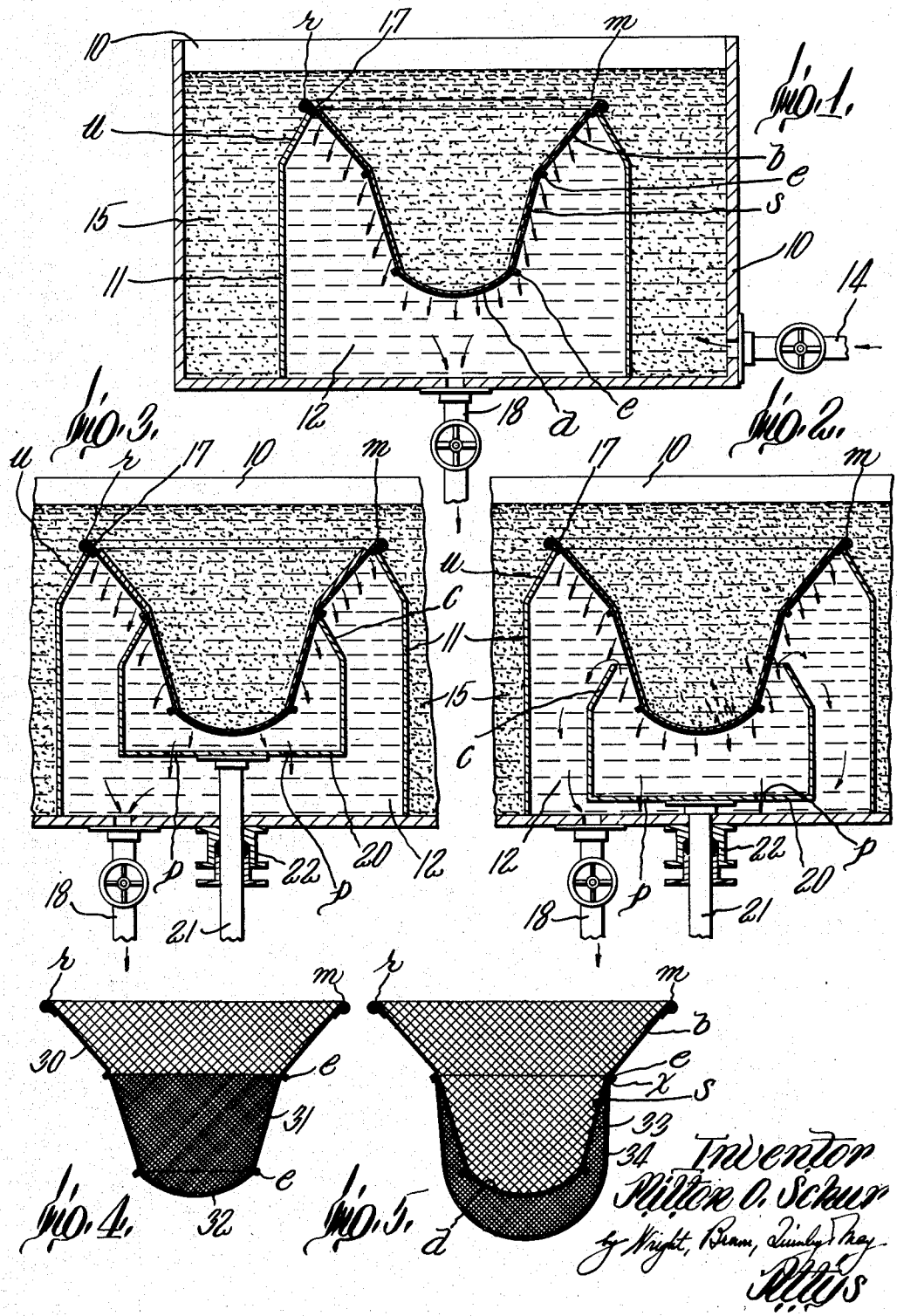
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MANUFACTURE OF MOLDED, WATERLAID FIBER ARTICLES

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MANUFACTURE OF MOLDED, WATERLAID FIBER ARTICLES

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This invention relates to molded fiber articles and more especially to molded, waterlaid fiber materials such as are formed by depositing fiber from aqueous suspension on porous or foraminous molds. While not limited thereto, a principal objective herein is the economical manufacture of articles, such as hats, shoes, gloves, etc., which require a variety of molds of complex arbitrary configurations on account of the varying demands of style and size. Another objective is the economical manufacture of articles of this class possessed of a pliancy comparable to that of suede or true felt articles and preferably also simulating true felt articles in such qualities as appearance and feel.

In accordance with the present invention, the molding of the article is done by depositing the fiber from aqueous suspension on a porous, yarn-fabric mold of a porosity consonant with the desired drainage of the water of the suspension therethrough, whereupon the wet article is dewatered to a self-sustaining condition on the mold and is separated therefrom. I have found that when dewatering of the article has been partially or completely effected, the yarn-fabric mold, e. g. a woven cotton cloth mold, may be easily and cleanly stripped or peeled from the molded article. The fact is that even when deposition of pulp fibers occurs in the presence of flocculated rubber or other suitable binder, as will hereinafter appear, no difficulty whatever is had in stripping the flexible mold from the molded article, since there is very little, if any, felting affinity between the fibers being deposited from aqueous suspension and the yarns constituting the fabric of the mold. Accordingly, the molds may be reused directly or after they have been put through a washing operation, as in a household washing machine, designed to rid them of such fibers or other residues as may be enmeshed thereby and as might otherwise tend to accumulate therein and thus impede drainage of water therethrough during a molding operation.

The practice of the present invention as thus far described is advantageous in that it becomes possible to make molds inexpensively from ordinary woven cotton cloth or other yarn-fabrics, e. g. knitted ones, for hats, shoes, gloves, and other articles of complex arbitrary configuration by the simple expedient of stitching together, cementing, or otherwise uniting two or more appropriately cut pieces of such fabric into the desired mold form. In addition to obviating the comparatively much greater expense of making wire molds, such as have heretofore been generally used for molding fiber or pulp articles, the present invention affords the opportunity of dewatering the molded fiber article while it is on the mold in a novel and advantageous way, namely, by centrifugal extraction much in the same way as water is centrifugally extracted from washed clothes, since, unlike wire molds, the molds of the present invention are flexible and, along with the molded pulp articles carried thereby, can be placed in a centrifuge without any particular attention and be subjected to the centrifugal water-extraction forces without injury to the molded pulp articles.

In making such articles as hats, with which articles the present invention is particularly concerned, it is usually desirable that deposition of the fibers from aqueous suspension take place along with the deposition of flocculated rubber or other suitable binder added to the suspension so as to enable the resulting molded article in properly dewatered and self-sustaining condition to be stretched without danger of injury over a second mold or form serving to impart the desired finished lines or shape to the article. Thus, in applying the present invention to the manufacture of hats, the practice may advantageously involve depositing pulp fibers in the presence of suitable binder on a cotton cloth or equivalent mold structure into approximate hat shape, dewatering the hat shape to a self-sustaining condition on the mold, stripping the mold from the hat shape, and stretching the hat shape, preferably in the presence of moisture, over a finishing mold or form. When stretching of the hat shape on the finishing mold is done while the shape is sufficiently moist to lend itself to easy stretching over and conformation to the mold, the shape is then dried on the mold, in consequence of which the shape shrinks tightly against the mold surface so as to assume faithfully the configuration or lines of the mold. The finished hat shape may then advantageously be surfaced with fiber flock to simulate in appearance and feel a true felt hat. Surfacing of the hat shape with fiber flock may take place while the shape is supported on the finishing mold; and flocking with fiber may be performed in the usual way, that is, by spraying or otherwise applying to the hat surface such binders as rubber latex, glue, nitrocellulose cements, etc. and then showering fiber flock onto the sticky hat surface as the mold or form is undergoing rotary and/or other appropriate movement to ensure substantially uniform flocking of the hat surface. At least the outer hat surface is preferably thus flocked; and

it is usually desirable to turn the hat inside out on the finishing mold after its outer surface has been flocked and to flock the now-outer surface in the same way as the previously-outer surface. In some instances, the hat shape may be molded in the substantial absence of binder and then be impregnated with rubber latex or other suitable binder, as by spraying the binder on the hat shape while it is supported by the finishing mold, in which case sufficient binder may be applied not only to effect impregnation of the body of the hat to the desired degree, but to develop an adhesive coating on its surface which can be showered with fiber flock and then permitted to dry or set. Thereupon, if desired, the inside surface of the hat may be treated with binder and also flocked, as hereinbefore described. Of course, fiber flock of any suitable color or sheen may be employed; and, if desired flock of one or more colors may be distributed locally on the hat surface to produce highly ornamental effects, the binder for the flock and/or the flock being applied, for instance, through suitable stencils in producing such effects. The flocked hat may be provided with the usual accessory hat elements, such as a lining, sweat band, etc., and usual hat ornaments, such as an outer band or ribbon, buttons, feathers, buckles, etc.

With the foregoing and other features and objects in view, the present invention will now be described in further detail with particular reference to the accompanying drawing, wherein—

Figure 1 represents a section through hat-molding apparatus embodying the present invention.

Figure 2 illustrates similarly the mold and related parts of a modified form of apparatus equipped with means for impeding the drainage of water through the crown portion of the hat mold.

Figure 3 is similar to Figure 2 but shows such means in operative position.

Figure 4 is a section through a hat mold whose crown portion is of finer mesh cloth than its brim portion.

Figure 5 is a section through another form of hat mold of uniform mesh throughout and carrying suspended below its crown portion a bag of finer mesh cloth serving to impede the drainage of water through such portion.

The apparatus shown in Figure 1 includes a vat 10 within which is located an annular wall or partition 11 upstanding from the bottom of the vat and definitive of a central compartment 12 into which the water drains from the mold. The aqueous fiber suspension may be delivered into the vat through a valved pipe 14 so as to fill the annular space 15 between the wall of the vat and the partition 11 and to overflow into a hat mold 17 removably supported in inverted position by the upper edge of such partition. The water draining from the mold 17 into the compartment 12 may be removed through a valved pipe 18 at the bottom of the vat.

The mold 17 may be of a multi-piece construction comprising a brim piece *b*, a side wall piece *s*, and a dome piece *d*, which pieces may be sewed together at their complemental edges to form lap seams whose raw edges *e* are preferably, as shown, on the outside of the mold. The pieces are, of course, initially cut to the appropriate shape or pattern; and the brim and side wall piece *b* and *s*, respectively, are formed up into frustro-conical shape by sewing together edges (not shown) prior to being sewn together at their edges *e*. The marginal portion of the brim piece *b* is preferably wrapped about a wire ring *r* and stitched or cemented in place to form an edge bead *m* of a rigidity to prevent undesirable flexing and distortion of the mold when aqueous fiber suspension fills it. Such bead *m* may, as shown, rest on the upper edge of the partition 11, the upper portion *u* of the partition being depicted as inwardly inclined from the rest of the partition so as to leave ample space for water drainage in the mold regions immediately below the bead.

The aqueous fiber suspension flows into the mold 17 and fills it, the supply of suspension maintained in the vat 10 at least during the initial stage of the molding operation having a level above the edge of the mold. The mold, despite its flexibility, assumes the desired configuration by reason of the fact that it is freely suspended or hung from its upper margin or edge portion and the pressure set up therein through the hydraulic head of suspension and the resistance of the fiber deposited thereon to the drainage of water therethrough acts to expand or push it outwardly and substantially uniformly taut in all directions. Once a molded fiber or pulp layer of the desired thickness has been deposited on the mold, the valved pipe 14 is closed and such free water as is present in the mold is permitted to drain therethrough. The mold may then be removed from the vat and the molded fiber or pulp layer may then be partially or substantially completely dried, as in a centrifuge or hot-air chamber, to permit the stripping therefrom of the mold with the molded hat shape in self-sustaining condition. The mold may then be replaced in the vat for the molding of a new hat; and the molded, approximate hat shape may undergo the desired after-treatments, including stretching from its approximate shape to finished shape over a suitable mold, for instance, a finishing mold consisting of an aluminum shell of the desired hat shape finished nicely on its surface. It is preferable that the pulp suspensions delivered to the molding apparatus contain precipitated or flocculated rubber or other elastic or semi-elastic binder which deposits on the mold along with the binder and thus leads to a partially or substantially completely dewatered hat shape whose fibers are bonded together, the binder imparting to the shape sufficient toughness to permit its being stretched and otherwise manipulated over the finishing mold without danger of rupture or other damage thereto even when it is roughly handled. Specifically, the fiber or pulp suspensions may advantageously contain 20% to 60% or more of flocculated rubber, based on the weight of fiber. In order to ensure substantially uniform texture in the pulp layer deposited on the mold, it is preferable that the fiber suspensions delivered to the molding apparatus be of very low fiber content, namely, of a fiber content of 0.10% to 0.04% or even less, based on water. Such small amount of flocculated rubber or other binder as drains through the mold along with the white water may be recovered by reusing the white water in preparing new pulp suspensions, that is, by providing a substantially closed white-water system as is sometimes done in papermaking practice.

In stretching the approximate hat shape over a finishing mold, it is of advantage that the shape be quite moist, as moisture enhances its plasticity, stretchability, and other moldable or conformable qualities. The fact is that even when the

shape has been dried substantially completely prior to final shaping, it is preferable to rewet the shape, as by immersion in water, prior to conforming it to the finishing mold. After conformation to the finishing mold, the hat is dried on the mold. Since it shrinks considerably during drying, nicety of conformation to the finishing mold is assured, whereupon the finished hat shape may then be flocked, as hereinbefore described.

In some instances, one may pursuant to the present invention omit rubber or other binder from the fiber suspension, mold the approximate hat shape as hereinbefore described, dry it on the mold, separate it from the mold, spray it with rubber latex or other suitable binder, re-dry it, and then stretch it over a finishing mold, preferably after a re-wetting treatment. The hat may then be dried on the finishing mold and flocked while on such mold to produce the desired article.

It is frequently desired that the brim portion of a hat be firmer and/or thicker than its crown portion. Figures 2 and 3 show hat-molding apparatus equipped with means by which this result may be realized. The molding apparatus therein shown is no different from that of Figure 1, excepting that it is provided with a movable can 20 adapted to serve the function of impeding drainage of water through the crown portion of the hat mold at the desired stage of the molding operation. The can may be fixed to the upper end of a plunger 21 passing through a stuffing box 22 into the drainage compartment 12 and actuable by suitable means (not shown) to raise the can from its inutile position shown in Figure 2 to its operative position shown in Figure 3. The upper portion *c* of the can wall may be inwardly inclined so that when the can is in its operative position, as appears in Figure 3, its upper edge engages the hat mold at its brim and side wall juncture with ample can-drainage space in the mold regions immediately below such juncture. The can bottom contains a few minute perforations *p* designed to permit a slight drainage of water through the crown portion of the hat mold while the can is in operative position and thereby to keep the fiber or pulp layer deposited on such portion firmly adherent to the mold while at the same time impeding drainage of water through such portion.

When using the apparatus of Figure 2, the practice may be to keep the can 20 in its inutile position, as shown in this figure, during the initial stage of the molding operation, in the course of which fibers deposit substantially uniformly over the mold surface, since drainage of water through all portions of the mold is substantially uniform and such water as drains into the can readily circulates through the rather wide clearance between the can edge and the mold, as indicated by arrow, to the drain pipe 18. At the appropriate time in the fiber-depositing or molding operation, the plunger 21 may be actuated to raise the can 20 to its operative position shown in Figure 3, in consequence of which drainage of water through the crown portion of the mold is impeded and fiber is deposited at such portion at a much lower rate than at the brim portion of the mold through which the drainage of water remains substantially unaffected by the can. The resulting molded hat shape thus comprises a thinner crown than brim portion. The hat shape may then be subjected to the various after-treatments hereinbefore described.

It is possible to realize a molded hat shape of thicker brim than crown portion by adopting various other expedients for impeding drainage of water through the crown portion of the hat mold. Thus, as depicted in Figure 4, the hat mold may be formed of a brim piece 30 of coarser mesh than the crown pieces 31 and 32, in which case drainage of the water of the aqueous fiber suspension takes place more rapidly and with greater fiber deposition at the brim portion of the mold than at the crown portion, which latter portion affords greater impedance to the drainage of water therethrough than the brim portion. The mold of Figure 4 may otherwise be constructed similarly to that of the mold of Figure 1, being formed up, for instance, by sewing together appropriately cut pieces or blanks of woven cloth of suitable mesh.

Another form of hat mold affording increased impedance to the drainage of water therethrough at its crown portion than at its brim portion is shown in Figure 5. In this form of mold, the mold proper is formed up from pieces of woven cloth of uniform mesh, as in the mold of Figure 1, but suspended from the mold and encompassing only its crown portion 33 is a baglike cloth septum 34 of finer mesh than the mold proper serving to impede water drainage through its crown portion and thus to cause less fiber deposition at such portion than at its brim portion. The baglike cloth septum 34 may be of sufficient bagginess to leave a substantial clearance, as shown, between it and the mold proper; and its upper end portion *x* may be sewed to the raw edges presented at the juncture of the brim and crown portions of the mold.

In molding hat shapes in accordance with the present invention, it is possible to change the character or nature of the fiber delivered as an aqueous suspension into the molding apparatus during the molding operation. It is thus possible to produce a molded layer or article comprising strata of different characteristics either throughout the hat shape as a whole or at certain portions thereof, such as the brim. The strata are, of course, matted or felted together into an essentially integral layer or structure. Possible combined or composite strata may, for instance, be:

(1) An initial layer of wool,
(2) A secondary layer of cellulose pulp
(3) A final layer of wool;

or

(1) An initial layer of substantially unhydrated cellulose pulp,
(2) A secondary or inner layer of well-hydrated cellulose pulp,
(3) A final layer of substantially unhydrated cellulose pulp;

or

(1) An initial layer of fiber-flocculated rubber mixture,
(2) A secondary layer of wool,
(3) A final layer similar to the first layer.

Only the brim portion of the hat, whereat greater firmness and bulk is required, may consist of the combined strata, since the change in fiber suspension, when using the apparatus of Figures 2 and 3, may be restricted essentially only to the brim portion of the hat by encompassing the crown portion with the can when the change of fiber suspension is effected. In such case, the crown portion of the hat may, for instance, be made to contain as its fiber component practically only substantially unhydrated cellulose

fiber, such as substantially unhydrated wood pulp refined to an alpha cellulose content of, say, at least about 93%, whereas its brim portion may be made much thicker and to contain a stiff inner layer of highly hydrated cellulose fiber and comparatively soft external layers of the substantially unhydrated cellulose fiber already mentioned. By reason of the fact that special fibers can be localized at the brim portion of the hat, it also becomes possible to use therefor or therein such long fibers as manila, sisal, and hemp pulps for the purpose of imparting greater tear resistance and toughness to such portion. In all of such instances, the fiber may be deposited from aqueous suspension along with flocculated rubber or other suitable binder; or the hat shape may be molded in the substantial absence of binder and impregnated with suitable binder preparatory to the remolding operation, as hereinbefore described.

As already indicated, various binders may be added to the aqueous suspension of fiber delivered to the hat-molding apparatus; or the binders may be incorporated as impregnants into the molded hat shape in partially or completely dried, self-sustaining condition. In lieu of rubber, it is possible to use such semi-elastic binders as glue, viscose, etc. The hat shape may, for instance, be impregnated with about 8 to 40% of glue or about ½ to 5% of cellulose regenerated from viscose, based on the dry weight of fiber in the hat shape. In the case of all of these binders and especially in the case of glue and viscose, it may be desirable to introduce a suitable softening or plasticizing agent into the hat shape in order to neutralize or offset such undesirable stiffening action of the shape as may come from the binder. Thus, hat shapes impregnated with dry rubber latex solids may to advantage contain about 5 to 25% of glycerine, based on latex solids; those impregnated with glue, about 75 to 200% of glycerine, based on glue solids; and those impregnated with about ½ to 5% cellulose regenerated from viscose, about 5 to 30% of glycerine, based on the dry weight of fiber. Other softening agents, such as ethylene glycol or other homologues of glycerine, glucose or other invert sugars, "Nulomoline", and the like might be employed in lieu of glycerine. The glycerine or other softening agent may be introduced directly into such impregnants as rubber latex, glue solution, and viscose, with which they are compatible; or they may be applied to the binder-impregnated hat shape either generally or locally, as in the form of aqueous solutions. So, too, such stiffening agents as water-glass, starch paste, etc., may be added to the hat shape along with the binder. In some instances, binders such as rubber latex and glue, rubber latex and viscose, and rubber latex, glue and viscose may be admixed to develop the proper degree of stiffness in the hat. In this connection, it might be noted that the addition of glue and/or viscose to a rubber latex binder has the effect of increasing the stiffness of the hat shape impregnated with the binder. As in the case of the softening agent, the stiffening agent may be infused into the binder-impregnated hat shape, as in the form of an aqueous solution; and such infusion may be had generally or locally, for instance, only at the brim portion of the hat, whereat greater stiffness is generally desired than at the crown portion.

While the thickness of the hat body or structure prior to surfacing it with fiber flock is subject to variation, it is generally the case that the thickness desired ranges from about 20 to 60 mils, as at such thickness it can be finished with fiber flock to produce a final hat structure or body whose thickness is comparable to that of suede or felt in a true felt hat.

It might be added that principles hereinbefore described as applicable to the wet-molding of hats or other fiber articles might be extended to a dry-molding practice, by which latter expression I mean a practice involving the deposition on the molds of fiber in substantially dry condition from suspension in air or other gaseous vehicle, suitable binder being applied, if desired, to the fibers in the course of their deposition, as by spraying the binder thereonto.

I claim:

1. A method of making a molded, waterlaid fiber article imitative of a genuine felt article, which comprises depositing fiber and flocculated rubber from aqueous suspension into approximate article shape on a porous, yarn-fabric mold, dewatering the article to a self-sustaining condition on said mold, separating the article from said mold, stretching the article to its final shape on another mold, and surfacing the article with fiber flock.

2. A method of making a molded, waterlaid fiber article imitative of a genuine felt article, which comprises depositing fiber and an elastic binder from aqueous suspension into approximate article shape on a porous, flexible, yarn-fabric mold while causing the mold to expand to the desired approximate article configuration under the influence of the hydraulic pressure-head set up during the deposition of the fibers and the elastic binder, dewatering the article to a self-sustaining condition on said mold, separating the article from said mold, stretching the article to its final shape on another mold, and surfacing the article with fiber flock.

3. A method of making a molded, waterlaid fiber article imitative of a genuine felt article, which comprises depositing fiber and flocculated rubber from aqueous suspension into approximate article shape on a porous, flexible, yarn-fabric mold while causing the mold to expand to the desired approximate article configuration under the influence of the hydraulic pressure-head set up during the deposition of the fiber and the flocculated rubber, dewatering the article to a self-sustaining condition on said mold, separating the article from said mold, stretching the article in the presence of moisture to its final shape on another mold, and surfacing the article with fiber flock.

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