Jan. 30, 1951 J. J. BROPHY 2,539,608

STIFFENING UPPERS OF SHOES

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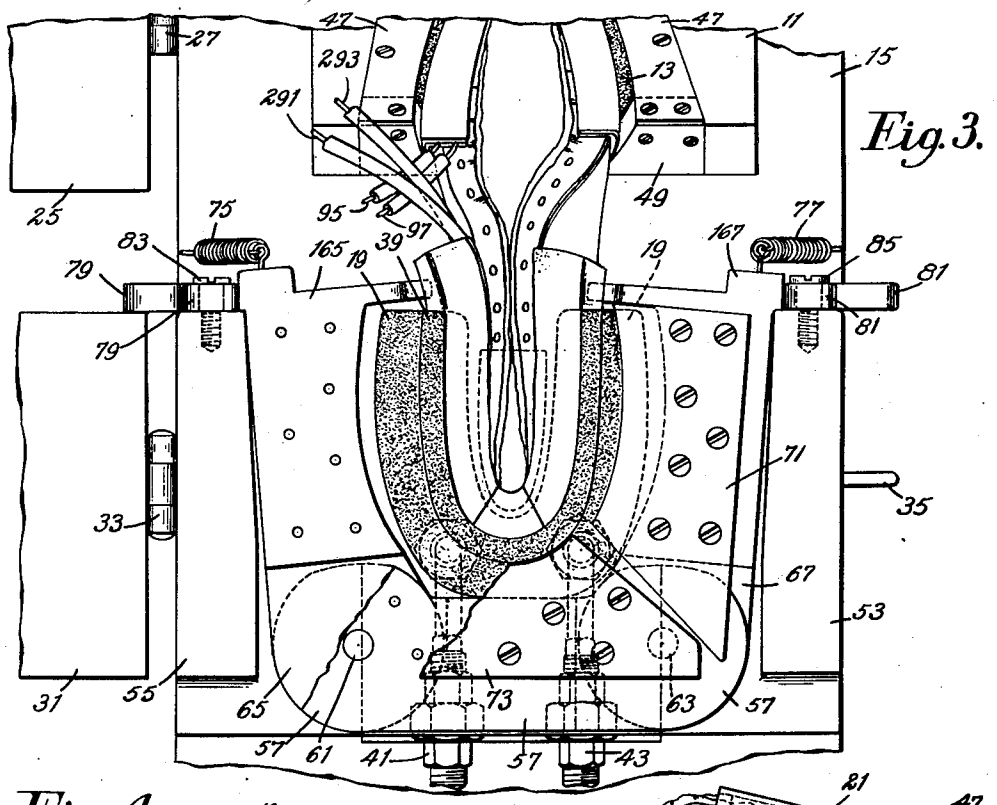


Fig. 3.

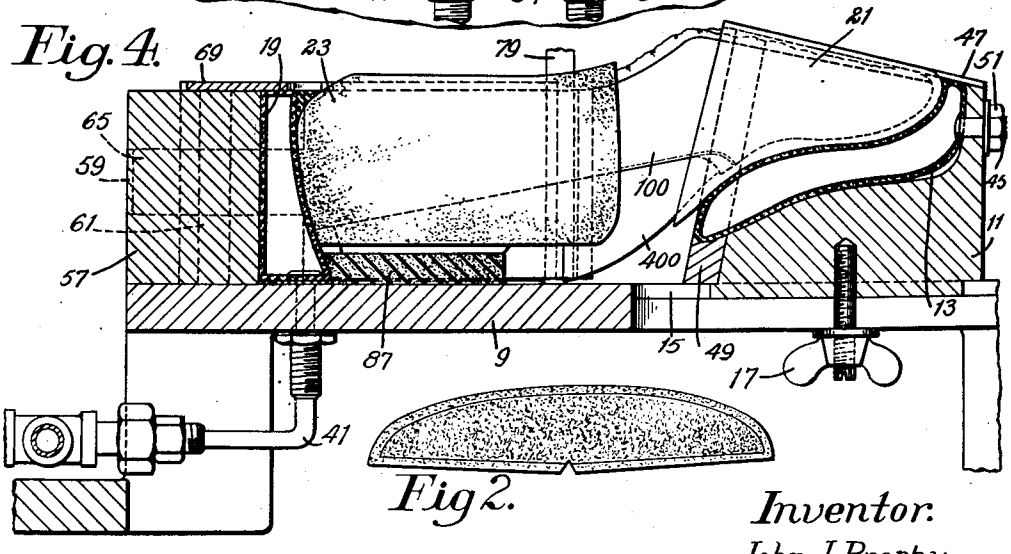


Fig. 4.

Fig 2.



Fig 1.

Inventor:
John J. Brophy.
By his Attorney.
Thomas J. Ryan.

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Fig 5.

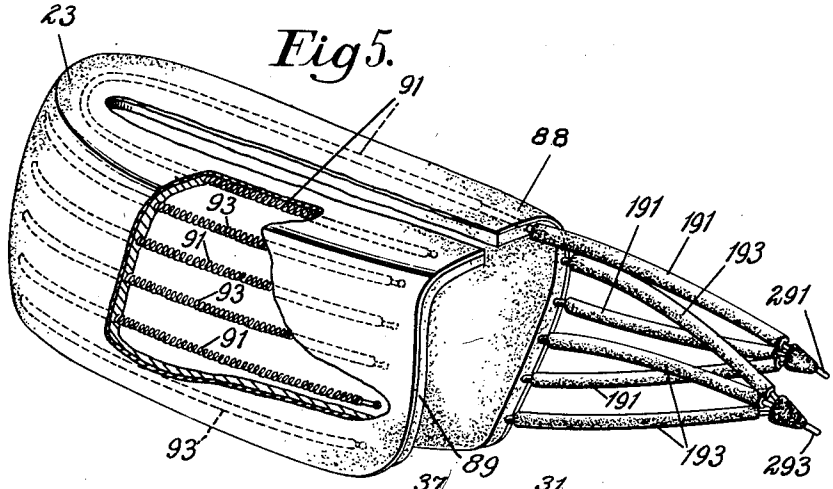


Fig. 6.

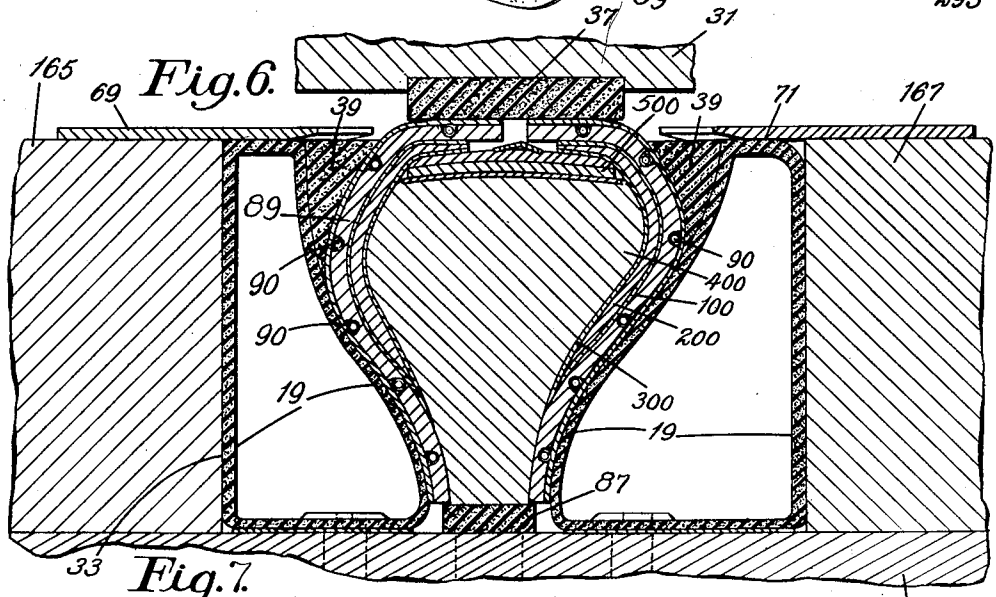
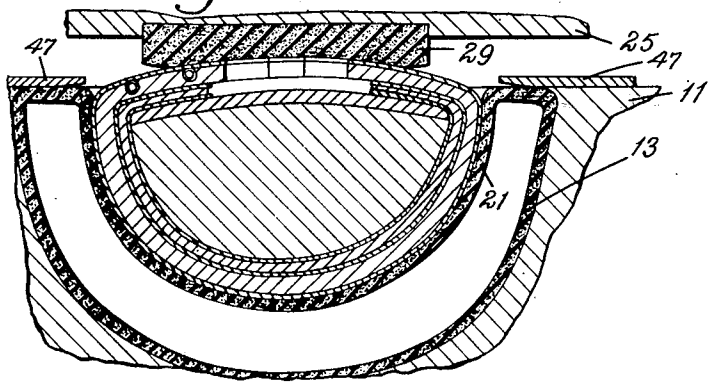


Fig. 7.



Inventor
John J. Brophy
By his Attorney
Thomas J. Ryan.

Patented Jan. 30, 1951 2,539,608

UNITED STATES PATENT OFFICE

2,539,608

STIFFENING UPPERS OF SHOES

John J. Brophy, Salem, Mass., assignor to United Shoe Machinery Corporation, Flemington, N. J., a corporation of New Jersey

Application May 5, 1949, Serial No. 91,607

5 Claims. (Cl. 12—146)

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This invention relates to stiffening selected portions of the uppers of shoes and is herein set forth in connection with stiffening the toe portions and the rear portions of uppers.

It is common to provide a toe stiffener blank, usually one having a fabric base impregnated with a stiffening substance, which can be softened and rendered limp by treatment with a solvent or with heat; to incorporate the softened blank in an assembled upper; and then to conform the upper with the softened blank to a last, the blank becoming hard and resilient upon evaporation of the solvent or upon dissipation of the heat.

There are certain disadvantages involved in the use of stiffener blanks of the general type outlined above. They can be most conveniently incorporated in the assembled uppers, and are usually so incorporated, just prior to the pulling-over operation, a special solvent-applying or heat-applying apparatus being provided for rendering them temporarily limp. They become hard and resilient as soon as the solvent has evaporated or the heat dissipated; but it is difficult to maintain them limp, and hence in condition for being conformed to the last, for just the right time, and then to have them become hard soon afterward so that the last may be removed from the upper. These and other disadvantages present very considerable difficulties to the use of such blanks as counter stiffeners so that, although toe stiffeners of the general type under discussion are widely used, no shoe manufacturer, so far as I am aware, uses them as counter stiffeners.

The patent to Schwartz No. 1,215,875 of February 13, 1917, discloses a method intended to avoid the disadvantages involved in the use of stiffener blanks which are given a preliminary treatment to render them soft and limp before they are conformed to the last. This patent discloses a method which comprises the use of a stiffener blank carrying shellac in powdered or broken form, whereby the blank is limp when cold and dry. Such a stiffener blank is incorporated in the assembled upper of a shoe and conformed to the last. After the shoe is lasted, the part of the upper which contains the stiffener blank is subjected to radiant heat to fuse the shellac whereby the particles of shellac are caused to run together so that, when the shellac hardens, a stiffened portion of the upper results. Shellac is not a satisfactory material for use in stiffening portions of the uppers of shoes; and subjecting the selected portion of the upper to radiant heat for approximately an hour at a temperature between 210° and 250° F., as is necessary in the patented process, is extremely injurious to all but a very few kinds of leather. Consequently no one, so far as I am aware, has ever made use of the Schwartz process, said patent never having advanced at all the art of shoemaking.

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According to the present invention there is incorporated in a selected portion of the upper, in unheated, dry, limp form, stiffener material comprising a themosetting resin which is soft or fluid when heated, for example, a resin obtained by condensation of a phenol and an aldehyde. The selected portion containing the stiffener material is then conformed to the shape in which it is to be stiffened, for example, by lasting the upper, and subjected to the heating effect of a high-frequency field to convert it to a tough, strong, resilient condition. The high-frequency field generates heat directly in the stiffener material so that the material is heated rapidly without the necessity of transmitting heat through the layers of the assembled upper. The field need be applied for only a very short interval; there is no danger of injuring the upper of a shoe such as is present when radiant heat is used, and a stiffener material having a comparatively high melting or softening point can be employed.

In accordance with another aspect of the invention, the heating rate of the stiffener material may be increased by incorporating with it a substance having certain electrical properties as hereinafter described.

An apparatus for use in carrying out a step of the method is disclosed in divisional application Serial No. 610,110, filed August 10, 1945, now United States Patent No. 2,406,738 of September 3, 1946. This application is a continuation-in-part of my application Serial No. 564,605 filed November 22, 1944, which has now matured into Patent No. 2,492,413, granted December 27, 1949.

Referring to the accompanying drawings:

Fig. 1 is a plan of a toe stiffener blank according to the present invention;

Fig. 2 is a similar view of a counter stiffener blank;

Fig. 3 is a plan of an apparatus for subjecting the front and rear portions of the upper of a lasted shoe to the heating effect of a high-frequency field, a shoe being shown in place, certain parts of the apparatus having been removed or broken away;

Fig. 4 is a vertical longitudinal section of the apparatus and lasted shoe shown in Fig. 3, the plate 69, which has been removed in Fig. 3, being shown;

Fig. 5 is a perspective of the rear electrode holder with the electrode;

Fig. 6 is a vertical cross section through the rear part of the apparatus and the shoe which are shown in Fig. 3; and

Fig. 7 is a vertical cross section through the forward part of the apparatus and shoe.

The stiffener blanks (Figs. 1 and 2) may be

made by coating or impregnating a flexible sheet or porous base, such as cotton flannel, felt or paper, with a solution or dispersion of a stiffening material comprising a thermosetting resin, for example, an uncured phenol-formaldehyde resin in a solvent, such, for example, as acetone; treating the impregnated base with a nonsolvent liquid, such, for example, as toluene, which is miscible with the solvent but is not a solvent for the resin, so as to precipitate the resin in the base; and then drying the sheet.

The procedure outlined above for impregnating a porous sheet by precipitating in its interstices a thermosetting resin may be carried out in any suitable manner, for example, as disclosed in United States Letters Patent No. 1,256,240, dated February 12, 1918, and No. 1,353,599, dated September 21, 1920, both granted upon applications of Stanley P. Lovell. The dry sheet carrying the stiffener material in precipitated form, if stiffer than desired, may be rendered limp or flexible by any suitable treatment. For example, the sheet may be carried between moving belts which make sharp reverse turns over small rolls so as to bend the sheet sharply first in one direction and then in another; or the sheet may be run through a mangle and thus be rendered limp and flexible by reducing the precipitated stiffener material more or less to discrete particles. After the above treatment the stiffener blanks may be cut out of the sheet.

It may be desired to omit the precipitating step, in which case the solvent may be caused to evaporate, and the dry sheet containing the stiffener material treated, if necessary, to render said sheet limp. It will be understood that the base, instead of being a separate member, may be some part of the assembled upper of a shoe, for example, the doubler, which has, for example, been cut out of an impregnated sheet. Also, if there is a carrier resin (e. g., Paraplex X100 in Example I), the porous base may be omitted, and limp, easily conformable stiffener blanks produced by spraying a suitable solution of a thermosetting resin in a suitable manner upon a smooth surface, peeling off the comparatively thick, porous sheet which results when the solvent has evaporated, and cutting out blanks from such a sheet. In any case, there will be incorporated in the upper of a shoe a limp stiffener material comprising a thermosetting resin in uncured form which when heated is soft or fluid and which, while unheated and dry, may be conformed with the upper to a last and may later be caused to set or cure by subjecting it to the heating effect of a high-frequency field. Advantageously, the softening point of the resin will be about 150° C. or lower.

In certain cases I have found it advantageous to impart to the material which is to be incorporated into the upper, a greater susceptibility to the heating effect of the high-frequency field than it normally possesses. It is well known in dielectric heating that, where a material fills the space between the electrodes, the high-frequency electric energy dissipated per unit volume of material per unit of time is represented by the equation:

$$Pv=2\pi KoE^2fe' \tan \delta \qquad (1)$$

where:

Ko=the capacitance per unit cube of free space
E=the voltage gradient
f=the frequency
e'=the dielectric constant
δ=the loss angle

Where the material is being treated between electrodes, and where a series dielectric such as an air gap is present, the formula becomes:

$$P_s=\frac{BE^2fe' \tan \delta}{k^2\left[1+2\left(\frac{e'}{e_i}\right)\left(\frac{1-k}{k}\right)+\left(\frac{e'}{e_i}\right)^2\left(\frac{1-k}{k}\right)^2(1+\tan^2\delta)\right]} \qquad (2)$$

where:

B=a constant
E, f, e', δ as defined above
e_i=the dielectric constant of the series dielectric
k=the ratio of the space occupied by the material to the total space occupied by the material and the series dielectric (spacing factor).

In a practical system comprising an oscillator, electrodes, and the material to be heated by the field between the electrodes, where such material is present in series with another dielectric, Equation 2 can be applied only as a general guide in ascertaining the optimum values of the electrical characteristics e' and tan δ of the material because of the effect of other variables which affect the strength and configuration of the electric field. Experience, however, has shown that the best conditions for heating a mass of stiffener material incorporated into the upper of a shoe would exist where the dielectric constant e' lies in the range of about 1–3 or somewhat higher and the loss factor tan δ lies in the range of 0.7–2.0. Although these represent optimum values, a stiffener composition having a tan δ of only about .01 can be softened and cured if the leather of the upper is dry.

While the aldehyde resins which I have found suitable for use in preparing a stiffener blank have sufficient values for e' and tan δ for proper heating in a high-frequency electric field, I have found that the heating rate of the mass of stiffener material can be increased both absolutely and also relatively to the heating of the upper leather by the addition to the stiffener material of as little as .5% of a substance which has a tan δ greater than that of the resin in the stiffener material. Additionally, the substance should be nonreactive with the resinous material lest by chemical association the dielectric loss of the material be lowered. Conveniently the substance may be an organic compound, for example, ethylene glycol.

The addition of organic compounds to material in large quantities may tend to adversely affect the quality of the finished stiffener and, accordingly, it is preferred to limit the amount of an added organic compound to less than about 15% of the combined resin and compound, that is, less than about 18% by weight of the resinous material.

Limp stiffener blanks, for example, a toe stiffener blank (Fig. 1) and a counter stiffener blank (Fig. 2), may be incorporated in the upper of a shoe at any suitable stage in the manufacture of the shoe. Conveniently the blanks may be incorporated in and become part of the upper during the assembling of the parts of the upper in the stitching room. The upper may then go through the regular shoe-manufacturing operations, including being mounted upon and conformed to a last; and, at any time after the lasting has been completed, the toe and heel ends of the upper, with the conformed, limp stiffener therein, may be subjected to the heating effect of a high-frequency field.

The stiffening material, as has been stated, is

preferably incorporated in selected portions of the upper by incorporating two separate stiffener blanks such as are shown in Figs. 1 and 2. In Fig. 6 a lasted upper is indicated at **100**, a stiffener at **200**, a lining at **300**, and a last at **400**. After the stiffeners have been incorporated in the upper and the upper has been lasted, the next step is to subject the selected portions of the upper to the heating effect of a high-frequency field. A convenient method of accomplishing this will now be described in connection with a suitable apparatus.

Referring first to Figs. 3 and 4, the apparatus comprises a base **9** upon which are mounted a front section and a rear section. The front section comprises a block **11** which is hollowed out to receive a flexible rubber bag **13** shaped to receive the toe portion of a lasted shoe, said block being adjustable toward and from the rear section in a guideway **15** formed in the base **9** and held in adjusted position by a clamping screw **17**, the purpose of this adjustment being to provide for shoes of different lengths. The rear section also has a flexible bag **19** which is shaped to extend around the rear and sides of the shoe, and the wings or sides of which can be moved from open to closed position. Two electrode holders **21**, **23**, the details of construction of which will be described later, are placed respectively upon the toe portion and the rear portion of the upper on the lasted shoe, and then the lasted shoe, with the electrode holders in place upon it, is placed as shown in Figs. 3 and 4 with the electrode holder **21** resting against the bag **13** and the electrode holder **23** resting against the bag **19**, the block **11** having been adjusted horizontally and locked in position by the clamping screw **17**. A cover **25**, which is hinged to the front section at **27**, is swung over and down into horizontal position and fastened in this position by a hasp (not shown) on the cover, the slot in the hasp receiving a staple (not shown) driven into the block **11**, a pin (not shown) being passed through the staple to hold the hasp in place. The cover **25** (Fig. 7) has set into it near its middle a block of resilient material **29** which presses down the electrode holder on the toe portion of the shoe. A similar cover **31** (Fig. 3), hinged to a stationary part of the rear section at **33**, is swung over and its hasp (not shown) held by a staple **35** which is driven into a stationary part of the rear section. This cover **31** (Fig. 6) has set into it near its middle a block of resilient material **37** which presses the electrode holder **23** and the rear portion of the lasted shoe against the flexible bag **19**. Next, the sides or wings of the rear bag **19** are forced inwardly in a manner presently to be described so as to press the sides or wings of the rear electrode against the upper and the upper against the sides of the rear portion of the last.

In the manufacture of shoes it is usual to tack an insole to a last, the heel end of the insole being somewhat narrower than the widest part of the rear end of the last so that there is a re-entrant angle which extends around the heel end of the last and insole, said angle (Fig. 6) being bounded on one side by the edge of the insole **500** and on the other by the somewhat curved surface at the bottom of the heel end of the last. It is desirable that the finished stiffener should bridge this angle; and in order that the stiffener, while soft, shall not be forced into this angle, the inner wall of the bag at this locality is given sufficient rigidity. In the illustrated construction there is vulcanized or otherwise attached to the adjacent portion of the inner wall of the bag **19** a strip of resilient material **39**, wedge-shaped in cross section, so that no objectionable crease or depression appears in the outer of the finished shoe.

With the shoe and the electrodes thus firmly held, a fluid under pressure, for example, compressed air, is forced through two pipes **41** and **43** into the rear bag **19** and through the pipe **45** into the front bag **13** to distend the bags. Thereafter the electrodes are energized from the terminals of an oscillator whereby the stiffening material is caused to soften and cure to a hard and resilient condition. The purpose of the pressure is twofold. First, it presses the electrodes, which are flexible, firmly into contact with the shoe, thereby rendering them much more effective. Second, it presses the outer, the stiffening matrial, and the lining of the shoe into firm contact with each other so that the three members are firmly bonded together in the finished shoe.

Although the pressure applied by the bags serves to press together the outer, the stiffening material and the lining to facilitate bonding, it has been found that adequate bonding is ordinarily obtained without external pressure by the pressure exerted between the lasted over upper and the last.

The general construction and mode of operation having been given above, a detailed description of the parts of the apparatus will be found in United States Letters Patent No. 2,406,738, the patent on the divisional application referred to above.

Example I

	Parts by weight
Paraplex X100	40
Durez Resin #12687	70
Benzoyl peroxide	1
Altax	1
Titanox R. A. 10MO	50
Acetone	134
Methanol	24

Paraplex X100, put out by the Resinous Products & Chemical Co. of Philadelphia, Pa., is an alkyd type thermosetting resin having a softening range of from 100° F. to 105° F. Durez Resin #12687 is a thermosetting phenolformaldehyde resin, put out by Durez Plastics & Chemicals, Inc., of North Tonawanda, New York, which has a softening range of 40°–60° C. and a melting range of 70°–75° C. Benzoyl peroxide is an accelerator for the curing of the thermosetting resinous material. Altax, benzothiazyl disulfide, put out by the R. T. Vanderbilt Co., of New York, N. Y., is a rubber accelerator but here probably acts to retard somewhat the curing operation. Titanox R. A. 10MO is a titanium oxide put out by the Titanium Pigment Corporation of New York, N. Y. It serves here principally as a filler. A cotton duck blank was impregnated with the solution, dried, subjected to flexing, forming a limp, dry, stiffener blank which was then incorporated into the upper of a shoe and subjected to a high-frequency electric field. Upon cooling, a stiff resilient toe was obtained.

Example II

	Parts by weight
Penacolite B–1	40
Hexamethylenetetramine	4
Methanol	40

Penacolite B–1, put out by Koppers Co. of Pitts-

burgh, Pa., is two-stage resorcinol-phenol-formaldehyde resin. Hexamethylenetetramine is a reactant for the curing of the thermosetting resinous material.

A blank of cotton duck was impregnated with the solution, dried, and incorporated in the upper of a shoe. The shoe was treated for twelve seconds in a high-frequency electric field giving a stiff resilient box.

Other solutions which may be used in the formation of stiffener blanks which may be used for stiffening shoes in the manner described above are:

Example III

	Parts by weight
GE No. 12315	75
Paraplex X100	35
Benzoyl peroxide	1
Acetone	80
Methanol	80

GE No. 12315, put out by the General Electric Co. of Schenectady, N. Y., is a two-stage phenolic-formaldehyde resin.

Example IV

	Parts by weight
Bakelite BR16190	70
Hexamethylenetetramine	10
Acetone	50
Methanol	50

Bakelite BR16190, put out by the Bakelite Corporation of New York, N. Y., is a two-stage resorcinol type of thermosetting resin.

Example V

	Parts by weight
Bakelite BR17540	80
Paraplex X100	20
Hexamethylenetetramine	10
Benzoyl peroxide	1
Acetone	75
Methanol	75

Bakelite BR17540, put out by the Bakelite Corporation, is a phenolic type of thermosetting resin.

Example VI

	Parts by weight
Bakelite BR16190	85
Ethylene glycol	12
Acetone	70
Methanol	70

The ethylene glycol is employed to increase the rate of heating of the stiffener material by the electric field.

Example VII

	Parts by weight
Penacolite B–1	30
Diethyl amine	3
Methanol	70

Here the diethyl amine is used to increase the rate of dielectric heating.

Example VIII

	Parts by weight
Beckamine No. 364	100
Water	200
P–198 Beckamine accelerator	5

Beckamine No. 364 is a 73–77% dispersion in water of a urea-formaldehyde resin put out by Reichhold Chemical Co., of Detroit, Michigan.

Example IX

	Parts by weight
Uformite F–200E	100
P–198 Beckamine accelerator	5
Butyl alcohol	50

Uformite F–200E is an alkylated urea resin 50% solids in (1-1 zylol and butyl alcohol) put out by the Resinous Products and Chemical Co., of Philadelphia, Pa.

Example X

	Parts by weight
Uformite MM–55	100
Butyl alcohol	55
P–198 Beckamine accelerator	5

Uformite MM–55 is a 50% solution of a thermosetting melamine-formaldehyde resin, in a 1 to 4 mixture of zylol and butyl alcohol, put out by the Resinous Products and Chemical Co., of Philadelphia, Pa.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a method of producing a stiffening portion in a shoe, the steps comprising incorporating in a selected portion of the upper in unheated, dry, limp form, a thermosetting resinous material which is soft or fluid when heated, associating said upper with a sole member and conforming the upper to a last, and thereafter, while holding the upper so conformed, subjecting the selected portion to the heating effect of a high-frequency electric field to cure the resinous material and bond it to the upper.

2. The method of claim 1 in which the material is an aldehyde resin.

3. The method of claim 1 in which the material is a ureaformaldehyde resin.

4. The method of claim 1 in which the material is a melamineformaldehyde resin.

5. In a method of producing a stiffening portion in a shoe, the steps comprising incorporating in a selected portion of the upper in unheated, dry, limp form a layer of thermosetting resinous material which is soft or fluid when heated, conforming said portion to the shape in which it is to be stiffened and while holding said portion so conformed, subjecting it to the heating effect of a high frequency electric field to cure the resinous material and bond it to the upper.

JOHN J. BROPHY.

REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
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