Aug. 24, 1948. E. L. BECKWITH ET AL 2,447,681

PROCESS OF STIFFENING SHOE PARTS

Filed July 18, 1944 2 Sheets-Sheet 1

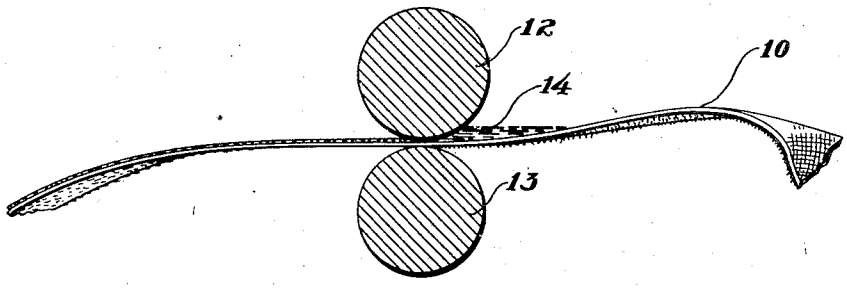


Fig. 1



Fig. 2

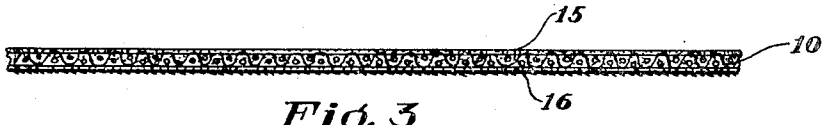


Fig. 3

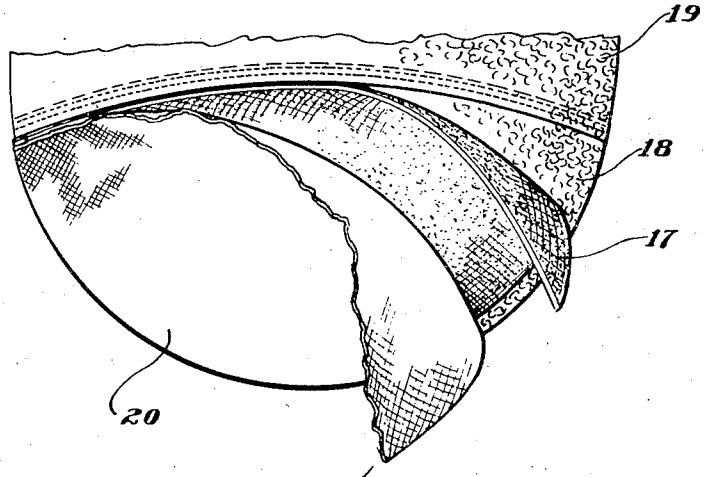


Fig. 4

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PROCESS OF STIFFENING SHOE PARTS

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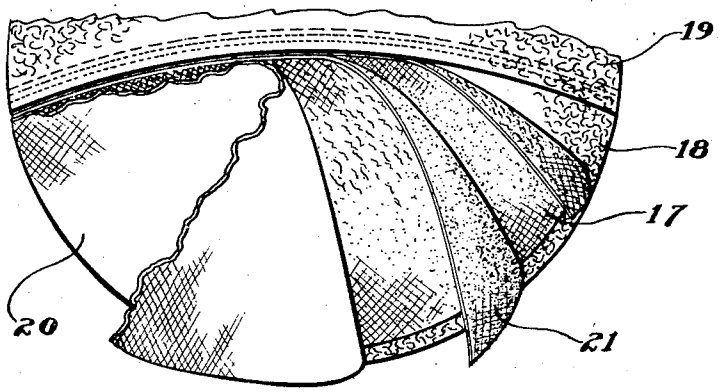


Fig. 5

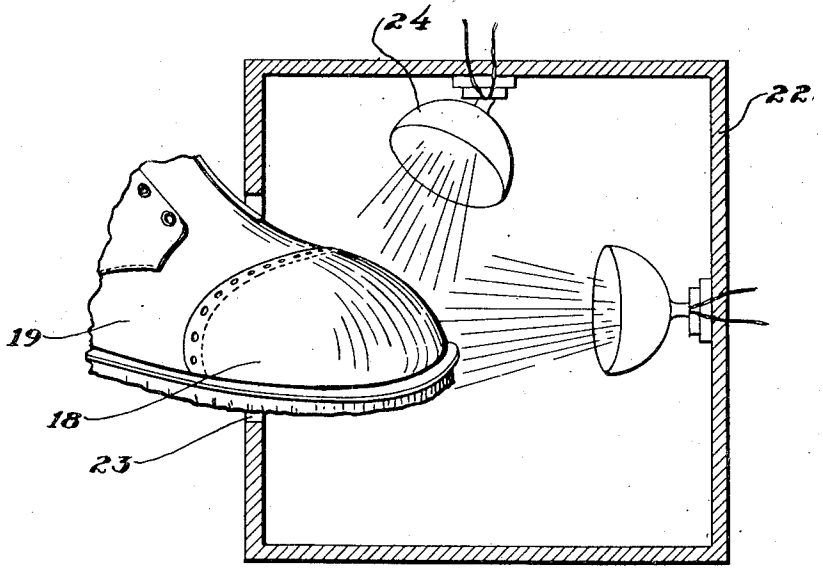


Fig. 6

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PROCESS OF STIFFENING SHOE PARTS

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8 Claims. (Cl. 12—146)

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The present invention consists in an improved process of stiffening parts of shoes and includes within its scope a novel shoe stiffener and the stiffened shoe structure produced by carrying out the said process.

Standard shoemaking practice for many years has required the employment of blanks of prepared sheet material adaptable to be temporarily softened either by heat or solvent in the shoemaking process, lasted with the shoe upper in temporarily softened condition, and then stiffened on the last by cooling or drying. While satisfactory results have been secured in this manner, the operations of temporarily softening a box toe or counter blank, of handling it while soft and of lasting the shoe while the blank is in the proper pliable condition, have always required expert supervision, elaborate equipment, and have introduced a critical time element with which the operator must accurately reckon.

An object of the present invention is to provide a stiffening fabric which may be introduced into the shoe as flexible sheet material in dry tack-free condition; in fact, a fabric which may be handled in the shoemaking operations as conveniently as ordinary shoe lining cloth and which may then, in the completely lasted shoe and while the last serves as a mold, be converted into a stiff, resilient, adherent shell. We have discovered that these highly desirable results may be achieved by properly treating a fabric with a thermosetting resin such, for example, as phenol formaldehyde resin in liquid form, so as to produce a coated and impregnated fabric which is thin and flexible and may be incorporated in the upper of a shoe and handled as conveniently as a ply of lining cloth. It may remain in the lasted shoe in this condition for any desired period of time and then, whenever convenient, may be converted into a stiff, resilient, adherent shell by being subjected in the upper to a curing or setting temperature. This temperature is well below that at which any damage to the leather of the shoe is likely to occur. By the process of our invention, not only do we avoid the shoemaking complications and expense above discussed, but we provide an improved shoe structure in that the thickness of the upper materials may be substantially reduced while still securing adequate stiffness and resilience. The fine lines of the last are thus carried more accurately into the finished product and the bulk and thickness of upper material is substantially reduced in the overlasted margin of the upper and in the inseam, when the invention is applied to welt shoes.

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By our invention, moreover, we secure improved union between the lining and the stiffening ply, on the one hand, and the outer integument of the upper and the stiffening ply, on the other hand. It is of course very important in shoemaking to bond these plies together in order to safeguard against any possibility that the lining may drop down in the finished shoe. By the process of our invention we are able to secure a union of remarkable strength and permanence, all without any objectionable penetration of either the lining or outer integument by the stiffening resin. This desirable feature is brought about in accordance with an optional feature of our invention by employing a textile fabric which is napped on one surface and disposing this napped surface so that it will catch and hold the stiffening material internally in the shoe structure; for example, by locating the napped surface in a stiffener blank and on the side away from the lining, only sufficient material is allowed to reach the lining in liquefied form to bond it firmly to the stiffening ply without showing any objectionable discoloration inside the shoe.

Another outstanding and unexpected advantage of our invention is that the united plies of the upper, including its leather integument, are not only firmly and permanently bonded together, but they are shrunk to the contour of the last and hardened in shrunken condition so that the lasting effect of the shoe upper is noticeably improved. The shrinking effect is due partly to contracting action of the stiffening material in the thermosetting stage and partly to the heating of the leather on the last in the step of curing the resin or converting it to its stiffened condition.

In accordance with another feature of our invention we contemplate the employment of two or more stiffening plies where the manufacturer desires to provide a particularly stiff and strong box. The blanks in this case may be napped on one surface and located in the shoe with their napped surfaces in contiguous relation. The result is that a relatively thick film or layer of the liquefied stiffening material is retained between the two stiffening blanks and only sufficient material reaches the lining and the outer integument of the upper to effect the desired bond. Thus we avoid objectionable penetration of the lining which might cause it to stick to the last, as well as discoloration of the lining or the leather of the upper.

The step of setting the resin-treated blanks in the shoe may be effected by dry heat supplied in

any convenient manner and at a temperature below that at which any damage is done to leather. We have secured the most satisfactory results by subjecting the lasted shoe to the heat of infra-red rays and this may be done by merely exposing the toe portion of the shoe to sources of infra-red radiation. The result is first to liquefy or soften the stiffening material, making it available as a bonding medium, and then to cure or set it in its final stiffened condition in the shape determined by the last. This results in a box toe of two or more stiffened plies which is inherently stiff, strong and resilient from the bonded-ply effect that has been built into it. The stiffened plies comprise the resin-treated blank or blanks and the contiguous lining or doubler and the leather layers of the upper which are all bonded in the finished shape of the shoe and stiffened by the phenol material carried by or absorbed from the treated blanks.

These and other features of the invention will be best understood and appreciated from the following description of a preferred manner of putting it into effect as shown in the accompanying drawings, in which:

Fig. 1 illustrates diagrammatically the initial coating step,

Fig. 2 is a sectional view on a greatly enlarged scale indicating the distribution of the coating material as first applied to the textile base,

Fig. 3 is a similar view indicating the distribution of the coating material after the drying step,

Fig. 4 is a view in perspective looking upward and suggesting the incorporation of a stiffening blank in the toe portion of the shoe,

Fig. 5 is a similar view suggesting the employment of two plies of stiffening material, and

Fig. 6 is a view in section suggesting the final step of curing or setting the stiffening material in the box toe of a shoe.

As a textile base we may employ any convenient closely woven cloth of homogeneous fibre and of sufficient strength such, for example, as single ply print cloth 4–60. To one side of this cloth is applied a uniform and continuous coating of thermosetting material in fluid form. A 10%–30% alcohol solution of phenol formaldehyde resin, obtainable in the market under the name "Makalot No. 204," has been found entirely satisfactory in practice, although other alkaline solutions of phenol formaldehyde may be used, or we may employ an emulsion of phenol or other thermosetting resins such as "Makalot No. 85 W," "Bakelite B. V. 16238" or B. V. 16887, or B. V. 16686, these being obtainable in alkaline solution with a content of approximately 53% of phenol formaldehyde concentration product; "Amberite Pr–14" or "Amberite Pr–75 B" with catalyst P–79; "Plaskon 700–2 A and B"; "Durez Plastic No. 12041," the latter being used if desired with "Durez Plastic Accelerator No. 7422"; or "Resinite."

The best procedure for coating a textile base known to us consists in pulling the cloth between steel rolls set at a predetermined space while flooding the upper surface of the sheet with the coating material. This step is suggested in Fig. 1 in which a sheet 10 of print cloth, shown as being napped on its lower surface, is drawn between the rolls 12 and 13 while the phenol formaldehyde resin solution 14 floods the upper face of the sheet behind the rolls. As the sheet is drawn forwardly from the rolls 12 and 13, it emerges with a thick coating 15 of phenol formaldehyde resin on its upper surface. The coating at this stage of the process is a heavy, thick, adhesive syrup, containing approximately 70–90% solid and having a pH of approximately 7.

The coated cloth as represented in Fig. 2 is now dried and impregnated by being advanced and draped over a series of horizontal rods in a drying room at a temperature of about 180° F., but in no case over 205° F. for at that point the polymerizing or setting action begins to take place. During the drying operation the syrupy coating material flows into and through the fibres of the cloth tending to distribute itself substantially uniformly on both surfaces thereof and to fill the interstices between the strands. In Fig. 3 the textile base is represented on a magnified scale as being in its dried condition, as having thin coatings 15 and 16 upon opposite surfaces, and as being also completely impregnated with the phenol formaldehyde resin which imparts a uniformly brownish color to the treated cloth. The cloth in dried condition is only slightly altered from its original texture, being stiffened to a slight degree and changed in color. It may be rolled, handled and shipped in this condition as conveniently as ordinary shoe lining cloth. It may be supplied to the shoe manufacturer rolled up in sheet form, or it may be died into shoe box toes or counter stiffening blanks and distributed to the shoe manufacturer in this condition. It will preserve its initial characteristics for many months in storage and in transportation.

In Fig. 4 a box toe blank 17 is shown as incorporated in the toe portion of a shoe between the outer leather tip 18 thereof, shown as sewed to the vamp 19, and the usual textile lining 20. The presence of the blank 17 in no way interferes with the lasting operation. The margins of the blank 17 may be pulled over, wiped and secured together with the other plies of the upper exactly as if it were merely another ply of textile lining material, except that, as already noted, the bulk of material to be handled is reduced as compared to that in which a heat-softening or solvent-softening stiffening blank has been employed. Preferably the fleece or nap side of the blank 17 is faced away from the shoe lining 20.

At any convenient time after the lasting operation the finished toe end of the shoe may be subjected to heat sufficient to set or cure the stiffening material. This may be effected advantageously by the use of infra-red rays as suggested in Fig. 6 in which a casing 22 is shown as provided with an opening 23 in one side wall for the reception of the toe end of a shoe. Within the casing are provided a pair of infra-red ray lamps 24, one directed toward the end of the toe and the other directed down upon its dome portion. An application of a temperature of 310° F. for approximately 30 minutes has been found effective to work the desired transformation in the character of the stiffening material, that is to say, it is first liquefied from a pliable solid material into a very tacky, resinous, adhesive condition, and then sets in a hard, stiff, resilient condition. It is changed in color from its initial brown or light brown to a dark red color. While liquefied or softened it forms a strong adhesive bond with the leather integument 18 of the toe on the one hand, and with the textile lining material 20 on the other hand, and when hardened the three plies are permanently and securely bonded together into a hard resilient shell. Meanwhile, partly on account of the retarding or absorbing effect of the napped inner surface of

the blank 17, there occurs substantially no noticeable penetration through the inner surface of the lining. The lining has no tendency to stick to the last and this, of course, is an important advantage from the shoe-making standpoint. On the other hand, there has been no detectable penetration or discoloration of the outer integument of the upper although a powerful and permanent bond has been formed with it.

If desired the curing time may be reduced to approximately 20 minutes or even less by adding to the alkaline thermosetting resin solution 1 to 3%, on the solid content, of an acid such as acetic or formic acid. This has the effect of throwing the solution slightly on the acid side. Makalot employed and cured as above explained is tough and not brittle in the shoe part. However, under some conditions it may be advisable to add a plasticizing ingredient such as polyvinyl butyral to that or to the other thermosetting resins above identified.

In Fig. 5 we have disclosed our invention as carried out in producing a box of greater strength and thickness than that suggested in Fig. 4. In this case a second blank 21, coated and dried in the manner already explained in connection with the blank 17, is superposed upon that blank. If the stiffening blanks have napped surfaces, these are disposed in face to face engagement and serve to retain substantially more of the liquefied thermosetting resin between the two blanks than is allowed to reach either the shoe lining 20 or the leather tip 18. The four plies of the upper shown in Fig. 5 are pulled over, lasted and then subjected to the curing or setting operation while the last remains as a mold within the upper as already explained in connection with the toe box of Fig. 4, but in this case the resulting box comprises four plies stiffened and united into a shell and shrunk tight to the wood of the last. If desired the usual doubler may be employed in connection with a single resin-treated blank or with two or more of such blanks.

It will be apparent that by the process above outlined we have provided the shoe with a molded toe or counter which has the natural shape of the last and which resiliently tends to return to that shape after any distortion, as distinguished from the stiffened shapes heretofore derived from a thermoplastic blank which is initially flat in its stiffened condition. Neither the box toe nor counter formed in accordance with the present invention, or any component part thereof, is stiffened except in conformity with the contour of the last.

Another important advantage of our invention is that the thermosetting resin may be made to coat the thread of the tip seam or of the inseam thus tending to waterproof and preserve these seams, to cement the thread in place, and to prevent a run in case of a break in the thread. Heretofore the use of water-softening or solvent-softening stiffening blanks has been a detriment to the thread of these seams.

Our invention may be applied with particular advantage to the manufacture of turned shoes in that the inclusion of the resin-treated ply in the upper in no way interferes with the turning operation.

We have referred to the possibility of controlling the direction of the liquefying resin by arranging napped surfaces wherever desired in the construction of the upper. This control may be carried even further by varying the texture of the weave of the resin-treated blanks. For example, by using a coarse weave in the blank next to the leather ply of the upper, the liquefied resin may be directed to it and a poor grade of leather may be thus reinforced and kept free of wrinkles.

In some instances we have found it desirable to increase the shock resisting properties of the phenol formaldehyde impregnant by adding Cresol up to 20% of the solid phenol formaldehyde in solution. The use of O-Cresol reduces the color of the resulting mixture, while M-Cresol, which is much more reactive than other phenol, is exceptionally pale in color and hard in texture.

Having thus disclosed our invention and described in detail illustrative embodiments thereof, we claim as new and desire to secure by Letters Patent:

1. The process of stiffening shoe parts which consists in first uniformly distributing a thermosetting resin in pliable uncured condition on a homogeneous textile base within the inner plies of a shoe upper, lasting the upper while maintaining the said plies in dry condition, and then subjecting the upper to external heating causing the resin to liquefy and disseminate throughout all the inner plies and into engagement with the outer plies of the upper and then to harden and thereby convert all of the plies while on the last into a stiff, resilient multi-ply shell.

2. The process of stiffening shoe parts which consists in inserting in the inner plies of an upper a textile sheet of homogeneous fibre coated with a thermosetting resin in dry uncured flexible condition, the said sheet having a napped surface facing away from the shoe lining, lasting the upper, and then heating the upper to liquefy the resin, its flow being partially restricted by the napped surface, and continuing the heating step until the resin sets and converts the plies while on the last into a stiff multi-ply shell shrunken to the contour of the last.

3. The process of stiffening shoe parts which consists in lasting into the shoe a dry flexible fabric having a coating of phenol formaldehyde resin mixed with not more than 20% Cresol, and then subjecting the shoe to a temperature of about 300° F. thus causing the coating mixture to liquefy and to unite the plies of the shoe and then to stiffen them into a hard resilient shell.

4. In shoemaking, the process comprising the assembly of an outer ply, an inner lining ply and an interposed pliable stiffening ply of homogeneous fabric impregnated with uncured thermosetting resin, lasting the assembled plies while dry to form a shoe upper, and finally heating the upper while on the last and still in dry condition to liquefy and cure the resin, the said resin upon liquefaction and curing adhering to the outer and inner plies and thereby uniting all of the plies to form a stiff resilient multi-ply shell.

5. In shoemaking, the process comprising the assembly of an outer ply, an inner lining ply and an interposed pliable stiffening ply of single napped print cloth impregnated with uncured thermosetting resin, lasting the assembled plies while the stiffening ply is maintained in dry condition and disposed with its napped surface facing the outer ply of the assembly, and finally heating the thus formed upper while stretched upon a last and while still in dry condition to liquefy and cure the resin, the said resin upon liquefaction and curing adhering to the outer and inner plies and thereby uniting all of the plies to form a stiff resilient multi-ply shell accurately conforming to the contour of the last.

6. In shoemaking, the process comprising the

assembly of an outer ply, an inner lining ply and a plurality of interposed pliable stiffening plies of homogeneous fabric each impregnated with uncured thermosetting resin, lasting the assembled plies while dry to form a shoe upper, and finally heating the upper while conformed to the last and still in dry condition to liquefy and cure the resin, the said resin in the interposed plies coalescing upon liquefaction and curing and the said resin also adhering to the outer and inner plies so that all of the plies are united to form a stiff resilient multi-ply shell.

7. In shoemaking, the process comprising the assembly of an outer ply, an inner lining ply and two interposed pliable stiffening textile plies of homogeneous fabric each impregnated with uncured thermosetting resin, the stiffening ply adjacent the outer ply having a coarser weave than that of the other stiffening ply, lasting the assembled plies while dry to form a shoe upper, and finally heating the upper while conformed to the last and still in dry condition to liquefy and cure the resin, the said resin in the interposed plies coalescing upon liquefaction and curing and the said resin also adhering to the outer and inner plies so that all of the plies are united to form a stiff resilient multi-ply shell.

8. In shoemaking, the process comprising the assembly of an outer ply, an inner lining ply and an interposed pliable stiffening ply of homogeneous fabric impregnated with a limited amount of uncured thermosetting resin, lasting the assembled plies while dry to form a shoe upper, and finally heating the upper externally while conformed to the last and still in dry condition to liquefy and cure the resin, the said resin upon liquefaction and curing adhering to the outer and inner plies and thereby uniting all of the plies to form a stiff resilient multi-ply shell and the amount of resin being so limited as to avoid penetration thereof through the outer and inner plies thus avoiding discoloring thereof.

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