundamentally consisting in applying one or more bats, layers, or pile fleeces of fibrous material to the front and back of the woven base and progressively needling it into and through the base, the material being gradually moved beneath vertically reciprocating needles which force the fibrous material into and through the woven base. In practice one or more layers or fleeces are needed at each side of the felt.

According to the invention the fiber material of at least one of the fleeces consists wholly or in part of synthetic fibers, as for instance nylon. The needling process is such that when such synthetic fibers are provided in at least one of the fleeces, parts of these fibers will be carried into the fleeces at both sides of the felt, and will therefore cooperate in the structure to bring about the functional and structural advantages characteristic of the needled synthetic fibers. Also, any or all of the fleeces may consist wholly or in part of synthetic fibers. The synthetic fibers may be blended or mixed in any suitable percentage with natural fibers such as wool, cotton, ramie, hemp, asbestos, or the like, and may also be mixed or blended with other synthetic fibres. Thus the entire front and back of the felt may be needled with fleeces consisting of 100 per cent synthetic fibers, for instance nylon, the front and back may be needled with fleeces consisting of a blend of synthetic fibers and natural fibers, as for instance nylon and wool, and the felt may have the front fleece formed of natural fibers and the back fleece formed wholly or in part of synthetic fibers. The synthetic fibers may be provided in any desired lengths and thicknesses, and may be either straight, crimped, or curled, and because of the controlled manner in which such synthetic fibers are produced these characteristics may be accurately predetermined.

The fleeces are first needled into the base fabric in the regular manner, that is, one or more layers or fleeces are needled at each side of the felt until the desired amount of fibrous material is attached to the base fabric. Thereupon the felt is subjected to a further needling operation without the addition of fibrous material. This consists in needling the felt from the opposite side from the side last fleece-needled, producing an interlocking tuck-in of the fibers from one side, and thereupon needling the felt from the same side as the last fleece-needled side, so that the fibers at this side are also given an interlocking tuck-in. The pronounced lines in Fig. 3 show the characteristic interlocked arrangement of certain of the synthetic fibers resulting from this

method. This gives an interlocking effect which it is not possible to accomplish through the needling in of the fleece alone, and results in certain of the fibers extending back and forth one or more times through the base fabric and interlocking with looped portions of other fibers at both sides of the felt, both ends of these certain fibers being "tucked in" at the respective sides of the felt. It is due to this interlocking tuck-in that it is possible to produce a felt constructed wholly of synthetic fibers, such as nylon, and have the fleeces stay tightly in place without the use of "fulling." It has also been found that by this "tuck-in" interlocking method important advantages are obtained where the synthetic fibers are blended with wool or other natural fibers. The individual nylon fibers are for instance much stronger than wool fibers and have a smooth and slippery surface, so that it is possible to interlace these fibers through the felt several times without breaking to thus interlock the nylon fibers in place and also hold the wool fibers in place. It is also found that with this interlocking method there is a great reduction in the amount of nap or loose hairs in the surface of the felt thus reducing objectionable shedding.

Since the fleeces are interlocked through the base fabric by the needling process in a position perpendicular to the base fabric, the fibers of the synthetic and natural materials are in the optimum position to cushion the base fabric and offer resistance to abrasion. It has been found that synthetic fibers, such as nylon, when blended with natural fibers, such as wool, contribute the following important qualities to the pile fleeces of the felt.

First, the felt having synthetic fibers, such as nylon, incorporated therein is highly resistant to abrasion. The nylon fibers are much stronger and resist abrasion much longer than wool fibers, with the result that as the wool fibers wear off and break off the nylon fibers come more and more to the surface taking more of the wear and thus tending to cover and protect the remaining wool fibers.

Second, the synthetic fibers, for instance nylon, are highly resistant to acid or alkaline conditions and to bacterial mold or mildew deterioration, so that they remain intact much longer than the natural fibers and tend to develop a protective covering over the natural fibers thus prolonging to a considerable extent the life of the felt as a whole.

Third, due to the fact that the nylon and other synthetic fibers have a smooth and slippery surface, dirt or foreign substances, passing through the felt with the drainage water, do not adhere to them as is the case with the scaly wool fiber. Thus, the use of synthetic fibers produces a felt which is less susceptible to "filling up" and therefore the useful life of the felt is increased as well as the uniform quality of the product produced on the felt. When a felt begins to "fill up" it begins to lose its draining and water removal properties, it causes a depreciation in the quality of the product being produced on it, and it becomes subject to more and more severe abrasive action. As the filling up continues, these three factors become progressively worse until the felt either will not take out enough water to operate successfully, or the product is not within saleable standards, or the felt rapidly wears out. By staying clean longer, a felt will produce a more uniform product and produce

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greater production because of fewer shut downs for cleaning and changing.

Fourth, it has long been known that wool and other natural fibers which have a "fulling" quality continue to "full" while in use on the paper machine, with the result that the felts become progressively more dense and in so doing tend to fill up with dirt and other foreign material. This "filling up" as mentioned above impairs the quality of the product being made and sharply increases the abrasive wear on the felt itself thus shortening its useful life. It has been discovered that when synthetic fibers, such as nylon, which do not have any appreciable "fulling" quality, are blended in a fleece with the natural fibers, such as wool, they tend to hold the wool fibers apart and materially retard "fulling" of the felt while in use on the paper machine, thus again increasing the useful life of the felt and maintaining the uniformity of the product being manufactured on the felt.

Fifth, due to the use of synthetic fibers, for instance nylon, in the fleeces of the felt it is possible to materially increase the amount of water removed, and the speed with which this water is removed, from the product being produced on the felt. This is due to the smoothness of the synthetic fibers and their ability to keep the fleeces open. This is a highly important quality in the felt, leading to increased speed of production of the paper or other material being produced, and a reduction in the cost of the drying of the product, since water not removed from the product by the felt has to be removed by some other means, usually heat.

What is claimed is:

1. A paper makers' felt for supporting and draining paper making material, comprising a non-fulled woven base in which the warp and weft strands have an open weave to provide drainage passages from the front side to the back side, and nap producing layers of fiber material respectively at the front and back sides of said woven base attached thereto by fibers of said layers needled into and through said base from one to the other of said layers, at least one of said layers being composed at least in part of non-fulfilling pliable synthetic fiber material, the individual fibers of which are disposed partially at the respective sides of said woven base and partially in the drainage passages in a direction substantially perpendicular to said woven base to direct drainage water therethrough.

2. The invention as defined in claim 1, further characterized in that said synthetic fiber material is nylon.

3. A paper makers' felt for supporting and draining paper making material, comprising a non-fulled woven base in which the warp and weft strands have an open weave to provide drainage passages from the front side to the back side, and nap producing layers of fiber material respectively at the front and back sides of said woven base attached thereto by fibers of said layers needled into and through said base from one to the other of said layers, at least one of said layers being composed in part of natural fiber material and in part of non-fulfilling pliable synthetic fiber material, the individual fibers of which are disposed partially at the respective sides of said woven base and partially in the drainage passages in a direction substantially perpendicular to said woven base to direct drainage water therethrough.

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4. The invention as defined in claim 3, further characterized in that said natural fiber material is wool.

5. The invention defined in claim 3, further characterized in that said natural fiber material is wool and said synthetic fiber material is nylon.

6. A paper makers' felt for supporting and draining paper making material, comprising a non-fulled woven base in which the warp and weft strands have an open weave to provide drainage passages from the front side to the back side, and nap producing layers of fiber material respectively at the front and back sides of said woven base attached thereto by fibers of said layers needled into and through said base from one to the other of said layers, at least one of said layers being composed wholly of non-fulfilling pliable synthetic fiber material, the individual fibers of which are disposed partially at the respective sides of said woven base and partially in the drainage passages in a direction substantially perpendicular to said woven base to direct drainage water therethrough.

7. The invention as defined in claim 6, further characterized in that said synthetic fiber material is nylon.

8. A paper makers' felt for supporting and draining paper making material, comprising a non-fulled woven base in which the warp and weft strands have an open weave to provide drainage passages from the front side to the back side, and nap producing layers of fiber material respectively at the front and back sides of said woven base attached thereto by fibers of said layers needled into and through said base from one to the other of said layers, all of said layers being composed at least in part of non-fulfilling pliable synthetic fiber material, the individual fibers of which are disposed partially at the respective sides of said woven base and partially in the drainage passages in a direction substantially perpendicular to said woven base to direct drainage water therethrough.

9. The invention as defined in claim 8, further characterized in that said synthetic fiber material is nylon.

10. A paper makers' felt for supporting and draining paper making material, comprising a non-fulled woven base in which the warp and weft strands have an open weave to provide drainage passages from the front side to the back side, and nap producing layers of fiber material respectively at the front and back sides of said woven base attached thereto by fibers of said layers needled into and through said base from one to the other of said layers, all of said layers being composed wholly of non-fulfilling pliable synthetic fiber material, the individual fibers of which are disposed partially at the respective sides of said woven base and partially in the drainage passages in a direction substantially perpendicular to said woven base to direct drainage water therethrough.

11. The invention as defined in claim 10, further characterized in that said synthetic fiber material is nylon.

12. A paper makers' felt for supporting and draining paper making material, comprising a non-fulled woven base in which the warp and weft strands have an open weave to provide drainage passages from the front side to the back side, and nap producing layers of fiber material respectively at the front and back sides of said woven base attached thereto by fibers thereof needled into and through said base from one to the other of said layers, at least one of said layers being composed at least in part of non-fulfilling pliable

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synthetic fiber material, the individual fibers of which are disposed partially at the respective sides of said woven base and partially in the drainage passages in a direction substantially perpendicular to said woven base to direct drainage water therethrough, at least some of said synthetic fibers being directed back and forth through said woven base and having their ends directed inwardly toward said woven base.

13. The invention as defined in claim 12, further characterized in that said synthetic fiber material is nylon.

14. The method of producing paper makers' felt for supporting and draining paper making material, which consists in providing a non-fulled woven fabric base in which the warp and weft strands have an open weave to provide drainage passages from the upper to the lower side, needling nap producing layers of fiber material respectively at the front and back sides of said woven base to cause fibers of said layers to be needled into and through said base from one to the other of said layers, and further needling

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without the addition of fiber material at each side of said felt to cause certain of said fibers previously needled in one direction to be carried through the felt in the opposite direction, and to cause loose ends of certain of said fibers to be inserted into the nap at each side of said felt.

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