

METHOD OF DEPOSITING A LAYER OF
FUSIBLE POWDERED MATERIAL

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5 This invention relates to a method of depositing
by a screen printing technique a layer of fusible powdered
material in a desired three-dimensional configuration on a
receiving surface for the subsequent formation therefrom of
a reinforcing/stiffening layer for a substrate, more
particularly for the formation of a reinforcing/stiffening
10 layer for a shoe upper component.

The shoe and apparel industry have for many years
provided reinforcement/stiffening or decorative means to
their products. Manufacturers of pajamas, blue jeans,
sports clothing, including sports equipment such as gloves,
15 caps with visors, and the like, as well as shoe
manufacturers have stitched, glued or otherwise applied
layers of reinforcing material to their products for a
variety of reasons. It has been standard for the shoe
industry to apply the reinforcement/stiffening or
20 decorative means as a layer of molten thermoplastic
material adherable to a shoe upper. Early attempts at
reinforcing or stiffening a shoe upper have included
providing preformed stiffener elements or counters, which
are inserted into a shoe upper, prior to lasting. Separate
25 mouldable sheet materials softenable by heating or by
solvent have been inserted in the shoe uppers prior to
lasting and are shaped in the course of lasting to a
desired configuration which configuration they retain by
being allowed to harden before removal of the shoe upper
30 from the last. Shoe uppers have also been stiffened by
impregnating a shoe component with a solution or dispersion
in a volatile liquid vehicle of hardenable stiffener
materials prior to lasting of the shoe upper, the shoe
upper being stiffened by hardening of the impregnating
35 material after the shoe is lasted.

One such way of stiffening shoe uppers is shown in US patent 3316573 to Chaplick et al, wherein a shoe upper has a selected area in which a resiliently flexible stiffener element is fluidly deposited, and heated to a mouldable point, and brought to a three-dimensional configuration which it will retain on cooling.

Another arrangement for coating shoe parts is shown in US patent 3342624 to Kamborian, wherein a stencil plate rests upon a shoe upper, a concave support surface holds the combination, whereupon a doctor blade wipes across the plate to deposit a fluid stiffener into the depression in the shoe upper.

A more recent arrangement for stiffening shoe components, is shown in US patent 3973285 to Babson et al, comprising an arrangement for depositing a molten charge of thermoplastic on a shoe upper held in a margin clamping means.

The prior art arrangements may occasionally work well, but they also may leak their molten material out of connecting joints, the nozzles may drool, the patterns require time and patience to change, and the final reinforced surface may not be as smooth as desired because the discharge pattern of the nozzles may remain, even if the molten material is pressed after it has been applied or cools. The material usable in these prior art machines are limited by their flow properties and heat stability characteristics, which necessitate careful tailoring to individual applications. Seams and overlaid patterns have also proved difficult for smooth application of the materials thereover, as well as being difficult in holding non-flat surfaces by the apparatus.

It is the object of the present invention to provide an improved method of depositing a layer of fusible powdered material, which method permits an accurately shaped reinforcing/stiffening layer to be provided, while mitigating the inconveniences of the prior art.

The present invention thus provides a method of depositing by a screen printing technique a layer of fusible powdered material in a desired three-dimensional configuration on a receiving surface for the subsequent formation therefrom of a reinforcing/stiffening layer for a substrate, said method comprising the steps of placing on a receiving surface a stencil assembly having a screen member, a non-permeable planar surface member in which a cut-out is formed corresponding in outline to the desired configuration for the powder, and a gasket member disposed on the under-side of the assembly adjacent at least part of the outline of the cut-out, and distorting the receiving surface from beneath in the region of the cut-out, whereby a cavity is formed into which powder is then deposited, the periphery of the cavity being determined by the outline of the cut-out and the extent of the gasket member along its outline, and the height of the cavity, and thus the thickness of the deposited quantity of powder, being determined by the height dimension of the gasket member and the amount of distortion of the receiving surface.

More particularly, the present invention provides a method of depositing by a screen printing technique a layer of fusible powdered material in a desired three-dimensional configuration on a receiving surface for the subsequent formation therefrom of a reinforcing/stiffening layer for a shoe upper component, said method comprising the steps of placing on a receiving surface a stencil assembly having a screen member, a non-permeable planar surface member in which a cut-out is formed corresponding in outline to a so-called toe puff (box toe) for reinforcing the toe end portion of a shoe upper component, and a gasket member disposed on the under-side of the assembly and extending around a curved edge of the cut-out representing a forward (toeward) edge of a finished toe puff, and distorting the receiving

surface from beneath in the region of a further edge of the cut-out, which further edge represents a rearward (heelward) edge of such finished toe puff, whereby a cavity is formed into which powder is then deposited, the
5 periphery of the cavity being determined by the outline of the cut-out and the extent of the gasket member along said outline, and the height of the cavity diminishing from said curved edge towards said further edge of the cut-out, to provide a scarf along the rearward edge of the finished toe
10 puff.

It will thus be appreciated that, by the use of powder, which, in its dry condition, is flowable and readily conforms to the configuration of the cavity provided as aforesaid, an accurately controlled layer can
15 be deposited on the receiving surface in a clean manner, without problems of leakage or handling tacky, viscous masses during the deposition step.

Depending upon the nature of the reinforcing/stiffening layer which it is desired to
20 provide, the gasket member may be of uniform or non-uniform thickness. In addition, it may extend around the whole or only part of the outline of the cut-out. In the case of the reinforcement of shoe upper components, desirably the gasket member tapers in thickness from a central part of
25 the curved edge of the cut-out at both sides towards said further edge thereof. By so tapering the gasket member, in combination with the distortion of the receiving surface in the region of said further edge, an accurately formed toe puff can be achieved.

30 In order to ensure that the accurately formed quantity of powder, once deposited, retains its shape, conveniently a plurality of stand-off elements is disposed, spaced from the cut-out, on the under-side of the stencil assembly for abutment with the receiving surface, said
35 elements serving to prevent the deposited quantity of powder from being disturbed by the passage of air therepast

18

when the stencil assembly is removed from contact with the receiving surface after the powder has been deposited.

There now follows a detailed description, to be read with reference to the accompanying drawings, of one method in accordance with the invention, together with a disclosure of a stencil apparatus (screen printing apparatus) for use in carrying out such method. It will of course be appreciated that this method has been selected for description merely by way of exemplification of the invention and not by way of limitation thereof.

In the accompanying drawings:-

Figure 1 is a perspective view of the stencil apparatus for use in carrying out the method in accordance with the present invention;

Figure 1A is an enlarged partial perspective view of the cut-out shown in Figure 1; and

Figure 2 is an alternative stencil apparatus also for use in carrying out the method in accordance with the invention.

Referring now to the drawing in detail and particularly to Figures 1 and 1A, there is shown an enlarged view of a stencil apparatus 12 comprising support means 25, a receiving belt 20 and template-like stencil means 26. The stencil means 26, which comprises the lower surface of the screen frame 28, receives a powder material which may be swept across the bottom of the screen frame 28 by wiper blades articulated on a movable carriage. The powder material is typically but not limited to polymers such as an ionomer, polyethylene, an ethylene vinyl acetate, polyvinyl chloride or nylon, typically in a size of 35 mesh for box toe applications or of 50 mesh to 100 mesh size when finer patterns and thinner products are desired.

The stencil means 26, retained in the channels 36, is comprised of a wire mesh screen 38 and an overlay of smooth stiff impervious plastic-like material 40 on top of

the screen 38 and a thin metal foil 40A on the bottom side thereof, being able to stick to the screen 38 and to one another by an adhesive coating on their common side. Thus, the screen 38 is "sandwiched" between the two layers of impervious material, each layer may have a pressure sensitive adhesive on their screen side to grip one another through the mesh in the screen 38 as well as to grip the screen 38. The smooth overlay of plastic-like material, and the underlay of foil on the bottom side, not the screen 38, has a cut-out 42 therethrough, which cut-out 42 is shown here by the generally semi-circular shape in the figures. The screen 38 is of a mesh size which will permit the smooth flow of powder therethrough.

A gasket-like perimeter spacing element 150 is arranged at least part-way around the outline or periphery (in this case, along the whole of a curved, forward, edge) of the cut-out 42 on the lower or foil side of the screen 38 thereof. The perimeter spacing element 150 has a particular thickness, recited here as TH1 at a particular location, and in the embodiment shown, at its mid-point. At other locations along the perimeter spacing element 150, the thickness thereof is less than the thickness at the mid-point, designated at this location as TH2. The thickness of the spacing element tapers to a thinner dimension or taper to a point at its ends, designated here as TH3. This spacing element 150 acts as a wall or partition to better keep powder swept through the cut-out 42 to its particular configuration "C". The spacing element 150 also permits the powder to be applied at those particular thicknesses TH1, TH2, TH3, etc., at those particular locations or points on the periphery of the cut-out 42, and permits the thickness of the powder applied to taper down accordingly.

The cavity formed by the receiving surface 20, the spacing element 150 and the screen 38 may also be varied in configuration by distortion of the receiving

surface 20. In particular, the powder configuration is provided with a scarf edge "E" by the use of a shim "S" on a lower support plate 82 beneath the surface 20, said shim being disposed along that/those portion(s) of the cut-out 42 without any spacing element 150 (in this case in the region of a further, rearward, edge of the cut-out 42).

A plurality of stand-off elements 160 are also spacedly arranged on the foil or under-side of the stencil 38, away from the periphery of the cut-out 42 preferably spaced from that portion of the cut-out without any spacing element 150 as shown more clearly in Figure 1A. The stand-off elements 160 can be placed anywhere necessary on the under-side of the stencil 26 away from the cut-out 42, to minimise any wind or vacuum which might occur there.

The stand-off elements 160 are "button" shaped pieces of rubber or plastic arranged to provide a gap between one another as well as between the bottom of the stencil 26 and the receiving belt 20, so that when the stencil means 26 is raised from the receiving belt 20 after the powder "C" has been configured thereon, no sudden irregular rush of air will disturb that configuration.

In the alternative apparatus shown in Fig. 2, the spacer element 150 comprises a plurality of individual spacing elements 170 which at least partially surround the cut-out 42. The individual spacing elements 170 may be likewise of different thicknesses as they approached the ends of their array, or they each may be of the same thickness all the way around the cut-out. This may be the preferred arrangement when the configuration of powder "C" is to be used for collar reinforcement or cloth-type applications. It is to be noted, that if the powder configuration is intended to be used for collars or the like, the cut-out would not necessarily be shaped as shown in the Figures, but would be of some other shape more adaptable to the shape of the substrate and its needs. The thickness of the individual spacing elements 170 may also

conform to the thicknesses of the perimeter spacing element 150 at their appropriate locations on the periphery of the cut-out 42.

Thus, when the stencil means 26 is raised slowly from the receiving belt 20 with its three-dimensional configuration of powder "C" thereon, the air does not rush in and disturb the powder because of the channels of air which pre-existed between the adjacent stand-off elements 160 to let an orderly flow of air therethrough. The powder may then be transported on its low thermal mass receiving surface, to subsequent work stations for fusing and subsequent joining with any desired substrate.

In carrying out the method in accordance with the invention, using the above-described apparatus for the provision of a reinforcement/stiffening for a shoe upper component, a 35 - 50 mesh ionomer powder of the sodium cation type is used having a melt index of 2.5, a flexural modulus of 51,000 psi (351.72mN/m²), and a heat softening temperature (Vicat) 63°C, with no additives. The cut-out 42 is prepared to the particular shape desired and placed on an 8 mesh screen woven from .015 inch (0.38mm) stainless steel wire. The choice of an 8 mesh screen represents a balance of opposing factors:

- a - fine mesh produces a smooth action to the wiper blades;
- b - too thick a screen wire size makes the scarf or taper edge too thick;
- c - coarse, small diameter wire mesh presents less surface for residual powder particles to cling to or bridge across.

The gasket 150 on the under-side of the stencil is dimensioned to provide a finished product approximately .040 inch (1.02mm) thick. Considering the bulk density and flow behaviour of the powder, a .100 inch (2.54mm) thick peripheral gasket is used on the under-side of the stencil

22

means. The scarf shim "S" on the lower support surface 82 is adjusted thereon so as to distort the receiving belt in the region of said further edge of the cut-out into contact with the under-side of the stencil means, thus to provide a proper (desired) taper on the powder applied on the receiving belt and within the confines of the peripheral gasket.

After deposition of the configuration of powder, the powder can be transferred to a fusing station having lower heating units set for about 490°F (254.4°C) and radiant heaters above the receiving belt, set for a 600°F (315.6°C) surface temperature. The fusing time is about 25 seconds, whereafter the product is transferred to a further station for application to the substrate, here the shoe upper component, being chilled on a chill plate against which it is pressed. The finished product, a shoe upper toe puff, is tapered from .012 inches (0.30mm) thick at its scarf edge to .035 inches (0.89mm) thick along its full edge.

In a further example the powder has in addition 0.3% polyalkoxy tertiary amine as an antistatic agent, and 0.3% fine silica as a dryer and flow promoter, resulting in less residual powder on the screen and less electrostatic motion of the powder particles during the deposition process, as well as having the printed pattern of a higher quality. The finished product here may be .040 inches (1.02mm) thick at its full edge.

Alternatively the powder may have an additional additive comprising .05% conductive furnace black. The deposition behaviour, flow behaviour and product pattern are similar to those set out in the preceding paragraph. The fusion time in this case may however be reduced to about 20 seconds, having a product thickness of about .040 inches (1.02mm).

For a flexible box toe for mens' or womens' shoes, a 35 mesh low density polyethylene powder may be

used, having a melt index of 22, a flexural modulus of 19,000 psi (131.04mN/m²), a heat softening temperature (Vicat) of 83°C with no additives. The lower heating block is raised to a temperature of about 400°F (204.4°C) and the upper radiant heater to about 500°F (260.0°C) for a tapered product from about .012 (0.30mm) to .035 (0.89mm) inches for a heating (fusion) time of about 18 seconds.

For a soft box toe for slippers, womens' and some childrens' shoes, a 35 mesh ethylene vinyl acetate copolymer, having a melt index of 9, a flexural modulus of about 13,500 psi (93.1mN/m²) and a heat softening temperature of about 59°C. The machine conditions are the same as those set out in the preceding paragraph, with a heating (fusing) time of 12 seconds producing a tapered product of from about .012 (0.30mm) to .035 (0.89mm) inches thick.

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Claims:

1. A method of depositing by a screen printing technique a layer of fusible powdered material in a desired
5 three-dimensional configuration on a receiving surface for the subsequent formation therefrom of a reinforcing/stiffening layer for a substrate, said method comprising the steps of

10 placing on a receiving surface a stencil assembly having a screen member, a non-permeable planar surface member in which a cut-out is formed corresponding in outline to the desired configuration for the powder, and a gasket member disposed on the under-side of the assembly adjacent at least part of the outline of the cut-out, and

15 distorting the receiving surface from beneath in the region of the cut-out, whereby a cavity is formed into which powder is then deposited, the periphery of the cavity being determined by the outline of the cut-out and the extent of the gasket
20 member along its outline, and the height of the cavity, and thus the thickness of the deposited quantity of powder, being determined by the height dimension of the gasket member and the amount of distortion of the receiving surface.

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2. A method of depositing by a screen printing technique a layer of fusible powdered material in a desired three-dimensional configuration on a receiving surface for the subsequent formation therefrom of a
30 reinforcing/stiffening layer for a shoe upper component, said method comprising the steps of

placing on a receiving surface a stencil assembly having a screen member, a non-permeable planar surface member in which a cut-out is formed corresponding in
35 outline to a so-called toe puff (box toe) for reinforcing the toe end portion of a shoe upper component,



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and a gasket member disposed on the under-side of the assembly and extending around a curved edge of the cut-out representing a forward (toeward) edge of a finished toe puff,

5 and distorting the receiving surface from beneath in the region of a further edge of the cut-out, which further edge represents a rearward (heelward) edge of such finished toe puff, whereby a cavity is formed into which powder is then
10 deposited, the periphery of the cavity being determined by the outline of the cut-out and the extent of the gasket member along said outline, and the height of the cavity diminishing from said curved edge towards said further edge of the cut-out, to provide a scarf along the rearward edge
15 of the finished toe puff.

3. A method according to either one of Claims 1 and 2 wherein the gasket member is of non-uniform thickness.

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4. A method according to Claim 2 wherein the gasket member tapers in thickness from a central part of the curved edge at both sides towards said further edge of the cut-out.

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5. A method according to any one of the preceding Claims wherein a plurality of stand-off elements is disposed, spaced from the cut-out, on the under-side of the stencil assembly for abutment with the receiving
30 surface, said elements serving to prevent the deposited quantity of powder from being disturbed by the passage of air therepast when the stencil assembly is removed from contact with the receiving surface after the powder has been deposited.

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