April 20, 1937. G. FERGUSON 2,078,131

SHOE CONSTRUCTION

Filed March 27, 1933

Fig. 1.

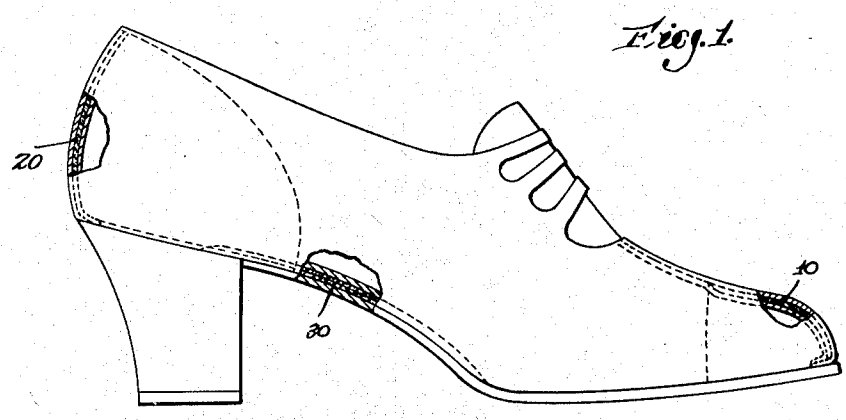
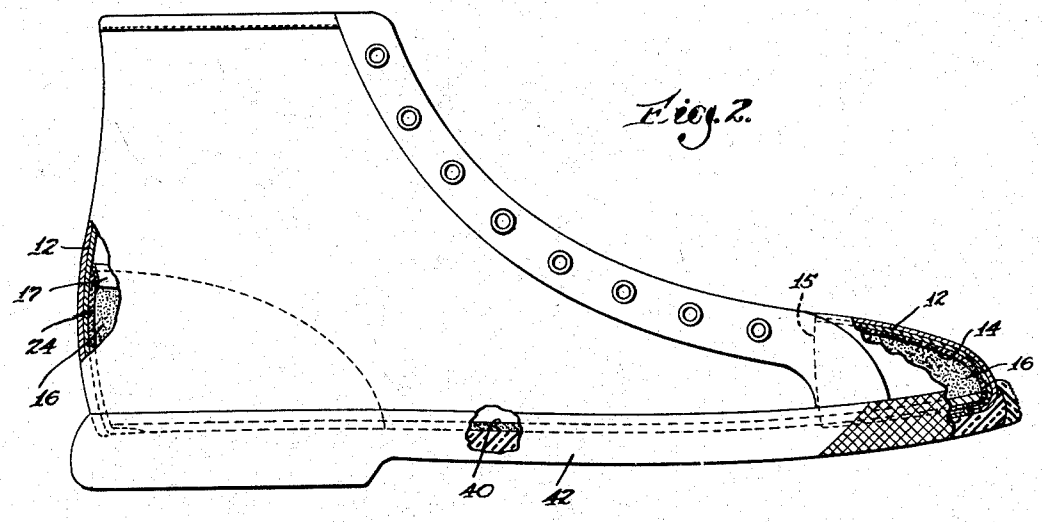


Fig. 2.



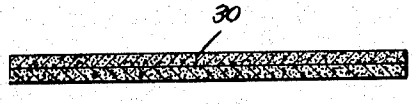


Fig. 3.

Inventor
George Ferguson
by Everett L. Kent
Attorney

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SHOE CONSTRUCTION

George Ferguson, Wollaston, Mass.; Harold F. Tracy and G. Barnum Redding administrators of said George Ferguson, deceased

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6 Claims. (Cl. 154—2)

This invention relates to improvements in shoe construction, including especially stiffeners and innersoles.

In the manufacture of shoes from flexible material, as leather and cloth, it has long been customary to introduce other elements to afford stiffness for special parts of the shoe. In typical instances the shank piece is rigid, of wood; the counter, less rigid, is of stiff fiberboard, preformed, to heel shape; and the toe box, still less rigid, is of felt, stiffened by a thermoplastic wax composition. Various other materials have been tried in each case; and, for the toe box, efforts have been made to use wood pulp because of its inexpensive character; but I am not aware of any of these wood pulp experiments having been sufficiently satisfactory to be adopted by the industry, although shoe men everywhere are alert to reduce costs, if it can be known how to do that and yet produce shoes of the quality desired. Moreover, wood pulp saturated with latex, has also been proposed for the innersole, where flexibility is the essential quality, and where stiffness degrades the shoe.

The present invention provides a wood pulp combination product which my experiments have shown to be successful for all four of the above named parts of a shoe. As compared with other proposals, it is lower in cost and yet has been found to give satisfactory results for the widely differing degrees of stiffness and of resilience which are desired for these different parts of the shoe. It has the further advantage that it renders it commercially practicable to introduce stiffeners into certain low priced shoes, at toe and counter, these shoes being made of rubber-treated cloth, and in the trade known as rubber shoes, into which it has hitherto been considered not practicable to introduce such stiffening elements; and it has other advantages in the practical working and handling of the material during the manufacture of the shoe.

The invention comprises the combining of a suitable sheet of wood pulp with a suitable solution of an artificial resin of particular description. Preferably, when used for toe box or for counter, there is also an admixture of small proportion of rubber; and a larger proportion when used for innersole.

These materials, the resin and rubber, penetrate a sheet of pulp to an adequate extent, when the pulp is immersed in liquid containing these materials, so that, upon solidification, as by evaporation of their solvent, the combined sheet of pulp, resin, and rubber, if any, thereafter possesses the requisite degree of stiffness, resilience, and toughness. When soft from an initial dipping or a subsequent dipping, the sheet of pulp and impregnated resin can be molded easily into toe box shape, or into the counter shape, or the shank shape, so as to solidify in the particular shape and tend permanently to hold this molded shape, or to return to it if flexed therefrom.

The kind of wood pulp which I have found most satisfactory is the white sulfite product of poplar wood of good quality, free from knots and impurities, but I have also used sulfate pulp, and other wood pulp can be used, including mechanical pulp. The pulp is to be taken in sheet form, of thickness selected, or even in a plurality of laminae, according to the purpose intended, whether for toe box, counter, shank, or innersole.

The artificial resin to be added to this pulp may be any of the firm resin-like products of the polymerization of unsymmetrically substituted ethylene, chosing one that will soften sufficiently either with moderate heat or by use of a solvent. The general class of stiffeners thus indicated includes polymerized styrol (phenyl ethylene) and polymerized vinyl derivatives and esters (ethylene monochloride or vinyl chloride, vinyl bromide, vinyl acetate, vinyl chloracetate, and the like). Other and similar compounds containing the vinyl group, $CH_2{:}CH$ are found to be usable when polymerized to such a degree that they are hard at ordinary temperatures. Some of the above are not soluble, so far as I know, and for this reason I mention that the product selected for this use must be one that is soluble, in some one or other acceptable solvent, or else must be reducible by heat to a state of fluidity or of high plasticity, so that it can penetrate the sheet of pulp. The material of this class which I particularly prefer at present is a polymerized styrol (phenyl ethylene) when polymerized to such a degree as to be hard at ordinary temperatures. This is obtainable in the market at present under the trade name of Resoglaz, and other products of the class described are obtainable under other trade names among which are Vinylite, which is a vinyl resin, available either in solution form or solid, and, if solid, either in sheet or powder form. These may be applied with varying assisting solvent agents, according to what particular resin is being used, and according to what in particular, of the ordinary solvents is a solvent for this resin and is deemed satisfactory for use. The particular such resin which I at present prefer being the polymerised

styrol, I find it will to apply it by solution in carbon tetrachloride, which is non-inflammable, or to use it with a solvent having a sufficient mixture of carbon tetrachloride to make the mixture non-inflammable. To make a treatment of wood pulp having a degree of stiffness and resilience suitable for a toe box, I can use a mixture of about four parts of this to one part of thick solution of rubber in naphtha. If this is to be used in such a way that it will be exposed to abrasion when in use, I have found that abrasion is prevented by brushing over the hardened product a thin coat of one of the polymerized vinyl derivatives obtainable under the name Vinylite commercially.

The described artificial resins differ discernibly in the qualities which they impart to the sheet of wood pulp, as regards degrees of stiffness, of yielding under pressure, of brittleness, and of resilience. In my observation Vinylite alone gives a quality of strong resistance to bending, without being disposed to break on bending; styrol alone gives a more brittle stiffness; the admixture of rubber with styrol gives a product which is capable, after resisting pressure to a desirable extent, of yielding when the pressure is sufficient to bend it, and flying back elastically. The admixture of styrol with Vinylite gives similar qualities, but less yieldable.

The accompanying drawing represents embodiments of the invention:

Figure 1 shows the invention embodied in a leather shoe in side elevation with fragments cut away to medial longitudinal section, to show toe box, counter and shank;

Figure 2 shows similarly a rubber shoe, so called, having also an innersole of the material of the invention; and

Figure 3 is a longitudinal section through a stiffening shank for a shoe.

In Figure 1, a toe box made according to the invention is presented in position at 10 between the leather exterior and the lining of the shoe, assuming it to have been set and shaped there in any usual or suitable way. A counter 20, embodying the invention is likewise shown in position and may be considered to represent either a pre-molded counter as is customary with fibre and other counters, or may represent one that was set in place without pre-molding and took its shape, as explained herein, during the lasting of this part of the shoe. There is also shown a shank set between the insole and the outsole of the shoe, represented as two-ply, although it will be understood that this may have more plies, or may be single ply and of rather thick pulp stock treated in accordance with the invention. The same is seen in Figure 3.

In Figure 2, the so-called rubber shoe has its upper made of the customary two thicknesses of canvas with rubber between them, and has the rubber outsole. This cloth is marked 12, and the toe box 14 is seen appearing within it and is not covered by any lining as is usual, but is covered with the dried residue of a solution of Vinylite applied as herein described, for making the surface tough, indicated by the stippling. Of course this may be covered with a lining if desired, or the edge 15 of it may be covered with a little strip like that shown at 17 as covering the edge of the counter 24, which is similarly made with a stiffer composition impregnated and which is represented by the stippling 16 as having the same kind of applied Vinylite surface as the toe box. This is shown in this way in order to indicate the possibility; although it is believed that in practice it may be found about as economical to cover the whole of the counter in a pocket or piece of lining as is usually done in shoes of this kind. This counter may be set in a pocket or may be adhering to the two-ply cloth of the upper without a covering.

In this shoe the outersole is marked 42, and the innersole 40 is of pulp impregnated in accordance with the invention and adhering strongly to the outersole; and no shank is here shown.

For the making of a counter of a leather shoe one may die-stamp from a large sheet, of selected thickness of wood pulp, a suitable plane shape for a counter, and dip this small stamped sheet of wood pulp into a liquid containing the desired artificial resin, mold it into shape in the lasting of the shoe, and let it dry. The liquid may be the above stated combination solution of polymerized styrol and rubber, but a stiffer counter is obtained by replacing the rubber with Vinylite; and I have found a good proportion to be one part polymerized styrol to two parts of Vinylite. The solvent readily penetrates the sheet of wood pulp; and although at first it appeared to me that the resin goes in with it and becomes distributed throughout the body of the sheet, other observation indicates that the resin is left largely in the surface portion of the pulp. Whichever is its position or whether it is both, or may be either, appears unnecessary to be determined, for the product affords the desired resilient stiffness when dry. Shoe manufacture hitherto has provided a pocket in the upper, at the quarter, into which a stiff pre-molded fiberboard or leather counter is to be inserted. The preparation of such requires a very heavy machine, with some fifteen to nineteen different operations for the pre-molding of the counter; and the shoemaker still has risk that the stiff molded counter may not exactly fit the particular shoe, as to size or shape. By my improved method, the counter need not be shaped until the shoe is lasted; and at that time the shaping is accomplished simply and easily by the lasting, and is precise to the last. In the case of a leather shoe, the pocket for counter may be used as before; the soft counter is simply set therein and lasted before it stiffens.

The plane counter can conveniently be kept wet, immersed, while waiting as long as may serve the convenience of the shoe factory, and thus be put into the shoe in its initial state of wetness, so eliminating the operations both of pre-molding and re-softening by heat or by solution. The heel plate wipers of the lasting machine wipe the under part of the counter over the bottom of the last, where it may be tacked for hardening and for permanent holding in position. Instead of by solution, the counter might be softened by heat, with methods already known in connection with thermo-plastic stiffeners for toe boxes. The pulp and resin materials are less expensive than leather, and than fiberboard. The reduction of weight of the shoe is an improvement which manufacturers seek. Structurally they may be expected to save at least a half a size on the heel of the shoe. And they provide a better heel seat for the customary wood heel of the shoe.

The desired thickness of counter varies with different shoes; and I have found it practicable to get a double thickness of wood pulp sheet for the counter by sticking together two sheets of the artificial resin and pulp with ordinary rubber cement. The two adhere strongly; and there is a stiffness greater than what would be propor-

tionate to pulp-thickness, because of the resin being on four surfaces of the pulp, instead of on two, as it is when the pulp is single thick, even though that single thickness be of double dimension.

As these resins are in themselves adhesive, if put together when in liquid form and wet, the above mentioned adhesive layer of rubber cement can be omitted when making up a double thickness for the counter.

If, however, it be preferred to have the counter pre-molded this can be done.

The invention also provides an improvement in another respect, as compared with prior structures, for the stiffening of the toe of a leather shoe. By the adhesive qualities of the artificial resin, an impregnated thin sheet of wood pulp, wet with the resin solution, can be laid against the leather of the toe and will stick there through the lasting operation and afterward, becoming permanent without being sewed in and if thin without the necessity of being skived, as customary with toe boxes. This reduces the number of manufacturing operations in a shoe, while producing for the toe a desirable resilient stiffness.

The invention also provides an improvement of particular importance as applied to what are called "rubber shoes", being shoes in which the upper is made of two layers of cloth, adhering together with a rubber treatment between the two. Such shoes are of very low cost, and sell at low prices; and it has not been customary to apply a toe box to them, and often not a counter, so far as I have seen; but the present invention makes such possible. The described impregnated and wet sheet of pulp can, just before the lasting operation, be stuck on the thin inner canvas of the upper, for toe box and for counter. If the impregnating be with the described composition of styrol and rubber it may thus make a suitably stiff and resilient toe box, but the brittleness of the styrol when hardened may make its surface liable to abrasion, when rubbed repeatedly by the foot of the wearer. This objection is eliminated by applying over it a thin coating of a solution of Vinylite. If found desirable to cover its edge, for the comfort of the wearer, a little strip of canvas may be sewed across the interior of the shoe at the place where the toe cap usually is sewed, for pocketing and covering the edge of the inserted pulp stiffener.

Although above described for parts of a shoe whose materials require to be stiffened, the invention also supplies an improvement as to the innersoles of the said "rubber shoes", notwithstanding that for an innersole stiffness is in general objectionable. For use as an innersole, a sheet of wood pulp, of suitable thickness, has the composition impregnating it made with a proportion of the artificial resin and of the rubber which is suitable to give the desired combination of toughness and easy flexibility of the innersole. This makes a workable innersole, notwithstanding the relative weakness of a sheet of wood pulp, as compared with leather and other materials in common use, because in the described type of shoe the innersole and outersole are cemented together, and both are cemented to the edges of the upper. The strength of these intimately adhering other parts reenforces the pulp, to which the impregnated resin has already supplied a measure of toughness and of hardness of surface, while the interior of the pulp sheet supplies a measure of cushioning effect.

The invention is also applicable with advantage for the making of the stiffening shank for a leather shoe, to replace the shaped and trimmed wood pieces now commonly used. For this purpose a sheet of wood pulp, single thick, or preferably made of a plurality of plies of thinner sheets, can afford a piece having desired shape and sufficient strength to stiffen the shank of the shoe. If multi-ply, each ply will have been stamped to suitable shape, and all pressed together when wet from separate impregnations with the resinous material. Desires may differ regarding the degree of flexibility desired, and the invention, unlike the customary wood, affords opportunity to have the shank stiff or flexible. By using only those ingredients which are stiffer, when dry, as polymerized styrol, mixed with a proportion of Vinylite, if desired, a high degree of stiffness may be had which will retain its strength without breaking under ordinary usage, as does wood; while if the shank be desired to possess more flexibility, a proportion of rubber in the impregnating solution permits of this, while still providing for a resilient return to the normal after being bent,—a quality not possible with a shank made of wood.

Thus it will be seen that important features of the invention consist in the combination with a layer or layers of very inexpensive types of material, such as wood pulp, of resinous materials having the quality both of stiffness and of elasticity, and which unlike ordinary resins are derived by polymerization of substances, which in their natural state do not have such qualities at all, as a rule, or even may be gases, but which in their polymerized state have the property of combining efficiently with wood pulp and with a further intermixture of rubber in liquid form, both rubber and resin being usually in solution which can penetrate the sheet of pulp.

The proportions in which the above described ingredients are to be mixed depend upon which of the particular uses are to be served and depend also upon the degree of hardness or stiffness desired, which will be different with different manufacturers. I have had satisfactory results in using, for toe box or counter, needing resilient flexibility, a mixture of the described resins four parts and rubber one part; for the innersole, where less resistance to bending is wanted, resin one part and rubber three parts; for the shank, where considerable resistance to bending is wanted, resin alone. However, as showing possible variations with successful results, the inner sole may be half resin and half rubber; and the resin components thereof may be half Vinylite and half styrol of the above described nature. The rubber thus referred to is in a thick liquid being in solution in a hydrocarbon solvent. In the usual process of making "rubber shoes" the whole shoe is submitted to heat which may be as high as 250° F. or more for a substantial period, for the vulcanizing of the rubber therein and for the securing of their various parts together in permanent fashion. This considerably exceeds the softening temperature of the resins described, or may do so, which, indeed, may be only slightly above blood temperature of the wearer's foot, i. e. above 100° F.; nevertheless these resins do not become injured or displaced by going through the long period of vulcanizing temperature to which the shoes are subjected at the higher temperature.

It is to be observed however that the temperature at which the Vinylite or other polymerized substance decomposes should be ascertained, and no temperature should be applied to the particu-

lar variety in hand which would be high enough to decompose the substance as this would in such cases release a halide or other corrosive or injurious product of decomposition. If the critical temperature is not known it can easily be learned by experiment.

When a sheet of pulp freshly soaked in the resinous solution is to be set next to kid stock, as in the toe of a shoe, it is advisable to apply latex to the flesh side of the kid first, to prevent the solution from breaking through to the finished side of the leather tip of the shoe. A tip thus applied can produce a desirable degree of reinforcement or stiffening with quite a thin sheet of the impregnated pulp.

And while I have described the wood pulp as being the preferred variety, owing to the low cost and abundant supply, and easy manipulation of such in manufacture, it is obvious that there may be other pulp stocks which may be its equivalent structurally and in technical effect.

It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty exist in the invention.

I claim as my invention:

1. A process, useful in the manufacturing of shoes and in like arts, for the reinforcing of sheet material, comprising the making of a solution, in an organic solvent, of a polymerized resin-like product which is in the class which includes polymerized styrol (phenyl ethylene) and polymerized vinyl derivatives and esters (ethylene monochloride or vinyl chloride, vinyl bromide, vinyl acetate, vinyl chloracetate, and the like), which product is hard when dry at ordinary temperature; the applying of this solution to the surface of a sheet of wood pulp, with impregnating effect; the laying of the impregnated sheet over the sheet of material which is to be reinforced, with an organic solvent between and to an extent penetrating both sheets, for making adhesive contact between them; moulding the two sheets together, under pressure, and eliminating the solvent.

2. A process as in claim 1 in which the solution also contains rubber, the rubber being within the range of approximately one-fifth to three-fourths of the mixture of resin and rubber solutions.

3. A process as in claim 1, in which polymerized styrol is present in the said resin-like product.

4. Sheet material, useful in shoes and the like, wherein a sheet of wood pulp is combined with a resiliently firm resin-like mixture of solid products resulting from polymerization of styrol and resulting from the polymerization of any from the class of vinyl esters comprising ethylene monochloride, vinyl chloride, vinyl bromide, vinyl acetate, vinyl chloracetate and the like which, being polymerized to a state characterized by hardness at ordinary temperatures, when not in solution, is further characterized by being capable of being rendered fluid by one of the conventional dissolving or heating methods; the said mixture being one of which an optimum form is about one part of polymerized styrol to two parts of the vinyl ester.

5. Sheet material, as in claim 4, in which the concentration of the resinous material is relatively greater in that portion of the pulp which is near and at the surface of the sheet of pulp, constituting that portion of the sheet relatively hard and tough, and is relatively less in the mid-portion of thickness of the sheet, constituting there a relatively greater cushioning effect; and the sheet of combined pulp and resinous product is adhesively attached to the overlying material of the shoe.

6. Sheet material, as in claim 4, in which the sheet of wood pulp is also combined with rubber; said sheet having a plurality of plies of wood pulp each of which plies has a greater concentration thereof at its mid-thickness, the surface bodies of the resin in adjacent plies being adhesively attached together to constitute the complete sheet.

GEORGE FERGUSON.