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COMPRESSED WOOL-SYNTHETIC FIBER PAPERMAKERS' FELT

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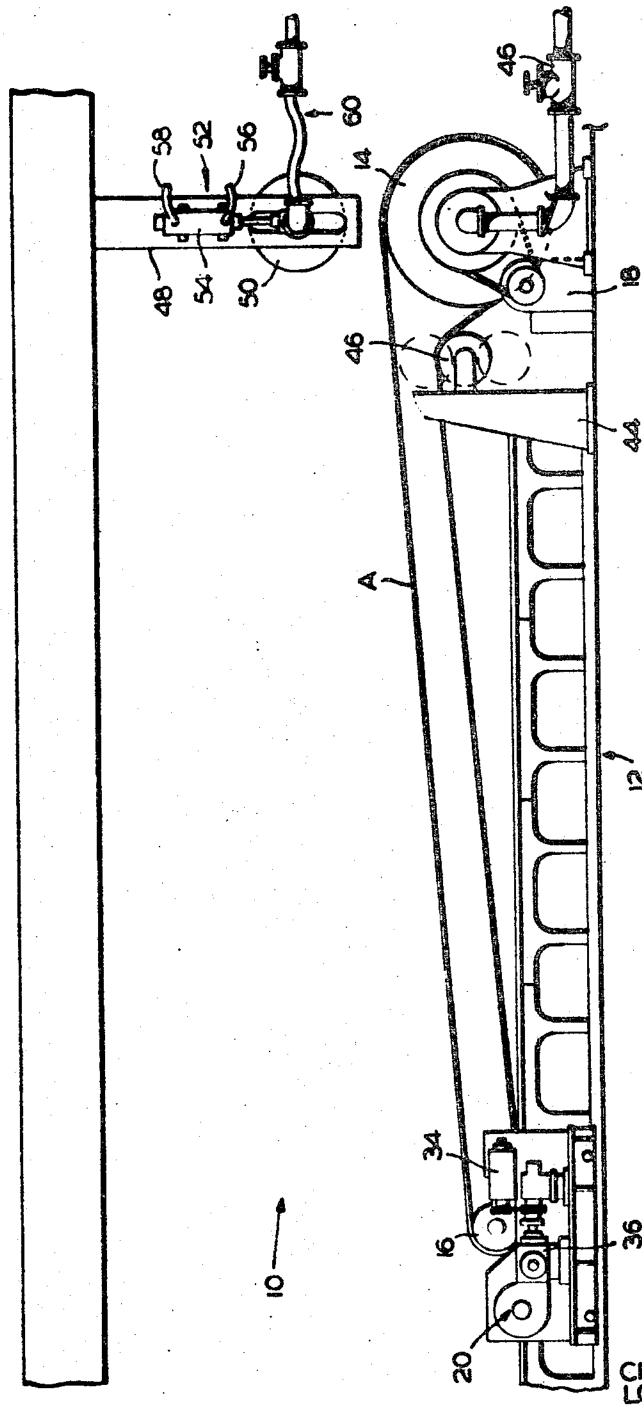

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COMPRESSED WOOL-SYNTHETIC FIBER PAPERMAKERS' FELT

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5 Claims. (Cl. 28—72)

This application is a continuation-in-part of our now abandoned application Ser. No. 250,812 filed Jan. 11, 1963.

This invention relates to improvements in wool-containing papermakers' felts and, in particular, to a method of making papermakers' felts which have physical characteristics resembling felts that have been in operation for substantial periods of time on papermaking machinery.

Papermakers' felts are employed in the manufacture of paper to pick up a freshly laid web of wet paper after it leaves the forming wire; to conduct the web through the paper finishing presses; and to remove water from the paper in press sections and the like.

A papermakers' felt must have a high degree of dimensional stability, properties permitting the felt to pick up and retain the fibers of the paper during the processing thereof and the felt must be of sufficient porosity to permit rapid removal of water from the freshly laid sheet. These properties of the felt must be uniform throughout the felt if the paper produced and finished thereon is to be uniform in quality.

Felts as conventionally constructed and finished by needling and/or wet fulling do not have the optimum characteristics or structure for rapid water removal at high paper machine speeds, the desired surface smoothness, and optimum resistance to migration of wool fibers during paper machine operation. It has been found necessary to run new felts on papermaking machinery at reduced rates of speed for a substantial period of time in order to "break the felts in." Because of the high unit cost of papermaking machinery and the substantially reduced production capacity of papermaking machines during the break-in period, breaking in of felts has been a comparatively expensive operation.

Tests have shown that during the felt break-in period, felts undergo substantial change in their functional and physical properties and after the break-in period, the felts' structure is substantially stable for the duration of the felt life. Compared to the same new felts, felts which have been run-in and reached comparatively stable conditions exhibit the following properties: improved water removability; improved surface finish; reduced thickness; reduced compressibility; and increased resiliency.

Such functional and physical properties resembling the properties of felts which have been run-in on papermaking machinery may be readily imparted to felts consisting predominantly of heat-settable synthetic thermoplastic fibers as disclosed and claimed in U.S. Patent 3,075,274, L. R. Mizell.

However, subjecting a wool or other natural keratin fiber papermakers' felt to heat and pressure will not result in permanent changes in the functional and physical properties of the felt resembling the properties of felts which have been run-in on papermaking machinery. Thus, while it is possible to produce a broken-in finish on a wool felt by subjecting the felt to heat and pressure, because of the inherent wet relaxation of wool fibers, the finish is found not to be durable and the felt tends to bloom or return to its original untreated condition when wet-out after installation on the paper machine.

While the desirable broken-in finish cannot be permanently imparted to all wool felts, it has been discovered that felts composed of substantial portions of wool, and which, therefore, have wool-like properties, can be provided with the desirable and permanent pre-break-in finish if the felt structure includes synthetic thermoplastic fibers in an amount equal to at least about 15% of the total weight of the felt, and the wool-synthetic fiber felt is subjected to heat and pressure. The thermoplastic fibers in the felt structure are compressed and set under the influence of the heat and pressure and hold the wool fibers of the felt in the artificially induced run-in condition.

It is, therefore, a principal object of the present invention to provide a papermakers' felt wherein the fibers thereof comprise a composite of wool fibers and from about 15 to 50% synthetic thermoplastic fibers, e.g., fibers which, after fulling, will deform and maintain a set under the influence of heat and pressure, and wherein the fibers thereof have been subjected simultaneously to heat and pressure whereby the finished felt may be run at substantially full operational speeds as soon as the felt is installed on a papermaking machine.

A further object is to provide a method of making a papermakers' felt having improved functional properties thereby eliminating or greatly reducing the normal felt run-in period on papermaking machines during which time the machines must be operated at some fraction of their maximum production capacity.

A further object is to provide such an improved papermakers' felt having a durable finish that is resistant to welt relaxation.

These and other objects and advantages are provided in a method of making a pre-broken-in papermakers' felt comprising forming a fabric from fibers which are composites of wool fibers and synthetic thermoplastic fibers, the synthetic fibers comprising from about 15% to about 50% and the portion of wool fibers comprising not less than 50% of the total weight of the felt; subjecting the felt to needling and/or moisture and other forms of mechanical agitation to full the composite structure and generally uniformly distribute the wool fibers throughout the entire fabric; compressing the thickness of the fabric by subjecting the fabric to heat to establish in the fabric a temperature of from about 150° F. to a temperature below the bonding temperature of the synthetic fibers, i.e., below the fusion or sticking temperature of the fibers to avoid fiber-to-fiber bonding, and simultaneously to a pressure of from about 50 to about 400 p.s.i. These objects are also provided by a fulled papermakers' felt comprising a heat and pressure compressed, fulled fabric composed of fibers consisting of a composite of wool fibers and synthetic thermoplastic fibers, the portion of synthetic fibers comprising from about 15% to about 50% and the portion of wool fibers comprising not less than 50% of the total weight of the felt with the wool fibers generally uniformly distributed throughout the entire fabric, said fabric in the compressed condition being about 40% to about 70% in thickness compared to the thickness of the woven fabric in the uncompressed state.

As used herein, the term wool is understood to include all feltable animal fibers, such as mohair, alpaca, wool, etc. and other natural keratin fibers.

The term fulling is intended to include those fabric finishing operations which compact or consolidate the woven structure in the plane of the fabric, and particularly in the width dimension. Such operations include conventional felting, in which a predominantly wool fabric is agitated in the presence of moisture or heat and moisture, with or without chemical felting aids; and mechanical fiber interlocking, such as needling. In the context of this invention fulling is also understood to include other means for compacting a fabric, such as chemical shrinkage of fabrics containing heat retractable synthetic fibers, or combinations of the previously mentioned operations.

The invention will be more particularly described with reference to the illustrative embodiment of the invention diagrammatically showing apparatus suitable for carrying out the finishing of woven felts constructed in accordance with the teachings of the invention.

Durable pre-run-in felt properties are provided by incorporating from at least about 15% to about 50% by weight of the total felt structure of synthetic thermoplastic fibers with the wool fibers used in the construction of the felt. The incorporated synthetic fibers provide a skeleton of permanently heat and pressure deformed fibers which will hold the non-thermoplastic fibers of the compressed felt in a compressed state.

It has been found that if less than about 15% by weight of synthetic thermoplastic fibers are employed in the composite structure the compressed state will not be permanent and the felt-like structure will bloom or return substantially to its original untreated condition when wetout after installation on a paper machine. Further, if the composite wool-synthetic fiber felt contains more than about 50% by weight of thermoplastic fibers, there is insufficient wool in the fabric to obscure the fabric weave during the wet felting operation and to impart desirable wool-like properties to the fabric.

The synthetic thermoplastic fibers may be incorporated in the warp and/or the filling yarns of a woven fabric by a number of processes, and the following composite yarn forms have provided satisfactory results:

A yarn blend, in which the synthetic fiber or filament yarn is plied with a wool yarn and the plied or twisted yarn is incorporated in the filling and/or the warp component of the felt.

A fiber blend, in which the synthetic fibers are blended with wool fibers before spinning and the uniformly blended yarns thereafter form the warp and/or the filling yarns of the felt. Or, the felt may be woven from a combination of plied wool and synthetic fiber yarns and yarns in which the synthetic fibers and the wool fibers are blended before spinning.

The synthetic component forming the skeleton structure for holding the wool fibers in a compressed state may be distributed equally between the warp and the filling yarns; may be entirely in one or the other sets of yarns; or may be predominantly in either the warp or the filling yarns. In the latter two situations, fulling of the fabric results effectively in a more even distribution of the synthetic component between the warp and filling yarns thereby providing generally uniform distribution of the wool fiber portion of the fabric. However, preferably, the synthetic component of the woven felt structure should be in the form of a fiber blend wherein the wool fibers and the synthetic fibers are blended before spinning so as to provide as uniform as possible distribution of the compression-stabilizing fibers. Further, the distribution of the synthetic thermoplastic fibers of the woven felt preferably should be balanced between the two yarn components with any excess being present in the filling yarns or in the batt, in case of needled fabrics, which normally operate in substantially direct contact with the paper sheets on the papermaking machinery. The final distribution would be such that there is at least an effective 15% by weight synthetic component in the warp and filling yarns in order to provide the necessary skeleton structure to hold the wool fibers in place. Similarly, in the case of needled felts, there should be an effective 15% by weight synthetic component in both the batt and its substrate.

The synthetic fiber component may comprise one or a combination of several different synthetic materials such as nylon, acrylic, modacrylic, polyester, polyolefin, polyvinyl chloride, polyvinyl alcohol, and polyvinylidine chloride. The synthetic fibers employed in the improved papermaker's felts must be capable of taking and retaining a set at a temperature above that ordinarily encountered in the use of papermaker's felts.

The synthetic fibers enumerated are often supplied by the manufacturer in the form of staple fibers to resemble a natural wool fiber. Such fibers may be straight length fibers or crimped, curled or spiralled, to more nearly approximate the natural wool fibers they replace and the synthetic fibers can be lustrous, dull, or semi-dull in appearance.

These synthetic materials are also supplied in tow or continuous filament forms, and they may be used in these forms or in combination with yarns spun on either the woolen or worsted system of manufacture, to produce staple and core-spun yarns.

Since yarns, filaments and/or fibers may be employed in the construction of felts in accordance with the teachings of the invention hereinafter, and in the claims appended hereto, the term "fibers" includes staple fibers, yarns spun therefrom, and multiple filament yarns in the bulked or unbulked form.

The selected synthetic thermoplastic fibers and the selected wool fibers are processed through the steps of producing yarns and yarn blends, weaving and splicing where the felt is not woven endless and, where desired, burling in substantially the same way that wool fibers are processed on the woolen or worsted systems, and, where applicable, the mechanical attachment of a batt of fibers to the surface of a felt.

Following the weaving of the felt or fabric, the felt is ready for finishing. The endless woven fabric at this state is subjected to a fulling operation as previously described. The fulled felt, which is generally reduced in area or at least in width from its woven dimensions, may then be chemically treated to cause shrinkage of synthetic fibers which in turn causes further consolidation of the fabric. Following the preconditioning of the fabric, the fabric is subjected to the application of heat and pressure in the thickness direction to be more fully described hereinafter.

One form of apparatus suitable for carrying out the compression and heating of the fabric is illustrated in the drawings and generally designated **10**. The treating apparatus includes a frame **12** having adjacent its ends a pair of rollers **14** and **16**. The width of the rolls **14** and **16** should be at least slightly greater than the width of the fabric to be treated. One or both of the rolls **14** and **16** may be driven; however, as illustrated in the drawing, only roll **14** is provided with drive means **18**, which drive means is preferably of the adjustable speed type whereby the speed of the fabric traveling about the pair of rolls **14** and **16** is selectively controllable.

The other of the rolls **16** is mounted in adjusting means generally designated **20** whereby the distance between the center of the rolls **14** and **16** may be variously adjusted to accommodate different size fabrics and to effect, where desired, mechanical width shrinking of the fabric.

The adjusting means **20** includes a motor **34** drivably connected to the speed reducing means **36** which, in turn, drives a shaft engaging a rack extending along each side of the frame **12** whereby upon actuation of the motor **34**, the frames carrying the idler roll **16** are moved toward or away from the roll **14**, depending upon the direction of rotation of the motor **34**. As illustrated in the drawing, the assembly also includes a conventional stand **44** having adjustably mounted thereon a felt roll **46** which maintains the lower flight of the felt A at a predetermined position of wrap about the roll **14** and prevents sag in the felt.

The driven roll **14** is provided with heating means which, as illustrated in the drawing, may comprise valve conduit means **46** for directing a heating fluid, such as superheated steam, hot oil, etc., into the interior of the roll **14** from a source not shown in the drawing.

Positioned vertically above the axis of rotation of roll **14** is a support means **48** which adjustably carries a further roll 50. The adjusting means generally designated 52 permits the surface of the roll 50 to be brought into contact with the surface of the felt A as it passes over the roll 14 during predetermined periods of treatment of the felt.

In the illustrated form of the invention, the means for varying the pressure applied to the felt includes a hydraulic ram 54 connected at opposite ends to a source of pressure fluid by conduits 56 and 58 which, in turn, are connected to suitable control valves not shown in the drawing.

The roll 50 may also be connected to a source of heating fluid through valve conduit means generally designated 60 whereby the temperature of the roll 50 may also be maintained at a predetermined temperature during a portion of the operation of the press.

In the illustrated form of the invention, the heating and compressing means for finishing the felt are metal-to-metal rolls; however, it will also be apparent to those skilled in the art that the heating and compressing means may comprise a stack of calender rolls such as used in paper mills or a platen press.

As hereinabove disclosed, after the felt is prepared and prior to subjecting the felt to heat and pressure in the thickness direction, the felt is subjected to fulling to entangle the fibers and compact the fabric in the plane of its weave structure. In addition, mechanical stretching in length with its attendant width shrinkage or chemical shrinking of the synthetic fiber portion of the felt may be effected. The mechanical width shrinking may be carried out in accordance with the process for treating predominantly synthetic fiber felt as disclosed in U.S. patent application, Ser. No. 767,109, L. R. Mizell, filed Oct. 14, 1958, for a Method of Making Improved Papermakers' Felts, consisting substantially entirely of synthetic thermoplastic fibers.

Following the preparation of the woven felt, the felt A, with or without a batt of fibers needled to it, is positioned between the pair of rolls 14 and 16 with the spacing of the rolls such that when the felt is removed after being subjected to heat and pressure, the felt will be at the desired finished length.

In compressing the felt A containing the composite wool and synthetic fibers, it is desirable to maintain a felt temperature equal to or slightly above the setting temperature of the synthetic fibers and below the temperature at which the synthetic fibers become tacky or sticky. It will be appreciated that the selected setting temperature for the synthetic fibers must be below a temperature which would be harmful to the wool component of the felt. It is desired to heat the synthetic fibers to a point where they will freely yield to the compressive forces in the nip of the pressure rolls 14 and 50 and then assume a permanent set in the compressed configuration, rather than form a fiber-to-fiber bond by fiber melting or fusing.

The setting conditions described above can be attained in either the wet or dry state of the felt. However, the process may preferably be carried out with the felt containing about 5% to about 100% by weight of water on the basis of the dry felt weight. Carrying out the heating and compressing of the felt while the felt is wet produces particularly advantageous results as when the felt is wet, the normally resilient wool fibers are temporarily plasticized, that is, made more compressible, thereby permitting maximum felt compression in thickness with a minimum roll pressure.

If the felt is heated and compressed while wet, the temperature in the felt will not exceed the temperature of boiling water until all of the water has been driven out of the felt. Thus, the roll temperature for wet compression is not critical as long as its temperature is above 212° F. However, for efficient drying, the roll temperature should be considerably above 212° F.

It has been found that the roll temperature for both dry felt compression and wet felt compression may be approximately the same. For several typical synthetic fibers, compression roll temperatures within which the process may be effectively carried out are shown in Table I.

TABLE I.—COMPRESSION ROLL TEMPERATURES FOR SELECTED SYNTHETIC FIBERS, ° F.

Fiber Type	Lower Temperature Limit	Upper Temperature Limit
Nylon 6	250	325
Nylon 66	275	375
Polyester	275	375
Acrylic	250	300
Polypropylene	200	275

Under the preferred wet felt treating conditions, it is desirable to completely dry the felt while it is being compressed in order to prevent the possibility of wet relaxation of the fibers before the synthetic component has been completely set in the compressed state. The drying may be attained either by continuously passing the felt through the nip of the heated rolls 14 and 50 or by drying the felt as soon as it leaves the compression rolls by conventional drying means such as drying drums, heat lamps, open-end drying ovens and the like.

The normal ranges of treating conditions for finishing felts in accordance with the teachings of the present invention are set forth in Table II.

TABLE II.—NORMAL RANGE OF TREATING CONDITIONS

Roll temperatures	° F.	200–375
Roll pressure	p.s.i.	50–400
Total dwell time	seconds	1–30

Dwell time is for each segment of felt length. Under these normal treating conditions, a temperature of at least 150° F. will be established in the fabric and the hot-compressed felt will be 40% to about 70% in thickness compared to the thickness of the fabric prior to hot compression.

The above conditions will vary, depending on such factors as the felt condition, that is, whether it is wet or dry, felt construction and thickness, nature and amount of the synthetic fiber, and the like. It will be understood that these factors are all interrelated and as one condition, such as temperature, is increased, the others will be decreased and vice versa. For example, if the roll temperature is 300°, then a pressure of, for example, 100 p.s.i. pressure can be used. If the roll temperature is decreased to, for example, 200°, it may be necessary to increase the pressure to, for example, 300 p.s.i. in order to obtain the same results in substantially the same period of time. It will also be appreciated that the dwell time in the nip of the pressure rolls is governed also by the size, that is, the diameter of the rolls and the speed of the travel of the belt through the rolls, and it is also dependent upon the temperature of the rolls and the pressure between the rolls. The roll pressures of 50–400 p.s.i. referred to are the average area loadings on the fabric being compressed. It will be understood that during operation, depending on the diameter of the rolls and their hardness, the thickness and composition of the felts, and other factors, peak loadings as high as 1000 p.s.i. or even higher may be encountered at the extreme nip.

EXAMPLES

A wet felt was constructed using filling yarns comprising a staple fiber blend of 30% 3 denier, 3 inch nylon fiber and 70% wool fiber and having a weight designation of 3 cut. The warp yarns were spun from a staple fiber blend of 15% 3 denier, 3 inch "Dacron" fiber and 85% wool and had a weight designation of 4 cut. The felt had a thread count of 12 ends per inch and 17 picks per inch and comprised 25% by weight of synthetic fiber. This felt is designated Felt A in Tables III and IV.

A wet felt was woven in a three-over-one broken twill construction using filling yarns composed of a staple fiber blend of 15% 3 denier, 3 inch nylon fiber and 85% wool and spun into a staple yarn having a weight designation of 6 cut. The warp yarns were constructed from 2520 denier continuous filament nylon yarn about which was wrapped 10 cut all-wool yarn. The woven felt had a thread count of 13 ends per inch and 14 picks per inch and a total synthetic fiber content of 40% nylon. This felt is designated Felt B in Tables III and IV.

A pulp felt was constructed in a plain weave from spun staple fiber yarns comprising a fiber blend of 25% 3 inch, 3 denier "Dacron" fiber and 75% wool. The filling yarns had a weight designation of 1 cut, and the warp yarns, 1½ cut. The woven felt had a fabric count of 6 ends per inch and 6 picks per inch. and comprised 25% of weight of Dacron fiber distributed uniformly throughout the felt structure. This felt is designated Felt C in Tables III through VI.

The constructed fabrics were prefinished by subjecting the fabrics to mechanical fulling operations to felt the wool content and then the fulled fabrics were hot compressed in thickness.

Tables III through VI show the results of varying specified conditions in the process of the present invention.

TABLE III.—FINISHED DRY FELT THICKNESS UNDER 10 OZ./IN.² PRESSURE AS A FUNCTION OF CUMULATIVE DWELL TIME IN PRESS

[Press conditions—100 p.s.i. at 300° F.]

Conditions	Felt Designation		
	A	B	C
Original uncompressed prefinished thickness in mils	136.4	88.0	125.2
Thickness in mils after 1 sec. dwell time	101.8	57.8	73.8
Thickness in mils after 5 sec. dwell time	90.0	57.2	68.0
Thickness in mils after 10 sec. dwell time	85.2	53.8	67.8
Thickness in mils after 30 sec. dwell time	78.6	51.4	63.4

TABLE IV.—FINISHED DRY FELT AIR PERMEABILITY AS A FUNCTION OF CUMULATIVE DWELL TIME IN PRESS

[Press conditions—100 p.s.i. at 300° F.]

Conditions	Felt Designations		
	A	B	C
Original uncompressed prefinished premeability in c.f.m./ft.²	38.4	470.0	337.5
Air permeability in c.f.m./ft.² after 1 sec. dwell time	18.4	373.0	212.4
Air permeability in c.f.m./ft.² after 5 sec. dwell time	12.0	373.0	241.9
Air permeability in c.f.m./ft.² after 10 sec. dwell time	9.9	370.5	276.0
Air permeability in c.f.m./ft.² after 30 sec. dwell time	9.8	385.0	201.3

The air permeability test results reported were measured at 70° F. and 65% relative humidity according to the procedure of A.S.T.M. standard test method D737–46.

TABLE V.—FINISHED DRY FELT C THICKNESS UNDER 10 OZ./IN.² PRESSURE AS A FUNCTION OF TEMPERATURE IN PRESS

[Press conditions—100 p.s.i. for 5 sec.]

Temperature ° F.:	Thickness in mils
250	92.6
275	76.8
300	68.0
325	68.6
350	67.8

TABLE VI.—FINISHED DRY FELT C THICKNESS UNDER 10 OZ./IN.² PRESSURE AS A FUNCTION OF PRESSURE IN PRESS

[Press conditions—300° F. for 5 sec.]

Pressure, lbs./in.²:	Thickness in mils
50	78.6
100	68.0
200	61.6

The following comparative example further illustrates the effectiveness of heat and pressure in producing a stable, broken-in finish on wool felts containing therein varying amounts of synthetic fibers.

A 100% wool felt was constructed of 4 cut wool yarns with a thread count of 10 ends per inch and 16 picks per inch in the loom.

An 85% wool and 15% synthetic fibers felt was constructed of 8 cut warp yarns comprising a blend of 85% wool and 15% nylon fibers. These yarns were woven into a double velour weave having a thread count of 14 ends per inch and 45 picks per inch.

A 75% wool and 25% synthetic fiber felt was constructed from two-ply warp yarns having a size equivalent to 4 cut and comprising 75% wool and 25% polyester staple fiber. The filling yarn was prepared from a fiber blend of 75% wool and 25% nylon staple and was spun into a 3 cut yarn. The yarns were woven into a broken twill construction containing 10 ends per inch and 36 picks per inch in the loom.

A 50% wool and 50% synthetic fiber felt was prepared by weaving a base fabric comprising 5½ cut warp yarns prepared from 100% polyester staple fiber and 3½ cut filling yarns spun from a fiber containing 75% wool and 25% nylon fibers. It was woven with 15 ends per inch and 20 picks per inch in the loom. A batt of fibers comprising 70% wool and 30% nylon was attached to the base fabric by mechanical interlocking, i.e. needling.

Each sample was finished by conventional means including fulling, washing and drying. After conditioning at 70° F. and 65% relative humidity for 24 hours, the samples were hot compressed at a roll speed of 2 feet per minute, a roll temperature of 365° F. and at a roll pressure of 200 p.s.i. The felt samples were given five passes through the nip of the rolls.

The stability of the samples, that is resistance to recovery from compression, was determined by immersing the samples for 30 minutes in water at 120° F. containing 0.1% by weight of a non-ionic surfactant. The thickness of the samples was measured at intervals during wet relaxation to determine the rate of recovery. The 100% wool sample quickly recovered or bloomed 75% based on its original compressed thickness. The 85, 75 and 50% wool samples bloomed 41, 27 and 15%, respectively.

All of the hot compressed samples initially exhibited the same characteristics of reduced thickness and improved surface finish and had the general appearance of a felt that had reached operating conditions. After wet relaxation, the 100% wool sample had the appearance and functional characteristics of the originl felt prior to hot compression.

The compressibilities of the four felt samples were measured after hot compression and after wet relaxation. The compressibility of the 100% wool sample, after wet relaxation, was characteristic of new or untreated felt. The synthetic fiber-containing samples, even after wet relaxation, retained the low compressibility imparted by hot compression. The test results are summarized in the following table:

Felt Sample Synthetic Fiber Content	Percent Compressibility	
	After Treatment	After Wet Relaxation
0	35.5	59.3
15	31.6	41.6
25	31.2	38.7
50	29.1	34.8

A wet papermakers' felt was constructed by interlocking by means of felting needles a batt composed of 30% nylon fiber and 70% wool fiber with a woven substrate comprising filling yarns spun from a fiber blend of 30% 3 denier, 3 inch nylon fiber and 70% wool fiber and warp yarns composed of nylon multifilaments plied with spun wool yarns. The felt contained 31% by weight of nylon fiber. Following needling the fabric was fulled, washed, rinsed and centrifugally extracted to approximately 45% wet pick-up and then was passed through the nip of a set of compression rolls heated to a surface temperature of 325° F. and loaded to exert a pressure of approximately 150 pounds per square inch of felt surface. A total of five passages through the nip were necessary to completely dry the felt. The felt, as finished by the above procedure, was found to have reduced air permeability and thickness, and improved ability to extract water from a wet paper sheet.

We claim:

1. A method of making a pre-broken-in papermakers' felt comprising forming a fabric from fibers consisting of at least about 15% to about 50% synthetic thermoplastic fibers and at least about 50% wool fibers based on the total weight of the fabric, fulling the composite fabric to distribute the wool fibers throughout the fabric, compressing the thickness of the fabric by subjecting the fabric to heat to establish in the fabric a temperature of at least about 150° F. but below that at which the synthetic fibers become tacky and simultaneously to pressure of from about 50 to about 400 p.s.i. to permanently set the thermoplastic fibers in the compressed configuration which, in turn, mechanically hold the wool portion of the fibers of the fabric in the compressed configuration.

2. A method of making a pre-broken-in papermakers' felt comprising weaving a fabric from yarns containing 15 to 50% by weight of synthetic thermoplastic fibers and at least 50% by weight of wool fibers in both the warp and filling yarns, fulling the woven fabric, compressing the thickness of the fabric by subjecting the fabric to heat to establish in the fabric a temperature of at least about 150° F. but below that at which the synthetic fibers become tacky and simultaneously to pressures of from about 50 to 400 p.s.i. to permanently set the thermoplastic fibers in the compressed configuration which, in turn, mechanically hold the wool portion of the fibers of the fabric in the compressed configuration.

3. A method according to claim 2 wherein the woven fabric is fulled by agitation in the presence of heat and moisture.

4. A method of making a pre-broken-in papermakers' felt comprising needling a batt into a substrate, the batt and the substrate each containing 15 to 50% by weight of synthetic thermoplastic fibers and at least 50% by weight of wool fibers, compressing the thickness of the fabric by subjecting the fabric to heat to establish in the fabric a temperature of at least about 150° F. but below that at which the synthetic fibers become tacky and simultaneously to pressures of from about 50 to 400 p.s.i. to permanently set the thermoplastic fibers in the compressed configuration which, in turn, mechanically hold the wool portion of the fibers of the fabric in the compressed configuration.

5. A method according to claim 4 wherein the needled fabric is fulled by agitation in the presence of heat and moisture prior to compression.

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