May 13, 1941. J. J. BROPHY 2,241,502

METHOD OF LAST SHELLING

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Fig1

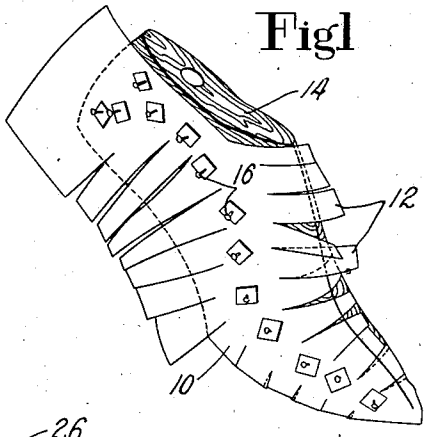


Fig2

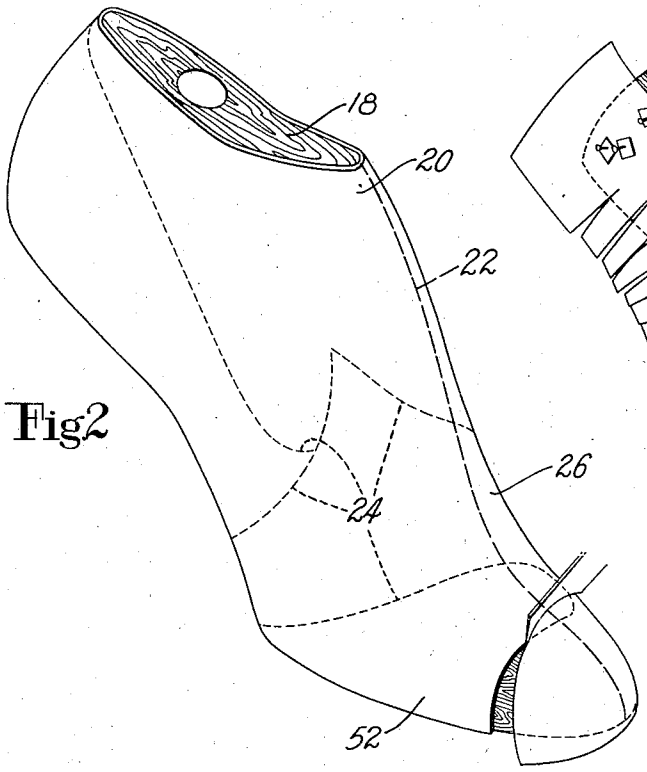
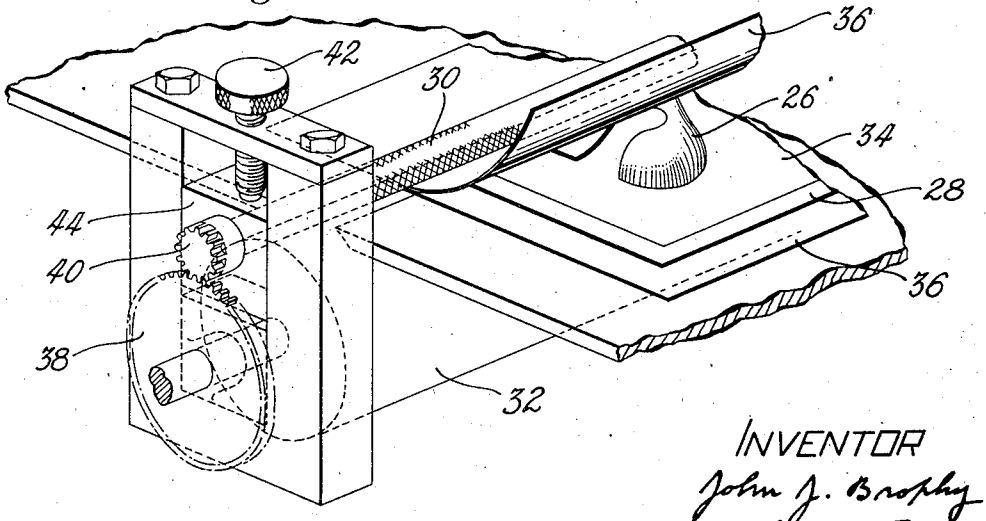


Fig5



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Fig.4

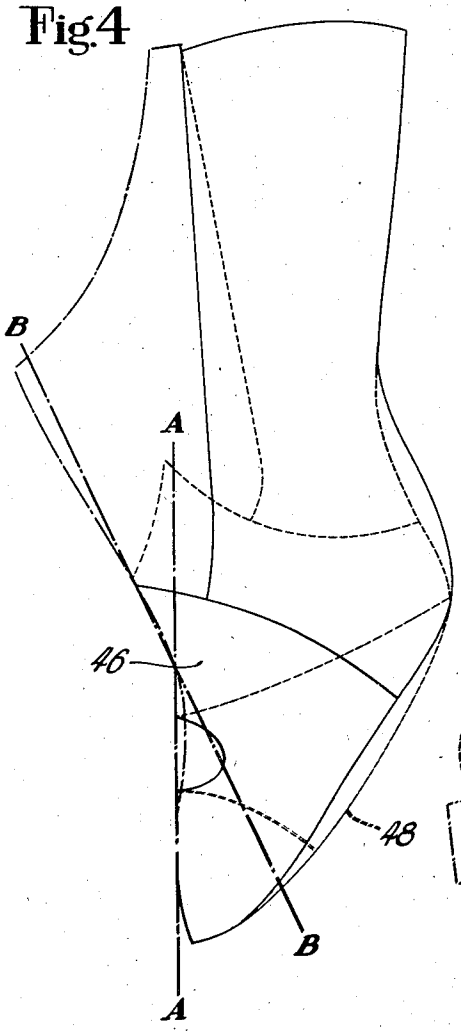


Fig.5

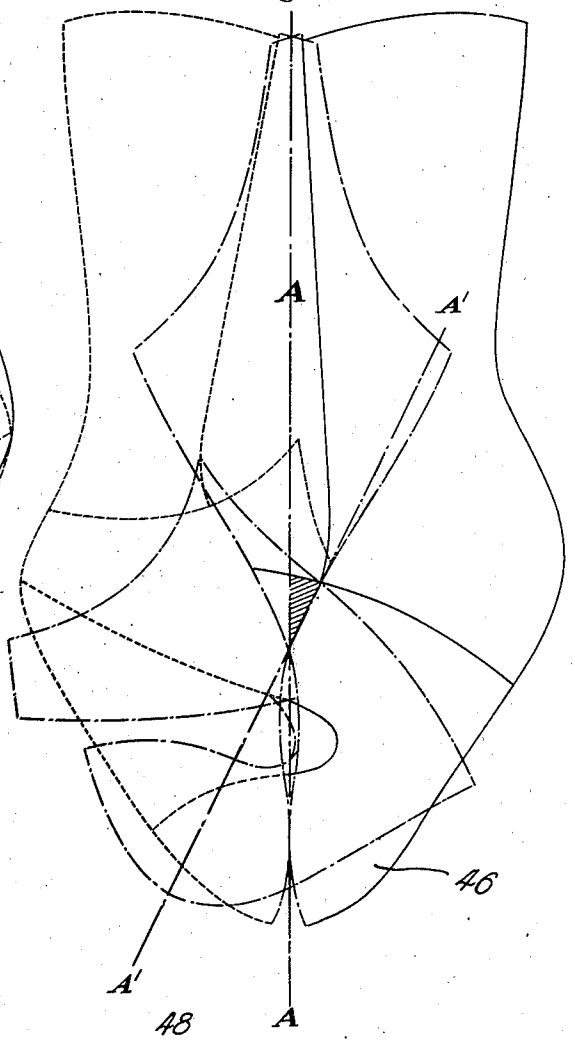


Fig.6

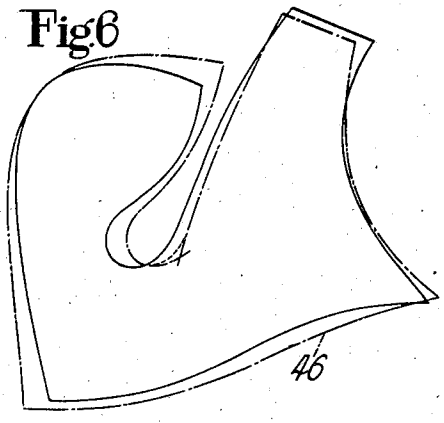
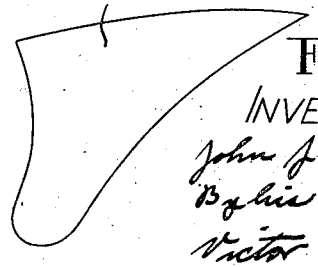


Fig.7



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2,241,502

UNITED STATES PATENT OFFICE

2,241,502

METHOD OF LAST SHELLING

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Application February 12, 1940, Serial No. 318,575

27 Claims. (Cl. 33—6)

This invention relates to methods of developing the peripheral shape of a doubly curved surface in a plane and is exemplified herein with reference to a procedure known as "last shelling" by the use of which the required shape of a pattern for a shoe part adapted to fit a portion of a last surface is determined.

Last shelling is ordinarily carried out by the use of a piece of paper which is secured to the midportion of one side of the last by a line of tacks extending lengthwise thereof, the paper being of such shape and of sufficient area to more than cover the entire side of the last between the edge of the bottom and the center line extending between the extreme toe and heel ends of the last along the middle of the instep of the cone. The paper is slit inwardly from its edges forming a series of tongues which enable the paper to be bent without wrinkling about the abruptly curved portions of the last, the tongues overlapping each other in some places and diverging from each other in others. After marks are made on the tongues where they cross the center lines of the instep ridge and heel and the edge of the last bottom, the paper which is now called a "shell" is removed from the last and flattened into contact with a piece of pattern material which then is cut along a line connecting the marks on the tongues in a smooth curve, thereby providing a "draft" of one side of the last. This procedure is repeated on the other side of the last, the two drafts representing in a plane the entire curved surface of the last.

If the design of the upper is simple, as in the case of a pump, or if it is symmetrical, a pattern representing the bottom and top lines of the upper is traced from the edges of the inside and outside drafts when so placed that their central edges which correspond to the center line of the last are brought together as well as possible. As these central edges are sinuous and are curved oppositely to each other, when the drafts are brought together, they overlap each other at certain places and are spaced from each other at other places, these differences being compensated for by cutting the pattern wider than the combined drafts opposite to their overlapping areas and narrower than the combined drafts opposite to points where they do not overlap. The shapes of patterns for individual parts of the upper, such as the vamp and the quarter, are then laid out on the pattern referred to above, and it is evident that any error in the cutting of the latter patern will give rise to other errors in the shape of a pattern for an individual shoe part.

Uniform drafts cannot be obtained from the same last by different operators or even by one operator at different times regardless of how skillful he may be because it is a matter of judgment as to how the paper which is to form the shell is applied to and bent around the last. Then, too, because of the difference between the relation of the tongues when in contact with the last and when in a flattened condition, as well as because of the difference between the required shape of a shoe part in a finished shoe and its shape as developed in a plane, a great deal of skill is required in laying out a pattern in a plane so that it will produce a shoe part of the desired appearance when it is embodied in a finished shoe.

For these reasons, the designing of a pattern is an uncertain procedure, the first steps of which produce, at best, only a general approximation of the required pattern.

Consequently, the first pattern for a shoe upper is regarded as merely the starting point of a cut-and-try process which involves making at least two and often more sample shoes, changes to correct errors in the design of one shoe being made in the pattern for the succeeding shoe until a satisfactory pattern is obtained.

Although the above procedure, in spite of its limitations, is useful in connection with certain classes of work, its value is questionable in designing patterns for upper parts of shoes of odd shape, as in the case of orthopedic shoes or shoes which are extreme in style; and this procedure is entirely inapplicable to the design of patterns for uppers which are characterized by the asymmetrical arrangement of their lines or parts.

In view of the foregoing, the general object of the invention is to provide an improved method of making patterns which is applicable to any type or style of work and by the use of which the difficulties and inaccuracies of the prior method referred to above are eliminated. Although the invention will be described herein in connection with making patterns for shoe upper parts, it is to be understood that it may have application in any instance where it is desired to develop in a plane the peripheral contour of a doubly curved surface.

The invention contemplates the use of a flexible shell which has and tends to retain the peripheral and doubly curved form of a shoe part for which a pattern is to be made. One method of employing a shell of this type, in accordance

with the invention, is characterized by the steps of deforming the shell under pressure along a line extending between the edges of the shell into conformity to the surface of a piece of pattern material, progressively moving the line of deformation of the shell along the shell, and transferring the positions of the edges of the shell at the line of pressure to the pattern material.

By thus progressively acting upon the shell only along a line at any time, the shell is subjected to a minimum of distortion, and the edges of the portion of the shell about to be operated upon are free to move into positions corresponding to the length of the shell along the line of pressure without any change in their orientation which would cause an inaccuracy in the peripheral shape of the shell as transferred to the pattern material.

Preferably, and as herein illustrated, the above-mentioned progressive deformation of the shell is effected by subjecting it to the action of a roll, pressure being exerted by the roll through the shell upon the pattern material which may be supported by any suitable means such as a table or another roll. Thus, the shell is progressively flattened along the line of pressure between the roll and the support for the pattern material as the shell and pattern material are presented to the roll, successive positions of this line of pressure being parallel to each other.

The transfer of the positions of the edges of the shell at the line of pressure to the pattern material may be effected at localities sufficient in number to represent an accurate outline of the peripheral shape of the shell on the pattern material or so as to provide a continuous mark. That is, the shell may be provided with embossed indicia, such as punch marks, indicating the outline of a shoe part for which a pattern is to be made, the indicia as well as the edges of the shell itself being adapted to make a mark on impressionable pattern material when the shell and pattern material are pressed together. Similarly, the invention contemplates providing a transfer medium either on the edges of the shell or other lines, or in the form of a sheet disposed between the shell and pattern material, the pressure exerted toward the pattern material by the shell being utilized to cause the transfer medium to be deposited upon the pattern material along a line corresponding to the edge of the shell or other indicia.

The invention will now be more fully disclosed in the following detailed description when read in connection with the accompanying drawings and will be pointed out in the appended claims.

In the drawings,

Fig. 1 is a perspective view of a last to which a piece of paper has been applied in accordance with the prior method of last shelling referred to above;

Fig. 2 is a view in perspective of a last having thereon a shell of the type employed in the practice of the present method, the shape of shoe parts for which patterns are to be made being indicated on the shell;

Fig. 3 is a view in perspective of one side of an illustrative machine adapted for use in determining the shape in a plane of the outline of a shell of the type illustrated in Fig. 2 and transferring its outline to a piece of pattern material in accordance with the method provided by the invention;

Fig. 4 illustrates a combined inner and outer draft of the last as made from shells obtained by the conventional last shelling method having upper parts of a shoe of the style illustrated in Fig. 2 laid out thereon in accordance with the general appearance of the shoe design of Fig. 2;

Fig. 5 illustrates the conventional method of using the draft of Fig. 4 and the difficulty of laying out a pattern of asymmetrical design by this method;

Fig. 6 represents superimposed patterns of a part of the vamp of the shoe of Fig. 2, one pattern having been made as indicated in Fig. 5, and the other by the practice of the present invention; and

Fig. 7 illustrates a pattern of another part of the vamp of the shoe of Fig. 2 made by the practice of the present invention.

The above-described prior method of last shelling, by the use of a paper shell, is illustrated in Fig. 1 in which a paper shell 10, the edges of which are slit to form tongues 12, as shown as secured to the outer side of a form or last 14, by tacks 16. This figure also indicates how the tongues 12, upon being wrapped about the last, separate from and overlap each other along the center line of the last and the edge of its bottom.

It will now be apparent that the length of the edges of a draft in a plane made from the shell 10 will not be equal to the length of the corresponding lines on the last surface unless the total overlap of the tongues 12 is equal to the total separation between them. It is unlikely that this relation of equality between the separation and overlapping of the tongues will ever occur, and it is unpredictable whether the center line of the draft will be longer or shorter than the center line of the last and to what extent. Moreover, because of the change in the angular relation between the tongues caused by bending them into a plane, the marks on the tongues representing the center line or bottom edge of the last will not always lie in a regular and smooth curve. The contour of the draft is therefore made so as to average as well as possible the positions of the marks on the tongues.

In view of the foregoing, it is apparent that this method of shelling lasts gives rise to errors in both the shape and length of any line on a last surface which is developed into a plane. The above inaccuracies and objections to the prior method of shelling a last are overcome in the practice of the method provided by this invention partly by the use of a homogeneous non-stretchable shell which is subjected to a limited distortion when a draft is made from it, this distortion being substantially the reverse of that to which upper material is subjected when the shoe is lasted. The invention thus contemplates the use of a shell which has, and tends to retain, the peripheral and doubly curved form of a shoe part of which a pattern is to be made, the essential requirements of this shell as to its material being that it is flexible enough to be easily bent without breaking, rigid enough to resist material change in its dimension along the line of bending, and resilient enough to return to substantially its original doubly curved form after being bent.

One satisfactory method of producing such a shell is to immerse a last in and then remove it from a liquid of such viscosity that it flows off the last except for a thin film, which upon drying has the properties referred to above. One

liquid which is suitable for use in practicing the present invention has the following composition:

	Per cent by weight
Ethyl cellulose (high viscosity)	8.7
Uformite F-225 (urea formaldehyde resin made by Resinous Products & Chemical Co., Philadelphia, Pa.)	2.2
Beckosol 1324 (non-drying type of alkyd resin—resin 80%, toluol 20%—made by Reichold Chemical Co., Detroit, Mich.)	2.2
Ethylene dichloride	52.1
Carbon tetrachloride	34.8
	100.0

As an example of this method of providing a shell, Fig. 2 illustrates a form or last **18** to which a shell **20** has been applied in the manner described above, excess shell material having been trimmed away from the last along the edges of its bottom and the top of its cone portion. The shell is then cut along a center line **22** and a similar center line at the heel end of the last if it is desired to make drafts of the sides of the last. However, in the case of a shoe the design of which is asymmetrical as indicated in Fig. 2, the shell is not cut along the center lines of the last, but, instead, is cut along lines **24** which correspond to the outlines of the various parts of the upper. The shell representing the surface of one side of the last or an entire shoe part as the case may be is then peeled off the last and its peripheral shape, as developed in a plane, is later transferred to a piece of pattern material as will presently be described.

The lines along which the shell is cut may be drawn on the surface of the shell while it is on the last or if, as contemplated by the invention, a transparent shell material is used, the lines may be drawn directly upon the last before it is coated.

The shell, although removed from the last, tends to retain the shape it had while upon the last and is next progressively deformed along a line into conformity to the surface of a flat piece of pattern material, the positions of the edges of the flattened portion of the shell being transferred to the pattern material whereby the shape of the normally doubly curved shell is progressively developed into a plane. As herein illustrated, this step of the method is carried out as indicated in Fig. 3, for example, by presenting the shell **26** of a vamp section and a piece of pattern material **28** in superimposed relation between rolls **30**, **32**, the pressure of which causes the shell to be flattened along a line, this line of pressure being moved substantially parallel to itself along the shell as the shell and pattern material pass between the rolls.

The pressure by which the shell is flattened is utilized to transfer the peripheral shape of the shell to the pattern material. Preferably, a transfer medium is used for this purpose, this medium being either applied to the edges of the shell or in the form of a sheet of carbon paper **34** disposed between the shell and the pattern material. The pressure necessary to flatten the shell is sufficient in either case to cause the transfer medium to be deposited upon the pattern material along a line corresponding to the outline or edge of the shell.

It has been found that the shape of the shell is most accurately reproduced when the line of deformation of the shell extends in such a direction across it that the shell is subjected to a minimum of distortion. Thus, the shell, if it represents one side of a last, is presented to the rolls so that the line of pressure extends substantially heightwise of the shell. This same result is achieved in connection with a shell of any form by presenting the shell to the rolls in such a way that the line of pressure on the shell extends between its proximal edges. As the line of pressure on the shell is moved under the action of the rolls, the portion of the shell adjacent to the bite of the rolls is progressively flattened, the portion of the shell about to be operated upon being swung slightly from side to side as compared to its position in its doubly curved form depending upon the difference between the extent of curvature of different parts of the shell. This action of the shell contributes to the accuracy of patterns made by the practice of this method since it automatically results in defining the relation between different parts of the pattern in such a way that shoe upper material cut by the use of the pattern is not distorted upon being shaped about a last any more than is necessary to make it conform to the double curvature of the last. That is, any necessity for straining the upper to bring its lines into their proper positions on the last beyond the amount necessary to make it fit the double curvature of the last is eliminated.

Sufficient pressure is exerted between the shell **26** and pattern material **28** at the bite of the rolls **30**, **32** to prevent any change in the orientation of the shell with respect to the pattern material along the line of pressure. However, to insure against any slippage between the shell and pattern material they may be presented to the rolls between the leaves of a folder **36**, the inner sides of which are covered with an abrasive material. If a soft type of pattern material, such as blotting paper or other form of impressionable pattern material is used, the transfer medium may be dispensed with, as the pressure which is necessary to flatten the shell is sufficient to cause the outline of the shell to be impressed into the pattern material.

As will be noted from Fig. 3, the rolls of the illustrative machine for flattening the shell are of different diameters, the upper roll **30** being as small as possible in diameter consistent with the required strength, for example about ½", so that the area of the shell which is subject to distortion at each side of the line of pressure is as small as possible. The upper roll **30** is made of metal and has a knurled surface so as to provide an effective grip on the folder or on the shell and pattern material if no folder is used. The lower roll **32** is made of rubber of such consistency as to provide a firm but somewhat yielding support for the folder or pattern material. The rolls are connected by gears **38**, **40**, the diameters of which have the same ratio as that between the diameters of the rolls whereby the rolls are driven at the same peripheral speed. The pressure to which the shell and pattern material are subjected is adjusted by a screw **42** which bears against a sliding journal **44** in which the roll **30** is rotatably mounted. It is to be understood that the right-hand side of the illustrated machine is constructed and arranged similarly to its left-hand side as shown in the drawings.

In order to avoid the necessity for estimating the allowance to be made for the thickness of lining material in designing patterns for the leather or outer shoe upper parts, the shell from

which the latter are made may be made over a similar coating on the last having the thickness of the lining materials, it merely being necessary that the material of which either coating is made shall not be soluble in the solvent for the other. Thus, the incompatibility of the two coatings will insure against any difficulty in the removal of the outer coating from the inner coating.

One liquid adapted for use in making such an inner coating, over which an outer coating made from the liquid disclosed above may be formed, has the following composition:

	Per cent by weight
Cellulose acetate No. 656 (made by Tennessee Eastman Corp.)	15.7
Santolite M. H. P. (condensation product of formaldehyde with aromatic sulfonamides made by Monsanto Chemical Co.)	7.9
Ethylene dichloride	64.7
Methanol	11.7
	100.0

After the outer shell has been taken off the last the inner shell, which represents the lining, may be cut from the last along lines representing the desired contour of the lining so as to produce a shell which provides a basis for a pattern to be used in cutting the lining.

An outstanding advantage in the use of the present method is that accurate and consistent results are easily obtained by an inexperienced operator regardless of whether or not the shoe design is of a type which lends itself readily to the prior method of last shelling. Moreover, the use of the present method facilitates making a draft of a last whether the last is of usual shape, or is odd in shape as in the case of an orthopedic last.

A particularly important advantage of the present method is realized in connection with the making of patterns of the upper parts for a shoe, the design of which is asymmetrical, the design indicated in Fig. 2 being one of this type.

In making a composite draft as a basis for laying out patterns in accordance with the prior method referred to above, the inside and outside last shells are superimposed upon each other (Fig. 4) so that their sinuous contours, which correspond to the center line of the last at the forepart and which are usually quite similar, are averaged as well as possible. As there often is a material difference in the widths of the inside and outside shells, their bottom lines are drawn separately on the draft. It is evident already that an error will be introduced in the draft as to its width because the above-mentioned sinuous contours of the shells cannot be usually placed exactly together. Moreover, because different areas of the shoe part which lie at opposite sides of the center line of the last are located in different planes, it is necessary to estimate, in laying out the shape of the shoe parts on the composite draft (Fig. 4), how different the angular relation of their outlines must appear in a plane from their apparent relation in a shoe. Thus, as will be demonstrated graphically below, it is impossible toc ombine the inside and outside shells without introducing errors in the width of the composite draft and also in the angular relation of the different parts of the upper as laid out on the draft, since the separate shells cannot be combined in the most advantageous relation angularly and laterally at the same time.

The conventional method of pattern making is subject to the above limitations regardless of the design of the shoe; but these limitations are so serious in connection with a shoe the design of which is asymmetrical that the use of the conventional method in such a case becomes impracticable.

A specific example of this problem will now be described with reference to Figs. 4 and 5 employing a vamp section **46**, which corresponds to the shell **26**, as the shoe part of which a pattern is to be made. It is to be understood that the usual lasting allowance will be disregarded to avoid confusing the drawings. Assuming that the outlines of the shoe parts have been drawn on the draft (Fig. 4) as accurately as possible, the inner outlines (solid lines, Fig. 4) of the vamp section **46** are first transferred to a piece of pattern material (Fig. 5) from the draft of Fig. 4. The draft is then turned over about the line A—A which corresponds to the center line of the forepart of the last and the outer outlines (dotted lines) of the vamp section **46** are drawn. It will now be noted that while the outline of the cut-out portion of the vamp section **46** is smooth and regular, its rear outline is not and that parts of the inside and outside drafts overlap each other (crosshatched area) along the line A—A. This obviously results in a serious lack in the width of the pattern as well as a discontinuity in its rear outline.

In an attempt to avoid this difficulty the outlines of the outside draft representing the rear portion of the vamp section **46** (dotted lines, Fig. 4) are transferred to the pattern material (dot-and-dash lines, Fig. 5) with the line B—B which corresponds to the center of the ridge of the cone of the last superimposed upon the line A—A on the pattern material. The draft is now turned over, again superimposing the line B—B of the draft on the line A—A of the pattern material, and the outlines (solid lines) of the inner draft are transferred to the pattern material (dot-and-dash lines, Fig. 5). The draft is then turned over about the line A'—A' and the outer outline of the toe portion of the vamp section **46** is added to complete the pattern. As indicated in Fig. 5, the width and shape of the rearmost part of the vamp section **46**, as well as its angular relation with respect to the toe portion, are now more accurately determined than formerly; but, as will also be noted from this figure, the outline of the cut-out portion of the vamp section **46** is irregular and does not conform to the required design of the shoe. However, the latter pattern (dot-and-dash lines, Fig. 5) approximates the required design more closely than does the former pattern and so the pattern maker arbitrarily alters the outline of the cut-out portion, as indicated in Fig. 6, to eliminate the jog in it. The errors in the size and the angular relations between the different parts of the pattern **46** as made by the conventional method (dot-and-dash lines, Fig. 6) are clearly indicated by comparing its shape with that of a pattern (solid lines) of the same shoe part as made by the practice of the present invention.

The difference between the shapes of the cut-out portion of the vamp section **46** and the vamp section **48** (Fig. 7) which later is united with the vamp section **46** also clearly illustrates how little reliance can be placed upon the original design as a basis for laying out the pattern for the vamp

section 46 as to the shape of its cut-out portion and the relation of different parts of its bottom line.

In the practice of the present invention, on the other hand, a shell having been applied to the last, sections of the shell, corresponding exactly to the shoe parts of which patterns are to be made, are cut off the last while in their normal doubly curved form. Upon developing their shape into a plane in accordance with the invention, it is found that their shape is considerably different from what would be expected and that an upper, cut by the use of patterns having the developed shape of these shells, fits the last accurately. This difference is clearly indicated by Figs. 6 and 7 which show the shape of the vamp sections 46 and 48 as determined by the practice of the present invention.

If it were attempted to last a shoe upper embodying the vamp section shown in the dot-and-dash lines of Fig. 6, the shoe upper would have to be strained excessively at some places in order to bring the lines of the design into proper relation with each other, if indeed the upper were near enough to the correct design to be capable of being lasted at all. On the other hand, when the parts of the upper of the shape illustrated by the solid lines in Figs. 6 and 7 are assembled, it is found that the upper can be made to fit the last with the slightest application of lasting tension and that practically no pressure is required to be exerted on the upper in addition to that which is necessary merely to form or shape the upper about the last; that is, the lines representing the design of the upper are brought into their proper locations on the last without subjecting the upper to uneven lasting pressures which might unduly strain the upper stock and stitching and eventually cause distortion of the shoe in use.

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

1. That improvement in methods of making patterns of shoe parts from a flexible shell having and tending to retain the peripheral and doubly curved form of a shoe part which consists in deforming said shell under pressure into conformity to the surface of a piece of pattern material along a line extending between the edges of the shell, progressively moving the line of deformation of the shell along the shell, and transferring the positions of the edges of the shell at the line of pressure to the pattern material.

2. That improvement in methods of making patterns of shoe parts from a flexible shell having the peripheral and doubly curved form of a shoe part which consists causing pressure to be exerted on a piece of pattern material through said shell along a line extending between the edges of said shell, progressively moving the line of pressure substantially parallel to itself along said shell, and transferring the positions of the edges of said shell at the line of pressure to said pattern material.

3. That improvement in methods of making patterns of shoe parts from a flexible shell having and tending to retain the peripheral and doubly curved form of a shoe part which consists in subjecting said shell and a piece of pattern material to pressure between rolls whereby the shell is progressively deformed along the line of pressure between the rolls into conformity to the surface of the pattern material, and transferring the positions of the edges of the shell at the line of pressure to the pattern material.

4. That improvement in methods of making patterns of shoe parts from a flexible non-stretchable shell having and tending to retain the doubly curved and peripheral form of a shoe part which consists in progressively deforming said shell into conformity to the surface of a piece of pattern material whereby the peripheral form of the shell is progressively developed on the surface of the pattern material, and simultaneously marking the developed outline of the shell upon the pattern material.

5. That improvement in methods of making patterns of shoe parts from a flexible shell having and tending to retain the peripheral and doubly curved form of a shoe part which consists in pressing said shell and a piece of impressionable pattern material into line contact with each other, and progressively moving the line of pressure along the shell whereby an impression of the peripheral contour of the shell is made in the pattern material.

6. That improvement in methods of making patterns of shoe parts which consists in applying to a last a homogeneous flexible covering which upon being removed from the last has and tends to retain the doubly curved form of the last, embossing said shell along a line representing the edges of a shoe part of which a pattern is to be made, and subjecting said shell and a piece of impressionable pattern material to pressure between rolls whereby an impression of the embossed portion of the shell is made in the pattern material.

7. That improvement in methods of making patterns of shoe parts from a flexible homogeneous shell having and tending to retain the doubly curved form of a shoe part which consists in embossing said shell on lines representing the edges of the shoe part of which a pattern is to be made, pressing said shell and a piece of impressionable pattern material into line contact with each other, and progressively moving the line of pressure along the shell whereby an impression of the embossed portion of the shell is made in the pattern material.

8. That improvement in methods of making patterns of shoe parts which consists in applying a homogeneous flexible covering to a last having thereon indicia representing the outline of a shoe part, said covering being adapted to retain the doubly curved form of the last upon being removed from the last, cutting said covering in accordance with the indicia to form a shell of the shoe part, pressing said shell and a piece of impressionable pattern material into line contact with each other, and progressively moving the line of pressure along the shell whereby an impression of the peripheral contour of the shell is made in the pattern material.

9. That improvement in methods of making patterns of shoe parts which consists in coating a last with a liquid adapted upon drying to form a homogeneous shell which has and tends to retain the form of a last upon being removed therefrom, trimming the shell along lines representing the edges of a shoe part of which a pattern is to be made, pressing the shell and a piece of impressionable pattern material into line contact with each other, and progressively moving the line of pressure along the shell whereby an impression of the peripheral contour of the shell is made on the pattern material.

10. That improvement in methods of making

patterns of shoe parts which consists in coating a last having thereon indicia representing the outline of a shoe part with a liquid adapted upon drying to form a transparent homogeneous shell which has and tends to retain the form of the last upon being removed therefrom, trimming the shell while on the last in accordance with the indicia, removing the shell from the last, and progressively pressing said shell and a piece of impressionable pattern material together whereby an impression of the peripheral contour of the developed shell is made in the pattern material.

11. That improvement in methods of making patterns of shoe upper parts which consists in coating the last with a liquid adapted on drying to form a shell which retains the form of the last upon being removed therefrom, trimming the shell in accordance with the shape of a shoe part for which a pattern is to be made, removing the shell from the last, and progressively rolling said shell and a sheet of impressionable material in superimposed relation into line contact with each other whereby the developed shape of the peripheral contour of the shell is impressed upon the pattern material.

12. That improvement in methods of making patterns of shoe upper parts which consists in coating a last having thereon indicia representing the outline of a shoe part with a liquid adapted upon drying to form a transparent homogeneous shell which has and tends to retain the form of the last upon being removed therefrom, forming embossed indicia on the shell in accordance with the indicia on the last, removing the shell from the last, and progressively pressing said shell and a piece of impressionable pattern material together whereby an impression of the indicia on the shell is made in the pattern material.

13. That improvement in methods of making patterns of shoe parts which consists in coating a last having indicia which indicate the outline of a shoe part with a liquid adapted upon drying to form a homogeneous flexible covering which upon being removed from the last has and tends to retain the doubly curved form of the last, embossing indicia upon said covering in accordance with the indicia upon said last, and pressing said covering and a sheet of impressionable pattern material in superimposed relation between rolls whereby an impression of the embossed portions of the shell is made in the pattern material.

14. That improvement in methods of shelling lasts which consists in applying to a last a covering equal in thickness to that of the lining material of a shoe to be made on the last, applying a homogeneous flexible shell in close fitting relation over said covering, said shell corresponding to a lasted upper on a last and being adapted upon removal therefrom to retain the form of the upper as lasted, cutting said shell in accordance with the shape of a shoe upper part, and removing the shell from the last.

15. That improvement in methods of shelling lasts which consists in applying to a last a covering equal in thickness to that of the lining material of a shoe to be made on the last, coating said covering while it is on the last with a liquid having no affinity for said covering and adapted upon drying to form a homogeneous shell which has and tends to retain its original form on being removed from said covering, and cutting the shell in accordance with the shape of the shoe upper part.

16. That improvement in methods of shelling lasts which consists in coating a last with a liquid adapted upon drying to form a covering equal in thickness to that of the lining material of the shoe to be made on the last, coating said covering while it is on the last with a second liquid in which said covering is insoluble and which upon drying and removal from the last forms a homogeneous flexible shell which has and tends to retain the normal shape of the lasted upper, and trimming said shell in accordance with the shape of the parts of which the shoe upper is composed.

17. That improvement in methods of making patterns of shoe parts from a flexible homogeneous shell having and tending to retain the peripheral and doubly curved form of a shoe part of which a pattern is to be made which consists in applying transfer medium to the edge of said shell, deforming said shell under pressure into line contact with the surface of a piece of pattern material, and moving the line of deformation of the shell along it whereby the developed outline of the edge of the shell is transferred to the pattern material.

18. That improvement in methods of making patterns of shoe parts from a flexible homogeneous shell having and tending to retain the peripheral and doubly curved form of a shoe part of which a pattern is to be made which consists in applying transfer medium to the edge of said shell, and subjecting said shell and a piece of pattern material to pressure between rolls whereby the shell is progressively deformed into line contact with the pattern material and the developed outline of the shell is transferred to the pattern material.

19. That improvement in methods of making patterns of shoe upper parts from a flexible shell having and tending to retain the peripheral and doubly curved form of a shoe part which consists in deforming said shell under pressure into line contact with a sheet of transfer medium disposed between said shell and a piece of pattern material, and progressively moving the line of deformation of said shell along it whereby the developed peripheral contour of the shell is transferred to the pattern material.

20. That improvement in methods of making patterns of shoe upper parts from a flexible shell having and tending to retain the peripheral and doubly curved form of a shoe part which consists in causing pressure to be exerted on a piece of pattern material by said shell through a piece of transfer medium along a line extending between the edges of the shell, and moving the line of pressure parallel to itself along the shell whereby an impression of the developed shape of the shell is made on the pattern material.

21. That improvement in methods of making patterns of shoe upper parts from a flexible shell having and tending to retain the peripheral and doubly curved form of a shoe part which consists in progressively flattening said shell into straight line contact with a sheet of transfer medium disposed between said shell and a piece of pattern material whereby an impression of the developed shape of the shell is made on the pattern material.

22. That improvement in methods of making patterns of shoe upper parts from a flexible shell having and tending to retain the peripheral and doubly curved form of a shoe part which consists in subjecting said shell, a piece of pattern material, and a sheet of transfer medium disposed therebetween to pressure between rolls whereby

said shell and pattern material are pressed into line contact with the transfer medium and the developed peripheral contour of said shell is transferred to the pattern material.

23. That improvement in methods of making patterns of shoe upper parts from a flexible shell having and tending to retain the doubly curved form of a last which consists in embossing said shell on lines representing the edges of a shoe part of which a pattern is to be made, pressing said shell and a piece of pattern material into line contact with the opposite sides of a sheet of transfer medium disposed therebetween, and progressively moving the line of pressure along the shell whereby an impression of the embossed portion of the shell is made in the pattern material.

24. That improvement in methods of making patterns of shoe parts which consists in applying to a last on which the peripheral contour of a shoe part of which a pattern is to be made is outlined, a transparent homogeneous covering adapted upon being removed from the last to retain the doubly curved form of the last, cutting said covering along the outline on the last to form a shell, removing the shell from the last and pressing the shell and a piece of pattern material into line contact with the opposite sides of a sheet of transfer medium disposed therebetween, and progressively moving the line of pressure along the shell whereby an impression of its peripheral contour is made on the pattern material.

25. That improvement in methods of making patterns of shoe parts from a flexible homogeneous shell having the peripheral and doubly curved form of a shoe part which consists in enclosing said shell and a sheet of impressionable pattern material in superimposed relation in a folder and causing pressure to be exerted through said folder against opposite sides of said shell and pattern material along a line extending between the edges of said shell, and progressively moving the line of pressure along said shell whereby the positions of the edges of the shell at the line of pressure are transferred to the pattern material.

26. That improvement in methods of making patterns of shoe parts from a flexible homogeneous shell having the peripheral and doubly curved form of a shoe part which consists in disposing a sheet of transfer medium between said shell and a piece of pattern material, enclosing said shell, transfer medium and pattern material in a folder, applying pressure to the opposite sides of the folder to cause the adjacent sides of said shell and pattern material to be pressed into line contact with the pattern material, and progressively moving the line of pressure along said shell whereby its developed outline is progressively transferred to the pattern material.

27. That improvement in methods of making patterns of shoe parts from a flexible homogeneous shell which consists in disposing a sheet of transfer medium between said shell and a sheet of pattern material, enclosing said shell, transfer medium and pattern material in a folder the sides of which, adjacent to said shell and pattern material, are coated with abrasive, and presenting the folder between rolls whereby the shell and pattern material are progressively pressed into contact with opposite sides of the pattern material and the developed outline of the shell is transferred to the pattern material.

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