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ART OF STIFFENING SHOES

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My invention relates to stiffeners of the class used to reinforce and stiffen or maintain the shape of certain parts of the shoe upper, and more particularly to those stiffeners known as box toe stiffeners and employed in the fore parts of shoes.

To allow the stiffener to be molded or shaped during shoemaking, it must be transformable to a soft or flaccid condition; and the stiffener must also have the property of becoming quite hard and resilient after it has been appropriately molded or shaped with the shoe upper during the lasting operations. In general, the practice has been either to employ a fibrous base stiffener blank containing thermoplastic compounds and lastable at moderately elevated temperature or to employ a fibrous base stiffener blank containing a stiffening impregnant which, when exposed to the action of a volatile solvent, becomes lastable and which sets or hardens to acquire resiliency after the solvent has evaporated.

Shoe stiffeners of the thermoplastic kind must be heated to moderately elevated temperature, such as is reached by the use of steam, not only during the initial lasting operation, known as the pulling-over operation, but also during the final lasting operation, called the bed-lasting operation. The second-named operation is performed after the over-lasted margins of the toe portion of the shoe upper have been tacked to the last or form employed; and, for that reason, heat is necessarily applied not only to the box toe stiffener now within the shoe upper itself, but also to the leather or fabric of which the shoe upper is made. Since many upper leathers, such as delicately embossed or printed leathers, and many upper fabrics, such as damask or satin, may be damaged by such elevated temperature, the use of heat at this stage of shoemaking has always been attended by considerable difficulty.

Shoe stiffeners of the solvent-softenable type require no heat during the bed-lasting operation, but the solvents themselves are troublesome. Being volatile, they tend to pass as wet vapor through the material of which the shoe upper is composed and to dissolve or discolor dyes or coloring matter in the upper leather or fabric, sometimes causing unsightly stains which are very difficult to remove since they originate from within the shoe and are apt to be embedded deeply within or all the way through the thickness of the upper. Further, the box toe stiffener must be soft and easily lastable during the bed-lasting operation; and this is most difficult of obtainment with any degree of uniformity when a volatile solvent is employed, since shoe upper materials vary widely in their ability to restrain the volatilization of the volatile solvent, varying all the way from highly porous materials, such as canvas, that offer little resistance to the diffusion of vapors therethrough, to such comparatively impervious materials as heavily greased or oiled leather and enamelled or patent leather. It is thus seen that the two most commonly used practices of stiffening shoes are compromises at best.

The present invention affords a novel and advantageous art of shoe-stiffening and a shoe stiffener blank which is heated, as is a so-called thermoplastic stiffener, preparatory to the initial lasting or pulling-over operation but which requires no heating for the bed-lasting operation and thus has the virtue heretofore attributable only to solvent-softenable stiffeners and which can be manufactured at low cost and be adopted by shoemakers at once, that is, with equipment available at present in shoe factories and with no increased labor costs. Broadly stated, the shoe stiffener blank of the present invention comprises the usual sort of fibrous base but contains distributed as an impregnant therethroughout substantially raw or uncooked granules of an amylaceous substance capable of being burst and gelatinized under moist moderate heat, such as that furnished by steam, and of setting under cooling and drying influences to the desired hard resilient condition. The amylaceous substance is introduced into the fibrous base as a mixture with water at a temperature well below the bursting temperature of the granules. It may be any one or a mixture of such starches as sago, tapioca, corn, rice, wheat, potato, cassava, or the like, the particular starch or starch mixture employed being selected with reference to the particular qualities realized after the stiffener blank containing the particular starch or starch mixture has been steamed and also after the blank has been shaped and set in the shoe. If desired, the raw starch or starch mixture may contain a certain small amount of so-called soluble starch, that is, starch which is readily gelatinized or dissolved in water, particularly under the application of slight heat. The use of a small amount of so-called soluble starch is of advantage in that it promotes a fixation or bonding of the raw starch granules to the fibrous base and thus minimizes dusting out of the raw starch granules from the dried, starch-impregnated fibrous base. The raw starch is mixed with water at, say, seasonable temperature and the starch is preferably kept substantially

uniformly suspended or mixed with the water as by agitation of the starch-water mixture. A suitable fibrous foundation, such as canton flannel or felt, may be run through the substantially uniform starch suspension, whereupon excess suspension may be squeezed, scraped or otherwise removed from the impregnated fabric and the fabric dried. Care must be taken to effect drying of the impregnated fabric at a temperature that at no time exceeds the bursting temperature of the starch granules with which the fabric is loaded.

As a typical, but not limiting, formula for the starch suspension, I may cite the following:

	Parts by weight
Raw starch	200
Dextrin	40
Borax	20
Water	300

The function of the relatively small additions of dextrin and borax to the starch suspension is to effect a fixation or bonding of the raw starch particles in the impregnated fabric upon the evaporation of water therefrom, so that, as already explained, excessive dustiness in the dried sheet may be avoided. Being a weak alkali, the borax promotes hydrolysis and dissolution of the dextrin in the comparatively cold water used as the suspension medium for the raw starch.

It might be observed that the impregnating composition consisting essentially only of a raw starch and water mixture has comparatively little pastiness or stickiness. On the contrary, the granules or particles of raw starch remain suspended in the water as floating discrete units capable of being filtered out as on ordinary filter paper or fine cheesecloth with little tendency for the particles to cohere tenaciously even after the filtered mass or cake has been dried. Thus, when the filtered mass has been dried, it tends to revert to pulverulent condition under manipulation or mild rubbing between the fingers. It is for this reason that, as in the foregoing formula, I prefer to admix with the raw starch granules a small amount of water-soluble binder of the nature of dextrin, water-soluble starch, "British gum", etc., that functions to bond the starch granules together to some extent upon drying of the composition in the fibrous base. However, the bonding action afforded by the water-soluble binder is not tenacious, being sufficient only to prevent "dusting out" of the starch granules under manipulation of the dried impregnated sheet. The fact is that the bonding effect of the water-soluble binder is in large measure masked or diluted by the comparatively large amount of crumbly starch deposit or charge within the sheet, the granules of which occur throughout the sheet in essentially discrete or individualized condition so far as concerns their being wetted rapidly and substantially uniformly by water or water vapor brought into contact with the sheet. Accordingly, it will be seen that the starch phase or charge within the sheet is not in the nature of a filmy body or sizing material, since, rather than repelling or shedding water from the sheet it tends to permit water and water vapor to pass readily therethroughout while at the same time imbibing a quota of water permitting the starch-bursting or cooking operation to be carried out in situ in the fibrous base. Of course, once the starch phase or charge within the stiffener has been cooked with the desired rupture or explosion of the starch granules in the fibrous base and the stiffener blank carrying the freshly cooked starch has been incorporated into the shoe upper, lasted, and permitted to set or harden, the starch acquires a filmy, horny, and dense quality coupled with a commensurate sizing or water-repelling quality, both of which qualities are prized in finished shoe stiffener structures.

The dried, starch-impregnated sheet is now ready for the customary cutting or dieing out into box toe stiffener blanks, which may to advantage be skived as ordinarily at all their margins. They are thus supplied to the operator of the pulling-over machine. The operator preferably dips the starch-bearing blank momentarily in water and lays it upon a steam table or otherwise subjects it to the desired moist heat. In short order, the starch granules are burst or cooked in situ in the blank; and the blank containing the freshly cooked or gelatinized starch is then incorporated into the shoe upper in the customary manner and the assembly put through the pulling-over and other shoemaking operations. In its freshly cooked and gelatinized condition, the starch tends during lasting to squeeze out from the stiffener blank into the underlying and overlying parts of the shoe upper, namely, the lining, doubler, and upper material, so that union or bonding together of the separate layers constituting the fore part of the shoe may be realized.

Because the shoe stiffener blank goes into the shoe immediately after its starch content has been cooked, the blank is sterile, that is, free from live mold or spores. This is of importance in that the dark and often damp interior of a shoe would otherwise serve as a favorable environment or breeding ground for the mold or spores, in consequence of which the shoe would be unsanitary and its materials of construction, especially the cotton fabric therein, would tend to undergo rotting or spontaneous destruction.

Of great importance to the shoe manufacturer is the fact that the shoe stiffener of the present invention enters the shoe with water in limited amount and at practically boiling temperature as the only gelatinizing medium. This makes for very rapid drying or setting of the stiffener; and in actual practice allows the wooden last to be withdrawn from the shoe after a maximum interval of only about two hours. Since the number of lasts necessary for a given shoe production is a reflection of the last-replacement cost, which cost is a significant one in a shoe factory, it follows that the practice of the present invention is attended by an economy in shoe manufacture heretofore attainable only through the use of shoe stiffeners of the thermoplastic kind.

When a shoe upper containing the stiffener of the present invention reaches the bed-lasting machine, it is found that no further heating or conditioning of the stiffener is necessary, as it contains sufficient residual moisture from the starch-cooking operation to possess ample flexibility and moldability to be conformed nicely and permanently to the shape of the last. Again, since the stiffener blank containing the freshly cooked starch is assembled with the shoe upper and is lasted shortly after having been at starch-cooking temperature substantially uniformly throughout, the stiffener is limp and moldable substantially uniformly throughout its thickness, that is, is substantially without any unactivated localities even in its interior, whereas the softening of a shoe stiffener as ordinarily by a volatile solvent is apt to be in the nature of a localized

etching or gelatinizing action at the surfaces of the stiffener whereat the solvent is of greatest concentration but be attended by little work of gelatinization in the interior of the stiffener on account of the relatively small amount of solvent passing into the interior. In the case of a thermoplastic shoe stiffener blank, on the other hand, the heating of one face of the blank tends to cause the thermoplastic compound to erupt or break out on the opposite face of the blank. It is thus seen that in neither of the two generally employed prior art practices of conditioning shoe stiffener blanks are the conditions necessarily such as to conduce to a conditioned blank possessed of homogeneous plasticity or moldability therethroughout, whereas the practice of the present invention ensures the acquisition of such plasticity or moldability by the blank. This has a distinct bearing on the realization of fine lasting of the shoe upper, since a shoe stiffener transformed to substantially the same degree of plasticity or moldability throughout its structure invariably follows the contours or lines of the last on which its molding is effected with the desired fidelity.

I wish to stress the value of using raw or uncooked starch or starch-like material as the stiffening impregnant in the fibrous base which is transformed to shoe stiffener material in situ in the shoe by the practice of my invention. As is well known, raw starch, e. g., raw potato starch, may be mixed with water to form a suspension of comparatively high solids content while at the same time possessing a fluency comporting with the desired impregnation of the fibrous base. Thus, aqueous suspensions of starch containing as high as or even much higher than 50% by weight of raw starch are sufficiently fluent to lead to the desired impregnation of canton flannel or equivalent fibrous bases, such as dry-laid felts, waterlaid felts, blotting or similar porous papers, woven fabrics of various descriptions, knitted fabrics, etc. Such impregnation may be realized as by dipping the fibrous base into a bath of the suspension, by depositing the suspension as a coating on the base and preferably squeezing it into and throughout the base, or by spraying the suspension onto either or both faces of the base. As a result of any one or more of these modes of application of the starch suspension to the fibrous base, it is possible to incorporate from, say, about 50%, to, say, about 400%, of starch solids, based on the dry weight of the fibrous material constituting the base. A percentage of starch solids lying at the lower end of the range just given may be desirable in the case of comparatively light or delicate shoes, such as women's turned shoes, McKay shoes, bedroom slippers, and the like, whereas a percentage of starch solids lying at the upper end of the range may be desirable in the case of heavy men's shoes, such as men's street shoes, workingmen's shoes, and heavy-duty shoes in general. It might be remarked that the charging of the fibrous base with such a high percentage of starch solids can be realized only when the starch is used in raw or uncooked state, for when starch is initially cooked or hydrolyzed so as to render it water-soluble or partially water-soluble and the modified starch is mixed with water, it is found that a mixture or solution containing only a relatively small proportion of starch is highly viscous, so much so, that it cannot enter readily as an impregnant into a fibrous base. Accordingly, when cooked or hydrolyzed starch is admixed with water with a view toward using the resulting composition as an impregnant for a fibrous base, it is necessary to work with compositions of comparatively low solids content in order to maintain the composition at the desired low fluency and thereby to effect the desired impregnation of the fibrous base. It is thus seen that in order to reach a suitable starch solids content in a fibrous base through the use of hydrolyzed or cooked starch compositions, it is necessary to resort to repeated impregnations of the fibrous base; and even with such repeated impregnations, it is impossible to introduce into the fibrous base anywhere nearly as large an amount of starch solids as is introduced in a single treatment of the fibrous base by the practice of the present invention. By virtue of the fact that the stiffener blanks of the present invention are charged with a high proportion of raw starch solids, the cooking or modification of the starch solids in situ in the blanks in the course of shoemaking, as hereinbefore described, results in a far more effectively stiffened shoe, wherein the stiffener structure possesses greater strength, resiliency, moisture-resistance, and other desired qualities. In this connection, it is apposite to remark that the cooking of the starch granules in situ in the stiffener blanks is accompanied by swelling and ultimate rupture of the granules, wherefore, such voids or interstitial spaces as are originally present in the blanks are filled and the finished or completely shaped stiffener structure constitutes a substantially impermeable barrier against the passage of moisture or other liquids. The ultimate stiffener structure produced in the shoe is highly resistant to decomposition or degradation during the life of the shoe, remaining intact against localized impact or pressure such as is usually encountered and containing sufficient stiffening starchy element to withstand the action of perspiration within the shoe and access by rain water or the like from outside the shoe.

As already indicated, the blanks are conditioned for assembly with the shoe upper preparatory to the lasting operation by exposure to a steam atmosphere. In those instances when wet steam is not available, it is preferable to moisten the blanks, as by dipping them momentarily in water, before they are exposed to the steam atmosphere. In such way, the blanks take on sufficient free water to respond quickly to the steaming atmosphere in the sense that the starch granules contained therewithin are in contact with sufficient water to be promptly swollen or burst. It is possible to simulate a steaming atmosphere by dipping the blanks momentarily in water and then subjecting them to dry heat, but the best and quickest results are realized by exposing the preliminarily moistened blanks to the action of live steam. However, I consider an initial moistening of the blanks with water and their subjection to dry heat as being the equivalent of exposing them directly, or immediately after a moistening operation, to a steaming atmosphere.

I claim:

1. In the art of stiffening shoe uppers in the course of shoemaking, those steps which comprise preparing a fibrous stiffener blank containing therethroughout a heavy charge of uncooked amylaceous substance, exposing the stiffener blank to a steam atmosphere to cook and gelatinize its charge of amylaceous substance, assembling the blank containing the freshly cooked

and gelatinized amylaceous substance with a shoe upper, and putting the assembly promptly through the lasting operations and permitting said gelatinized amylaceous substance to set and stiffen said blank in lasted conformity with said upper.

2. In the art of stiffening shoe uppers in the course of shoemaking, those steps which comprise preparing a fibrous stiffener blank containing therethroughout a heavy charge of substantially dry but uncooked starch, moistening the stiffener blank with water, exposing the moistened blank to a steam atmosphere to cook and gelatinize its charge of starch, assembling the blank containing the freshly cooked and gelatinized starch with a shoe upper, and putting the assembly through the lasting operations and permitting said gelatinized starch to set and stiffen said blank in lasted conformity with said upper.

3. In the art of stiffening shoe uppers in the course of shoemaking, those steps which comprise preparing a fibrous stiffener blank carrying therethroughout as an impregnant unburst granular material whose granules are capable of being burst and gelatinized under the action of moist heat, exposing the blank to moist heat to effect a bursting and gelatinization of the granules, assembling the blank containing the freshly burst and gelatinized granules with a shoe upper, and putting the assembly through the lasting operations and permitting said burst and gelatinized granules to set and stiffen said blank in lasted conformity with said upper.

4. A shoe stiffener blank comprising a fibrous charge carrying therethroughout a heavy charge of substantially raw amylaceous substance capable of being cooked and gelatinized in a steam atmosphere, said blank being readily moldable to the shape of a shoe last while its charge of amylaceous substance is in freshly cooked and gelatinized state and capable of setting and stiffening said blank in lasted conformity with a shoe upper.

5. A shoe stiffener blank comprising a fibrous base carrying therethroughout a heavy charge of unburst starch granules capable of being burst and gelatinized quickly in a steam atmosphere, said granules being bonded to the fibers of said base and said blank being capable of setting and stiffening in lasted conformity with the shoe upper promptly after its starch granules have been burst and gelatinized.

6. A shoe stiffener blank comprising a fibrous base carrying therethroughout a heavy charge of unburst starch granules capable of being burst and gelatinized quickly in a steam atmosphere, said granules being bonded to the fibers of said base by water-soluble binder and said blank being capable of setting and stiffening in lasted conformity with the shoe upper promptly after its starch granules have been burst and gelatinized.

7. A shoe stiffener blank comprising a fibrous base carrying therethroughout a charge of substantially raw starch capable of being cooked and gelatinized in a steam atmosphere, the starch content of said blank being bonded to the fibers of said base by solubilized dextrin and said blank being capable of setting and stiffening in lasted conformity with the shoe upper promptly after its raw starch content has been cooked and gelatinized.

8. A shoe stiffener blank comprising a fibrous base carrying therethroughout a heavy charge of substantially raw starch capable of being cooked and gelatinized quickly in a steam atmosphere, the starch content of said blank ranging from about 50% to about 400% by weight of the fibrous base and said blank being capable of setting and stiffening in lasted conformity with the shoe upper promptly after its raw starch content has been cooked and gelatinized.

9. A shoe stiffener blank comprising a fibrous base charged with granular stiffening material in substantially unburst condition, the granules of such material being capable of being swollen and burst under the action of moist heat to render said blank limp and readily moldable to the shape of a shoe last and said blank being capable of setting and stiffening in lasted conformity with a shoe upper promptly after its granules of such material have been swollen and burst.

10. A shoe stiffener blank comprising a fibrous foundation containing as an impregnant therethroughout starch granules in a substantially unburst condition but capable of being burst and gelatinized in situ in the blank upon exposure of the blank to a steam atmosphere, the freshly burst and gelatinized granules imparting to the blank limpness and easy moldability to the shape of a shoe last and the blank being capable of setting and stiffening in lasted conformity with a shoe upper promptly after its starch granules have been burst and gelatinized.

11. In the art of stiffening shoe uppers in the course of shoemaking, those steps which comprise preparing a fibrous stiffener blank impregnated with a charge of amylaceous substance capable of being activated to a gelatinous state under the influence of moist heat, exposing the stiffener blank to moist heat to convert said amylaceous substance to a gelatinous state, assembling the blank containing the freshly gelatinized amylaceous substance with a shoe upper, and putting the assembly promptly through the lasting operations and permitting said gelatinized amylaceous substance to set and stiffen said blank in lasted conformity with said upper.

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