Feb. 28, 1939. M. O. SCHUR ET AL 2,148,999

INSOLE

Filed Sept. 19, 1936

Fig. 1.

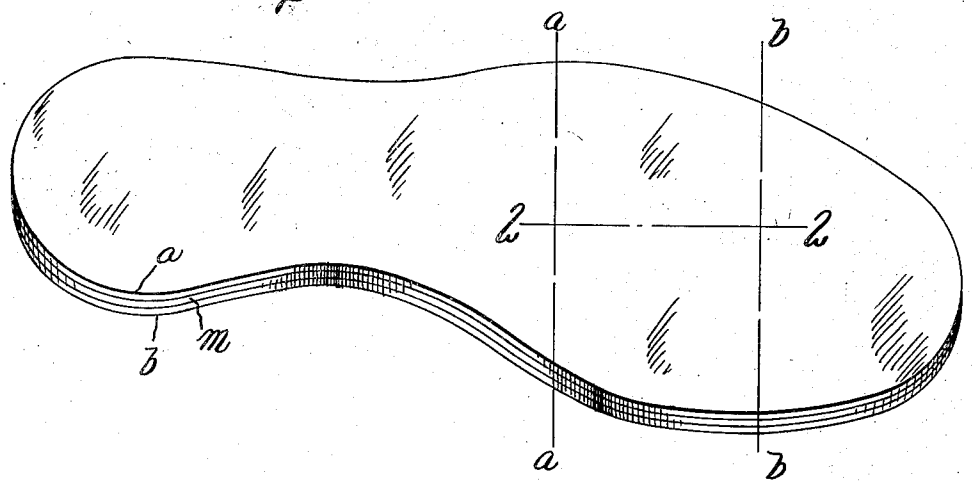


Fig. 2.

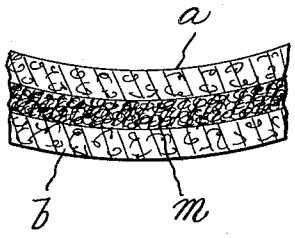


Fig. 3.

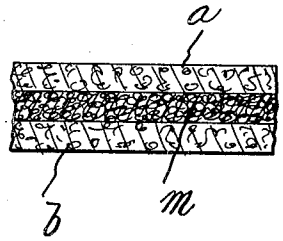
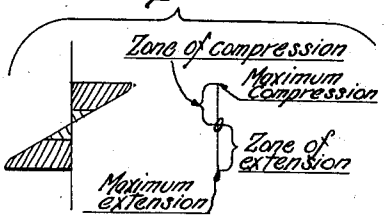


Fig. 4.



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UNITED STATES PATENT OFFICE

2,148,999

INSOLE

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Application September 19, 1936, Serial No. 101,626

5 Claims. (Cl. 154—46)

This invention relates to an insole more particularly of a plied or laminated structure that is useful to advantage instead of leather in various types of shoes and that may be cut without fraying (i. e. with clean-cut edges) from insole stock capable of being fabricated at low cost in the form of large sheets or sheets of indefinite length.

The insole hereof in its preferred embodiment comprises three bonded-together plies, namely, a middle or interior ply of relatively low stretchability or compressibility and outer plies of relatively high stretchability and compressibility, all of which plies have an interfelted fiber base and thus lend themselves to cutting or dieing-out operations with the development of clean-cut edges. Such an insole structure affords high resistance to buckling when it is subjected, as in the shoemaking process or during wear, to compressive forces either composite or component acting perpendicularly to its edges or the planes of its edges and at the same time flexes comparatively easily under the foot during wear with little, if any, "piping" in its outer ply in normally compressed condition and with little, if any, rupture or flaking of its outer ply in normally extended or stretched condition. The middle or interior ply of the insole hereof, which, being comparatively stiff, requires considerable work or energy to become greatly distorted, serves as a barrier to resist deformation such as tends to take place in thinly outersoled shoes, for instance, light weight ladies' shoes, when the wearer is walking on pebbly ground or other irregularities tending to bite or project into the outersole and thus to deform also the insole. In such latter case, the plied insole structure hereof resists in large measure the penetration or projection of the pebbles or other irregularities into the insole and the wearer's foot hence suffers minimum discomfort.

The foregoing desiderata are realized in the insole hereof for the reasons that the ply which is stretched and/or compressed the least during the normal flexing of the insole, namely, the middle or interior ply, is of relatively great stiffness, whereas, on the other hand, the outer plies are more easily stretched and compressed and are possessed of the desired qualities of compressibility and stretchability through the inclusion in their interfelted fiber structure of suitable elastic or semi-elastic binders, which additionally impart thereto such other desirable qualities as scuff resistance (both wet and dry), internal ply strength (particularly necessary where cement-lasting or cemented shoes are involved), leathery handle and appearance, water-repellency, resiliency, etc. The middle or interior relatively stiff ply may be fabricated substantially without any binder therein and thus be quite inexpensive, for instance, fall into the category of such inexpensive interfelted fibrous materials as pulpboard, fiberboard, leatherboard, etc., all of which will, for purpose of convenience, be designated in the appended claims by the term "fiberboard." In such latter instance, the middle ply may be absorptive of moisture or perspiration; and, being sheathed or protected by the outer water-repellent plies, it does not tend to disintegrate or "pulp up" when the insole is exposed to moisture or perspiration. In some instances, the stiff middle ply may be enhanced in stiffness by impregnation with a relatively non-elastic binder or stiffening agent, such as casein, sodium silicate, starch, etc.

Our experience with insoles made of leather substitutes and more especially binder-impregnated interfelted fiber bases had led us to the conclusion that the ideal insole for many types of shoes is one which combines a maximum of flexibility under the foot during normal use with a maximum of edge stiffness or resistance to buckling under edge compression. When it is attempted to balance the composition of the binder with that of the interfelted fiber base so as to produce more or less homogeneous insole stock wherein both flexibility and resistance to buckling under edge compression are present simultaneously, a compromise is inevitable. The insole of the present invention, on the other hand, couples a high degree of edge stiffness or resistance to buckling under edge compression with a high degree of flexibility in normal use and additionally has a resistance to deformation when pressed against a pebbly or similar surface, which appreciates its value especially in thinly outersoled shoes. In the insole structure hereof, it is unnecessary to compromise as has heretofore been done, for, by using therein a middle ply deformable with difficulty, we realize the desired edge stiffness or resistance to buckling and deformation and we do not interfere seriously with the overall flexibility of the insole, since its outer plies, which are stretched and/or compressed the most during use of the insole, are of relatively pliant material that readily responds or yields to the stretching and compressing forces at play during normal use of the insole.

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 illustrates in perspective an insole embodying our invention with its ball zone substantially defined by the lines *a*—*a* and *b*—*b*.

Figure 2 is a longitudinal section through the ball zone in flexed condition along the line 2—2 of Figure 1.

Figure 3, which is a similar section through the ball zone in unflexed condition, is given for the purpose of facilitating and understanding of Figure 4.

Figure 4 illustrates diagrammatically what takes place at various points of depth or thickness of the insole stock when it is flexed to the downwardly concave form shown in Figure 2.

The insole hereof illustrated in Figure 1, which may have a total thickness of, say, about three to four iron, is made up of three superposed, bonded-together plies of substantially equal thickness, namely, the outer plies *a* and *b* and the middle or interior ply *m*. While the outer plies *a* and *b* may comprise various kinds of interfelted fiber bases impregnated with elastic or semi-elastic binders, they may readily be made to possess the desired high degree of pliancy, compressibility, and stretchability, by being formed as water-laid felt of relatively low compactness impregnated with the elastic binder solids deposited from rubber latex. Thus, the interfelted fiber base may be formed at relatively low compactness on a papermaking machine from fiber furnishes containing or consisting essentially of refined wood pulp in substantially unbeaten or only lightly beaten condition, for instance, refined wood pulp of an alpha cellulose content upwards of about 93% and characterized by its softness and bulkiness as compared to the usual commercial wood pulps, such as sulphite and kraft. The dry waterlaid felt may, by way of illustration, be impregnated with a rubber latex composition to a latex solids content of, say, about 20%, based on the dry weight of fiber, and the impregnated sheet then dried. Other elastic or semi-elastic binders may also serve as impregnants for the felt, including rubber-containing solutions, such as a rubber-in-benzol solution, so-called rubber substitutes, glue-glycerine mixtures or other properly plasticized glue compositions, various artificial resin compositions, etc. In some instances, the elastic or semi-elastic binder composition may be incorporated into the bulk fibrous stock from which the felt is made, for instance, be admixed with and precipitated onto the fibers, so as to do away with the need for after-impregnation of the felt with the binder composition. When a glue composition or solution serves as the binder, it preferably contains a suitable tanning or insolubilizing agent for the glue, such as formaldehyde or chrome alum; or the glue-impregnated felt may be exposed to the action of a suitable tanning or insolubilizing agent, for instance, to an atmosphere of formaldehyde fumes.

The middle or interior ply *m* may be ordinary pulpboard, such as is composed of kraft, sulphite, or like wood pulps or mixtures of such pulps; or leatherboard, that is, a board formed from a furnish containing pulped leather scrap in admixture, if desired, with one or more cellulosic or other fibers; or a board formed on a wet machine and containing, if desired, more or less sizing material. Any one of the boards for the middle or interior ply is thus composed of a fiber furnish that makes for the stiffness required therein; and it also undergoes sufficient pressure or compaction during its fabrication to acquire such stiffness. In those instances when especially high edge stiffness or resistance to buckling under edge-compression is desired in the insole hereof, the pulpboard for the middle ply may be formed from well beaten or gelatinized cellulose pulp.

The binder-impregnated webs or felts for the outer plies and the board for the middle ply may be progressively bonded as continuous sheets or sheets of indefinite length by suitably applying rubber latex or other adhesive to the contacting faces of the plies and pressing the superposed plies together as by passage through a pair of rolls. Insoles may then be cut or died out from the resulting plied insole stock.

Because the middle ply or layer of the insole hereof is relatively stiff pulpboard or its equivalent of relatively dense interfelted fiber structure or high compactness and the outer plies or layers contain interfelted fiber bases of comparatively bulky or less compact structure, such insole in its preferred embodiment may be properly described as comprising interfelted fiber plies of markedly different fiber density and more specifically as having surface portions of markedly lower fiber density than its interior; and it may be further described as comprising surface portions more easily stretched and/or compressed than its interior or middle portion. Heretofore, it has sometimes been the practice to make insoles entirely of such material as we use only as the outer plies of the insole hereof or to make insoles entirely of such material as we use only as the interior ply or layer of the insole hereof. Typical of prior art insoles of the former kind is one that consists of a rubber-impregnated interfelted fiber base and that has been sold for some years under the trade-mark "Onco"; and typical of prior art insoles of the latter kind are those that are known as fiberboard or Swedish board. An "Onco" type of insole is generally of much lower fiber density than insoles composed of boards such as fiberboard or Swedish board. The following is a table showing the total basis weight (weight in pounds of 480 square yards) of fiber only in the finished sheet of an "Onco" type of insole material and in typical finished insole material of the present invention at different thicknesses or irons.

Iron	Basis weight of "Onco" type of insole material	Basis weight of typical insole material of present invention
2½	290	450
3	372	520
3½	420	540
4	435	610

It will be observed that there is a much greater amount or density of fiber per unit of volume in the finished insole material of the present invention than in the "Onco" type of insole material.

From the shoemaker's standpoint, such boards as fiberboard and Swedish board, which are comparatively very rich or dense in fiber, afford excellent insoles by reason of their stiffness or resistance to buckling and their tack-holding ability, but insoles composed of such material are lacking in those qualities requisite from the standpoint of the shoe-wearer. Thus, Swedish board insole contains little or no binder and is without the water-resistance, scuff-resistance, pleasing feel, and attractive appearance desired by the shoe-wearer; and it exhibits marked "paper break" or piping when bent or flexed. Despite their comparatively poor wear qualities, they do possess an absorbency and resiliency or cushioning effect making for comfort to the shoe-wearer. Again, fiberboard insoles, while responding nicely to shoemaking operations by reason of their comparatively very high fiber density, stiffness, tack-holding ability, and resistance to scuffing and moisture, consequent upon the thorough beating and sizing that its fibers have un-

dergone preparatory to the board-forming operation, are definitely deficient in the flexibility, absorbency, resiliency or cushioning effect, and other qualities conducive to satisfactory wear or comfort to the shoe-wearer. The insole hereof, on the other hand, affords conjunctively those various qualities desirable from the standpoints of both the shoemaker and the shoe-wearer in that its structure combines in the form of a core or interior layer the desirable qualities of fibrous material, such as fiberboard or Swedish board, of relatively high density but of comparatively little or no binder content with the desirable qualities of fibrous material of relatively low fiber density but of comparatively high binder content, preferably elastic or semi-elastic binder content, such as "Onco" insole stock, in the form of outer plies or layers.

As will be seen from the diagram of Figure 4, which depicts qualitatively what happens when, as occurs during the use of an insole, the ball zone of the insole is flexed to downwardly concave form, the inner surface of the insole or side lying next to the foot undergoes maximum compression and the compressed condition of the insole body progressively decreases downwardly to the central horizontal plane of the insole, whereat the compression is nil; and, conversely, the outer surface of the insole or side lying next to the outsole undergoes maximum extension or stretch and the extended condition of the insole body progressively decreases upwardly from such surface to the central horizontal plane of the insole, whereat the extension is nil. It is thus clear that it is the outer plies of the insole hereof that should readily respond to compressing and/or extending forces and have the properties so to do, as is the case; and the middle or interior ply, which need yield comparatively little by reason of the comparatively small compressing and/or extending forces acting thereupon, may, as is the case, advantageously be formed as a comparatively stiff, non-distortable medium imparting to the insole hereof the desired edge stiffness or resistance to buckling under edge compression and serving as a deformation-resistant barrier when a pebbly or similar surface is pressed against the insole.

The insole stock hereof may, if desired, be fabricated to possess essentially the three-ply structure desired herein by methods other than those already described. Thus, a cylinder or multi-cylinder machine might be used in building up the desired plied structure. In the case of a wet or cylinder machine, the method may be based on changing the nature of the binder as the wet web of interfelted fibers is being convoluted on the makeup roll of the machine, for instance, involve building up the desired initial outer ply layer and while so doing spraying it with elastic binder in desired amount, building up an inner or intermediate ply thickness while spraying it, if desired, with a stiffening binder, such as sodium silicate solution, casein solution, starch solution, etc. in desired amount, and building up the other outer ply layer while spraying it with elastic binder in desired amount. When the composite tubular layer is then slit axially and removed as a sheet from the makeup roll, dried, and, if desired, rolled out, one arrives at essentially a three-ply insole stock whose component plies impart to the composite stock the qualities requisite for the insoles of the present invention. In the case of a multi-cylinder machine, the webs coming from the various cylinders and intended to constitute the middle and outer plies of insole stock hereof may be impregnated preparatory to plying with the amount and kind of binder necessary for the purpose hereof; or the appropriate binder may be added to the bulk stock from which the plies are formed.

The principles of the present invention may be embodied in two-ply insoles comprising a relatively pliant, compressible, and stretchable ply on the foot side (i. e. next to the foot) and a relatively stiff pulpboard or similar ply of, say, substantially the same thickness, next to the outsole, each of the plies being of a composition such as hereinbefore described and the two plies being united or bonded together to form an insole body of a total thickness of, say, about three to four irons. In such case, one does not, however, realize the full benefits possible of attainment by the present invention, since the outer face of the insole (i. e. the face lying next to the outsole) does not possess the qualities best adapted to meet the requirements of service even though the inner face or foot side of the insole does have such qualities.

We claim:

1. A plied insole comprising three plies of interfelted fiber structure in facially bonded relationship, the internal ply being relatively stiff fiberboard and the outer plies being impregnated with elastic binder and being more pliant and more easily extended and compressed than the relatively stiff internal ply which imparts to the insole resistance to buckling under edge-compression.

2. A plied insole comprising three plies of interfelted fiber structure in facially bonded relationship, the internal ply being relatively stiff fiberboard impregnated with a relatively inelastic stiffening agent and the outer plies being impregnated with elastic binder and being more pliant and more easily extended and compressed than the relatively stiff internal ply which imparts to the insole resistance to buckling under edge-compression.

3. A plied insole comprising three plies of interfelted fiber structure in facially bonded relationship, the internal ply being relatively stiff fiberboard and the outer plies being impregnated with rubber and being more pliant and more easily extended and compressed than the relatively stiff internal ply which imparts to the insole resistance to buckling under edge-compression.

4. A plied insole comprising three plies of interfelted fiber structure in facially bonded relationship, the internal ply being relatively stiff fiberboard composed essentially of thoroughly beaten cellulose pulp and a relatively inelastic stiffening and sizing agent and the outer plies being impregnated with rubber and being more pliant and more easily extended and compressed than the relatively stiff internal ply which imparts to the insole resistance to buckling under edge-compression.

5. A plied insole comprising plies of interfelted fiber structure in facially bonded relationship, the ply of said insole on its foot side being impregnated with elastic binder and being more pliant and more easily extended and compressed than the adjacent ply, which latter ply is stiff fiberboard serving to impart to said insole resistance to buckling under edge-compression.

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