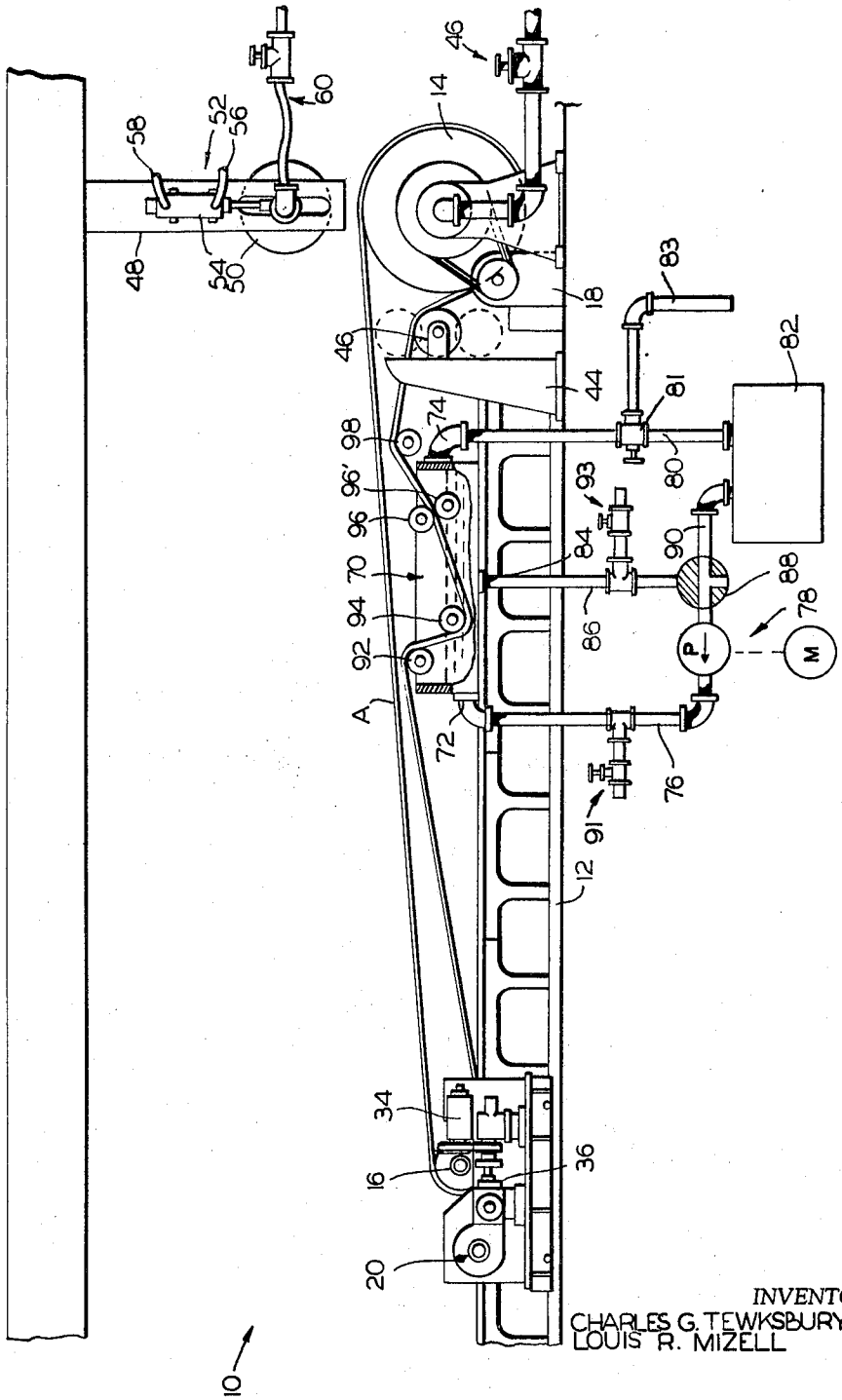
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METHOD OF MAKING PRE-BROKEN-IN PAPERMAKERS' FELT

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# METHOD OF MAKING PRE-BROKEN-IN PAPERMAKERS' FELT

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6 Claims. (Cl. 117—65.2)

This application is a continuation-in-part of our application Ser. No. 523,493, filed Dec. 21, 1965, which in turn is a continuation-in-part of our application Ser. No. 250,919, filed Jan. 11, 1963, both now abandoned.

This application relates to improvements in papermakers' felts and, in particular, to a method of making wool or predominantly wool papermakers' felts which have physical characteristics resembling felts that have been in operation for substantial period on papermaking machinery.

Papermakers' felts are employed in the manufacture of paper to convey 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 of the machinery.

A papermakers' felt must have a high degree of dimensional stability, properties permitting the felt to convey or to pick up and retain the wet fibrous 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 do not have uniform functional and physical properties and it has been found necessary to run new felts on papermaking machinery at reduced rates of speed for substantial periods 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 for the papermaking industry.

Tests have shown that during the felt break-in period a felt undergoes substantial changes in its functional and physical properties and after the break-in period, the felt is more or less stable for the duration of the felt's 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; reduced air permeability; improved surface finish; reduced thickness; reduced compressibility; and increased resiliency.

Further tests indicated that subjecting a wool or predominantly wool papermakers' felt to heat and pressure would result in 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 or predominantly wool woven 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, in operation, the felt would tend to bloom or return to its original untreated condition when wet-out after installation on the papermaking machine.

It has been found that the pre-break-in finish of a wool felt imparted by subjecting the felt to heat and pressure can be rendered substantially permanent by curing a partially polymerized heat settable composition within the wool fibers while the fabric is under the influence of the heat and pressure whereby the fabric will be compressed and set and the wool fibers of the felt held in the artificially induced run-in condition.



It is, therefore, a principal object of the present invention to provide a woven, or knitted, or needled, or woven and needled, and the like, wool or substantially wool, papermakers' felt provided with functional and physical characteristics whereby the felt may be run at substantially full operational speeds as soon as it is installed on a papermaking machine.

A further object is to provide a method of making a papermakers' felt having improved functional and physical properties to thereby eliminate or greatly reduced the normal felt run-in period on a papermaking machine during which times the machine must be operated at some fraction of its maximum production capacity.

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

These and other objects and advantages are provided in the method of making an improved papermakers' felt comprising forming a predominantly wool fabric, incorporating a solution of a polymerizable heat settable composition in the fibers of the fabric, subjecting the fabric to indurating conditions to partially polymerize the composition within the wool fibers, compressing the thickness of the woven fabric by subjecting the fabric simultaneously to heat and pressure and curing the polymerizable heat settable composition prior to relaxation of the compressed fabric, thereby to maintain the fabric substantially in the compressed configuration.

These objects are also provided by a wool or predominantly wool papermakers' felt comprising a heat and pressure compressed fabric composed of predominantly wool yarns having incorporated in the fibers of the yarn a polymerized heat settable composition after the fabric has been heat and pressure compressed and prior to relaxation of the compressed fabric.

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 felts constructed in accordance with the teachings of the present invention.

The basic felt structure may comprise a fabric woven from wool yarns, a needled fabric structure, a woven felt that is subsequently needled, and the like, and the basic felt structure may have incorporated therein synthetic fibers to impart to the fabric improved abrasion resistance and other improved physical characteristics. Further, the basic fabric structure may be subjected to conventional wool or predominantly wool finishing operations such as burling, fulling, singeing, and the like.

Following the finishing of the wool papermakers' felt in accordance with conventional felt finishing procedures, there is incorporated in the fibers of the fabric a polymerizable heat settable material such as phenolic-aldehyde resin-forming materials, which resin-forming materials are subjected to indurating conditions to partially polymerize the resin forming materials within the fibers of the fabric to be treated as opposed to a surface resin application on the fibers. After partial polymerization of the resin-forming materials within the fibers, the fabric is subjected to heat and pressure to compress the fabric and cure the resin whereby the cured resin will maintain substantially the hot compressed configuration of the fabric during operation of the felt on a papermaking machine.

Preferably, the process involves impregnating the fabric with a solution of a phenol and an aldehyde; condensing, that is, partially polymerizing the phenolic-aldehyde resin within the fibers of the felt and then subjecting the felt to heat and pressure and curing the phenolic-aldehyde resin

while the fabric is in the desired finished configuration and thereby obtain a durable, compressed finish.

The phenols are a class of aromatic hydroxyl derivatives, in which the hydroxyl group is attached directly to a benzene nucleus within the molecular structure. For example, some common phenols and phenol itself, the simplest of the compounds; ortho-, meta-, or paracresol; thymol; carvacrol; ortho-, meta-, or paranitro-phenol; ortho-, meta-, or para-chlorophenol; picric acid; resorcinol; alpha- or beta-naphthol; phloroglucinol; catechol; and hydroquinone.

The aldehydes on the other hand, are a class of oxygen-containing compounds having the general formula $C_nH_{2n}O$. Some typical aldehydes are formaldehyde, glyoxal, acetaldehyde, propionaldehyde, butyraldehyde, chloral, and benzaldehyde.

Other polymerizable heat settable materials which may be used to provide a durable, "broken-in" finish when used in combination with hot compression are:

(1) Acrylonitrile;

(2) Acrylamide and its derivatives;

(3) Acrylic acid and derivatives of acrylic acid, such as methacrylic acid;

(4) Acrylic acid esters, such as methyl acrylate;

(5) Esters of substituted acrylic acids such as methyl methacrylate;

(6) Polyamides, such as the reaction produce of polyamines and acid chlorides (hexamethylenediamine and adipoyl chloride);

(7) Epoxies, such as vinyl cyclohexane dioxide.

The complete break-in treatment for wool fabrics involves saturation of the felt in a bath containing the polymer forming materials, elevation of the bath temperature to cause the chemicals to partially react within the fibers, rinsing and extracting, and hot compressing the felt and curing the polymer-forming material while the felt is in the compressed form.

The effectiveness of the treatment depends on several factors, including the type and concentration of the chemical used, the pH of the treating solutions, the temperature of the treating conditions, and the time of treatment. In general, the treating conditions should be such that the chemicals will not react or polymerize within the treating bath and deposit resin on the surface of the fibers, but rather will react at a rate so as to allow formation of low molecular weight polymers within the fibers themselves.

In general, the treating conditions for a phenolic-aldehyde resin treatment fall within the following ranges:

| Treatment variable: | Preferred range |
|---|---|
| Phenol concentration | 0.02 to 0.5 molar. |
| Aldehyde concentration | 0.02 to 0.5 molar. |
| Temperature | 100° to 200° F. |
| pH | 6 to 8. |
| Time of treatment | 15 minutes to 2 hours. |

It should be borne in mind that the above treatment is in effect a pre-treatment for the hot compression process, and it is desired only to form low molecular weight polymers within the fibers rather than to completely polymerize the phenolic-aldehyde in the pre-treating step. It is not desired to completely cure or polymerize the internal polymer until the felt has been compressed and is in its final "configuration." If the polymer should completely cure before the felt is hot compressed, then the hot compression step will have little effect on the felt properties.

Since some of the phenols listed above, such as phloroglucinol and naphthol, are either insoluble or only slightly soluble in water, it is necessary to first dissolve them in a solvent such as alcohol and then either dilute the alcohol solution of the phenol with water to the desired concentration or use alcohol or an appropriate solvent as the treating medium.

After treatment with the phenolic-aldehyde solution, or other treating solution, the felt should be rinsed so as to remove any unreacted chemicals and/or other materials from the surface of the fibers, and preferably extracted to from about 30% to about 100% wet pickup. The felt, containing the low molecular weight polymer within its fibers, may then either be dried at low temperatures, hot compressed, and finally cured in the hot compressed state, or be hot compressed while still in the wet state and cured.



One form of apparatus suitable for carrying out the finishing of the fabric is illustrated in the drawings and is 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** is provided with drive means **18** which drive means is preferably of the adjustable speed type whereby the speed of the web 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 webs.

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 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** which prevents sag in the felt.

The driven roll **14** is provided with heating means which, as illustrated in the drawing, may comprise valved 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 valved conduit means generally designated **60** whereby 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.

When the felt is to be saturated in a bath containing the polymer forming material on the same apparatus employed to heat and compress the felt and polymerize the polymer-forming material, a tank generally designated **70** is positioned between the stand **44** and the idler roll **16**. The tank **70** has a width greater than the width of the largest felt to be treated on the apparatus and is provided with a lower pipe connection **72** and an upper pipe connection **75**. Pipe connection **72** is connected through suitable piping **76** to a motor-driven pump generally designated **78**. The other pipe connection **74** is selectively

connected by suitable conduit means 80 and valve 81 to a storage tank 82 for the treating material or through conduit 80, valve 81 and conduit 83 to a drain.

Within the tank 82 may be provided suitable heating means and a thermostat for maintaining the temperature of the polymer-forming material where desired. The connection 74 and its conduits 80 and 83 provide an overflow drain for the tank 70 whereby the level of the fluid in the tank 70 may be maintained at a predetermined level. The tank 70 is also provided with a bottom drain 84 which is connected to a downpipe 86 which downpipe is connected to a valve 88. The valve selectively connects the pump 78 or the drain 84 to conduit 90 which has connection to the storage tank 83. Wash liquid may be directed to the tank 70 from a source not shown via valved inlet 91 and drained from the tank via valve outlet 93.

A plurality of rolls 92, 94, 96, 96' and 98 control the path of the felt through the tank 70 and rolls 92 and 96' also act as extraction rolls to remove a portion of the polymer-forming material picked up in the felt when it passes through the polymer-forming bath. Roll 96 is mounted for adjustment toward and away from roll 96' whereby the extraction pressure may be suitably varied and the roll 94 is removable whereby passage of the felt through the tank 70 may be bypassed.

The normal ranges for hot compressing the felts in accordance with the teachings of the present invention are shown in the table below:

*Normal range of treating conditions*

| | |
|---|---|
| Platen or roll temperature ____° F__ | 200–500 |
| Platen or average roll pressure ____p.s.i__ | 100–300 |
| Dwell time ____seconds__ | 1–30 |
| Polymerization temperature within the felt ° F__ | 200–375 |

Under these normal treating conditions, the heat compressed felt will be 40% to about 70% in thickness compared to the thickness of the fabric in the uncompressed state.

The above conditions will vary, depending on such factors as the felt condition, felt construction and thickness, 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 temperature is 300° F., then a pressure of, for example, 100 lbs./square inch can be used. If the temperature is decreased to, for example, 200° F., it may be necessary to increase the pressure to, for example, 300 lbs./square inch in order to obtain the same results in substantially the same period of time.

When pressure rolls are used, the pressure increases from zero as the felt enters the nip to a maximum at mid-nip and then decreases back to zero as it leaves the nip. For this reason, the pressure in the nip is best described as an average pressure. This average pressure, expressed in lbs./square inch, is the weighting or load on the nip, expressed in lbs./inch, divided by the length in inches in the direction of travel over which the weighting force is exerted on the felt.

The dwell time of the felt in the nip of the pressure rolls is governed by the diameter of the rolls and the speed of travel of the felt through the rolls. The dwell time employed is dependent upon the temperature of the rolls and the pressure between the rolls, and is adjusted so that the temperature developed within the felt is 200°–375° F. The roll temperature may be greater than that developed in the felt up to 500° F. or even higher when the felt is being passed through the rollers at a high rate of speed.

Examples 1, 2 and 3 are examples of wool or predominantly wool fabrics which may be finished in accordance with the teachings of the present invention.

*Example 1*

A plain woven pulp felt was constructed from wool yarns. The filling yarns had a weight designation of 3/4 cut and the warp yarns a weight designation of 2/3 cut. The felt had a thread count of 6 ends per inch and 5 picks per inch and comprised 100% wool fiber.

*Example 2*

A cylinder top felt was constructed from 100% wool fiber, using 6 cut worsted warp yarn and 6 cut woolen filling yarn. The felt was constructed in a 3/1 weave and had a thread count of 13 ends per inch and 18 picks per inch.

*Example 3*

A C.F. wet grade felt was constructed by mechanically interlocking, in a needle loom, a thick web of randomly arrayed wool fibers into a woven substrate containing 85% by weight of wool fibers and 15% by weight of Dacron.

*Example 4*

An all-wool cylinder felt constructed in accordance with Example 2 was fulled in accordance with conventional fulling practices and placed on the apparatus illustrated in the drawings.

The storage tank 82 and the felt treating tank 70 were filled with an aqueous solution of 0.2 molar phenol and 0.2 molar formaldehyde. The driven roll 14 was actuated whereby the entire felt was passed through the aqueous solution in the tank 70 and then the solution temperature was raised to 150° F. No buffers were used to adjust the pH of the treating bath as it was found that the treating bath had a neutral pH. The felt was continuously passed through the treating bath heated to a temperature of 150° F. for approximately an hour. The solution was then drained from the tank and excess treating solution extracted from the felt.

Water was then directed into the tank 70 and the extracted felt was washed of excess treating solution. Following the wash the tank was drained and the rolls 14 and 50 were then seated to a roll temperature of approximately 300° F. and the upper roll 50 was lowered to provide a pressure of approximately 100 lbs./square inch the roll nip. The felt was passed through the compression roll until dried.

It was found that the finished felt had a permanently compressed finish which was resistant to wet relaxation and which exhibited the properties of a broken-in felt.

*Example 5*

A C.F. wet grade felt constructed in accordance with Example 3 was treated for one hour in a bath of 0.15 molar phenol and 0.15 molar formaldehyde. The bath temperature was maintained at 140° F. During the treatment, the felt was kept in constant motion within the bath. Following the chemical treatment, the felt was removed to a clear water bath and was thoroughly rinsed after which it was extracted. The wet felt was placed on apparatus of the type illustrated in the drawing and was passed through the hot compression rolls at a temperature of 300° F. and a roll pressure of about 100 lbs./square inch. The treated felt was found to have greater resilience, less compressibility, improved ability to extract water from a wet paper sheet, and stabilized dimensions, that is, resistance to recovery from compression when wet out, than the same untreated compressed felt.

The following are examples of predominantly wool fabrics provided with resin monomers other than phenol and formaldehyde.

*Example 6*

An all-wool cylinder tissue felt was treated for 15 minutes in an aqueous solution containing 0.30 molar resorcinol and 0.30 molar formaldehyde at a temperature of 180° F. The pH of the treating bath was maintained at 6.0 throughout the treatment. After rinsing in warm clear water, the felt was dried and was found to

be satisfactory for hot compression in accordance with the procedures set forth in Example 4.

*Example 7*

An all-wool C.F. wet felt was treated in an aqueous solution of 0.25 molar catechol and 0.25 molar formaldehyde for two hours at a temperature of 140° F. The pH of the treating bath was neutral. After rinsing and drying, the felt was found to be satisfactory for hot compression in accordance with the procedures set forth in Example 4.

*Example 8*

An all-wool pickup grade felt was treated in a bath comprising 0.2 molar phenol and 0.2 molar glyoxal at a temperature of 180° F. The pH of the bath was neutral and the treating time was 30 minutes. The rinsed and dried felt was satisfactory for hot compression in accordance with the procedures set forth in Example 4.

*Example 9*

An all-wool cylinder tissue felt woven from 2/20's cut plied worsted warp yarns and 10 cut singles of 51 ends per inch and 47 picks per inch was treated in an aqueous treating solution containing 6% by weight of vinyl cyclohexane dioxide, 1.5% zinc oxide, and 6.4% zinc fluoroborate. The wool felt was immersed in the treating solution at room temperature for 30 minutes, and then was extracted to 40% wet pickup and dried. The dried felt was satisfactory for hot compression in accordance with the procedures set forth in Example 4.

Examples 10 and 11 show the preparation of pre-broken in papermakers' felt using a platen press.

*Example 10*

The felt used in this example was a fine press all-wool papermakers' felt constructed of 4-cut woolen yarns and woven with 10 ends/inch and 16 picks/inch in the loom state. The woven felt was finished by conventional means including burling, fulling, washing and drying.

The finished felt was immersed in a cold aqueous treating solution containing 2% by weight of resorcinol and 1.5% by weight of formalin. The temperature of the solution was raised to 160° F. and the felt agitated in the heated solution for 30 minutes. The felt was then removed from the solution, rinsed thoroughly in lukewarm water and centrifugally extracted to remove excess moisture. Using an electrically heated, hydraulically loaded platen press, the indurated felt was hot compressed at a temperature of 350° F. at a pressure of 227.5 lbs./square inch for a dwell time of 30 seconds.

After standing in a conditioned atmosphere at 70° F. and 65% relative humidity, the compressed felt was flexible, resilient, relatively resistant to wet relaxation and had an air permeability of 12 c.f.m./square foot. The increase in weight due to the incorporation of polymer within the felt was 8%.

*Example 11*

A felt similar to that used in Example 10 was immersed in a cold aqueous treating solution containing 5% by weight of phenol, 3.75% by weight of formalin and 0.2% by weight of sodium carbonate. The temperature of the solution was raised to 180° F. and the felt agitated in the heated solution for 30 minutes. The indurated felt was removed from the solution, rinsed, centrifugally extracted and hot compressed as described in the previous example.

After standing in a conditioned atmosphere at 70° F. and 65% relative humidity, the compressed felt was flexible, resilient, relatively resistant to wet relaxation and had an air permeability of 7 c.f.m./square foot. The increase in weight due to the incorporation of polymer within the felt was 4%.

Comparable experiments wherein the same felt was saturated but not indurated with treating solution gave, after hot compression, stiff, glazed and/or filled felts unsuitable for use as papermakers' felts.

From the foregoing disclosure, it will be seen that the process of this invention provides a method of producing papermakers' felts having a durable compressed, broken-in finish with additional benefits of enhanced abrasion resistance, chemical resistance, dimensional stability and other improved functional properties.

We claim:

**1.** A method of making a pre-broken-in papermakers' felt from a predominately wool fabric which comprises indurating the fabric with an aqueous solution of a polymerizable heat settable composition to partially polymerize the composition within the fibers of the fabric, rinsing the indurated fabric, to remove heat settable composition from the surface of the fibers, and then heat curing the partially polymerized composition within the fibers of the fabric at a temperature between about 200 to 375° F. while maintaining the fabric in a compressed configuration between coacting pressure members at a pressure between about 100 to 300 lbs./square inch thereby fixing the fabric substantially in the compressed configuration.

**2.** A method according to claim **1** which comprises indurating the fabric at a pH between about 6 to 8 for about 15 to 120 minutes with a 0.02 to 0.5 molar aqueous solution of a phenol and an aldehyde to partially polymerize the phenol and aldehyde composition within the fibers of the fabric, rinsing the indurated fabric, to remove phenol and aldehyde composition from the surface of the fibers, and then heat curing the partially polymerized composition within the fibers of the fabric at a temperature between about 200 to 375° F. while maintaining the fabric in a compressed configuration between coacting pressure members at a pressure between about 100 to 300 lbs./square inch thereby fixing the fabric substantially in the compressed configuration.

**3.** A method of making a pre-broken-in papermakers' felt from a predominately wool fabric which comprises indurating the fabric with an aqueous solution of a polymerizable heat settable composition to partially polymerize the composition within the fibers of the fabric, rinsing the indurated fabric, to remove heat settable composition from the surface of the fibers, and then passing the rinsed and indurated fabric at a temperature of 200–375° F. through the nip of coacting pressure rolls exerting an average pressure of 100–300 lbs./square inch on the fabric a sufficient number of times to cure the heat settable composition and fix the fabric in the compressed configuration.

**4.** A method according to claim **3** which comprises indurating the fabric with a 0.02 to 0.5 molar aqueous solution of a phenol and an aldehyde to partially polymerize the phenol and aldehyde composition within the fibers of the fabric, rinsing the indurated fabric, to remove phenol and aldehyde composition from the surface of the fibers, and then passing the rinsed and indurated fabric at a temperature of 200–375° F. through the nip of coacting pressure rolls exerting an average pressure of 100–300 lbs./square inch on the fabric a sufficient number of times to cure the phenol-aldehyde composition and fix the fabric in the compressed configuration.

**5.** A method according to claim **3** which comprises indurating the fabric at a pH between about 6 to 8 for about 15 to 120 minutes with a 0.02 to 0.5 molar aqueous solution of a phenol and an aldehyde to partially polymerize the phenol and aldehyde composition within the fibers of the fabric, rinsing the indurated fabric, to remove phenol and aldehyde composition from the surface of the fibers, and then passing the rinsed and indurated fabric at a temperature of 200–375° F. through the nip of coacting pressure rolls exerting an average pressure of 100–300 lbs./square inch on the fabric a sufficient number of times to cure the heat settable composition and fix the fabric in the compressed configuration.

6. A method according to claim 5 wherein the phenol and aldehyde composition comprises phenol and formaldehyde.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,503,629 | 4/1950 | Miscall | 117—140 |
| 2,545,450 | 3/1951 | Dalton et al. | 117—141 |
| 2,589,765 | 3/1952 | Berlund | 117—140 |
| 3,075,274 | 1/1963 | Mizell | 28—74 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 650,190 | 10/1962 | Canada. |




MURRAY KATZ, *Primary Examiner.*