SHOE MAKING BY MOLDING WITH AN ADHESIVE

Fig. 1

Fig. 2

Fig. 3

Fig. 4

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SHOE MAKING BY MOLDING WITH AN ADHESIVE
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ABSTRACT OF THE DISCLOSURE
A shoemaking process in which plastic material is
molded directly onto the bottom of a shoe and the union
between the molded-on material and the shoe is improved
by disposing of a very thin sheet of heat-activatable adhesive
on the attaching surface of the shoe before the molding
material is formed. The heat of the molding material
activates the adhesive to improve the union of the molding
material to the shoe.

FIELD OF THE INVENTION
This invention relates to an improvement in direct
molding of shoe soles onto shoes and particularly to a
shoemaking process in which the strength of bond be-
tween the soling material and the shoe is improved.
An increasingly important method for making footwear
is the direct molding of plastic material onto the bottom
of a shoe upper. This process offers the advantage that
the sole is formed with an attaching surface directly com-
plementary to the bottom of the shoe upper at the same
time that it is joined to the shoe upper. With many shoe
upper materials the union between the shoe upper and
the molded-on sole is not sufficiently strong. To overcome
this weakness, adhesive or primer solutions have been ap-
plied to the bottom of the shoe upper before molding on
the sole. Although this improves the union between the sole
and shoe upper, it is a time consuming operation both in
the application of the material and in the time required
for drying of the primer or adhesive. Also, particularly
with shoe constructions in which the soling material comes
well up at the sides of the shoe upper, there have been
difficulties in applying the primer or adhesive far enough
up the side of the shoe upper to insure adhesion without
getting primer or adhesive on portions of the shoe upper
which will be exposed in the final shoe.
It is an object of the present invention to provide a
shoemaking process for direct molding of soles to shoes
in which the delays and difficulties of applying primer or
adhesive are avoided and a superior union of the molded-
on sole to the shoe is obtained.
To this end and in accordance with a feature of the
present invention, a thin sheet of heat-activatable adhe-
sive is disposed on the attaching surface of a shoe and
hot plastic sole forming material is molded against the
bottom of the shoe to activate the adhesive and establish
a firm bond between the molded-on sole and the attaching
surface of the shoe.
In accordance with the present invention, a shoe and a direct molded-on sole is secured according to the present invention through action on a thin adhesive sheet by hot sole-forming ma-
terial forced into the mold for forming the sole. The hot
sole-forming material moves along the attaching surface
of the shoe in contact with the adhesive sheet held on
that surface and by heat and by the activated adhesive state
brings the activated adhesive into wetting engagement with the attaching surface to provide adhe-
sion to that surface. When the sole-forming material and
the adhesive are cooled and hardened, the sole is joined
firmly to the shoe.
The invention will be described in conjunction with the
accompanying drawings forming part of the disclosure.
In the drawings,

FIG. 1 is a plan view on a reduced scale of an unlased
shoe upper of the string lasted type showing an adhesive
sheet in the form of a web of adhesive fibers secured to
the shoe upper;

FIG. 2 is an elevational view of the shoe upper of
FIG. 1 in string lasted condition with edge portions of
the sheet adhesive projecting outwardly and showing the
preheating of the shoe bottom and web material;

FIG. 3 is an elevational view on a larger scale with
parts broken away of the lasted shoe upper of FIG. 2
assembled against a sole-forming mold with portions of
the sheet adhesive projecting past the joint between the
shoe upper and the mold;

FIG. 4 is an angular view of a shoe upper with a sole
molded thereon showing the removal of projecting adhe-
sive sheet;

FIG. 5 is a section of a portion of a completed shoe
taken on the line V—V of FIG. 3 in the plane of the
junction between the sole and the shoe upper and show-
ing the distribution of the adhesive in the finished shoe;

FIG. 6 is a bottom view of a cement lasted shoe on a
last showing an adhesive sheet secured to the bottom of
the shoe upper with its edges projecting past the edges
of the attaching surface of the shoe;

FIG. 7 is a bottom view of a shoe upper showing a
composite unit including adhesive sheet secured to the
bottom of the shoe.

Successful operation of the present method calls for
holding a thermoplastic adhesive sheet 10 such as a web
of adhesive fibers, close to the attaching surface 12 of a
shoe 14 during the step of introducing hot sole-forming
material to mold it against the attaching surface of the
shoe. The adhesive sheet may be secured in any suitable
manner e.g., adhesively or mechanically and different shoe
constructions provide opportunities for specially advan-
tageous means of securing it. For joining an adhesive fiber
web 10 to a shoe 14 of the string lasted type, the web
10 may be stitched in place by the stitching 16 which
provides a loop for the lasting string 18 as shown in
FIG. 1. In a modification, not shown, an inseparable
reinforcement may be secured to the web, preferably adja-
cent one edge to aid in uniform feeding of the web for
stitching to provide uniform density of adhesive along
the attaching surface. The adhesive fiber web 10 is of
very open construction so that when such a shoe 14 is
placed on a last 20 and lasted by tightening the lasting
string 18, the web 10 can compress or extend in the plane
of the web to remain flat and does not interfere with the
last operation.

An adhesive sheet 10 useful in the method of the
present invention may be a network of very small cross
section elements such as fine fibers or filaments 22 of
thermoplastic adhesive material with substantial open
spaces between the elements. The fibers 22 may be in
woven or nonwoven relationship. A particularly satisfac-
tory web is made up of fibers laid down in crossing rela-
tionship with the fibers joined to each other at the points
of intersection so that the web itself is an integral unit
able of being handled as a sheet. The fibers of the web
should be at least about .002" in diameter and preferably
are from about .003" to about .010" in diameter. It is
important that the web 10 be free from large gaps and
ordinarily the gaps 24 between fibers should not exceed
.006" and preferably not exceed .004". The fiber sheet 10
should provide a quantity of adhesive corresponding to at
least about 30 grams per square yard, preferably from 40
to 80 grams per square yard and this quantity of adhesive
may be made up either as a single layer of web or as two
or more layers of web.

As an alternative adhesive sheet 10, there may also be
used a thin film of thermoplastic polymeric resin adhesive.
The film may be continuous or may have openings, for
example, perforations or slits, provided the total amount of
adhesive is at least 30 grams and preferably 40 to 80
grams per square yard. The film of adhesive may be se-
cured to the bottom of the shoe or the joint 38 which is
adhesive to the adhesive fiber web, i.e., adhesively or
mechanically. While the film of adhesive is effective it
lacks the ability to compress or stretch easily in the plane
of the sheet so that it is less readily laid down in the
curving path dictated by the outline of the shoe than is the
fiber web.

As the adhesive of which the sheet is formed, it is
preferred to use high molecular weight thermoplastic
synthetic polymer resins, for example, relatively high mole-
cular weight polystyrenes, polyamides, polyesteramines, and
thermoplastic polyurethane glycol urethanes or polyether gly-
col urethanes. Other normally solid thermoplastic resinous
materials capable of melting to a condition for wetting and
adhering to shoe upper materials and of hardening to
provide a strong bond may be used. Ordinarily the ad-
hesive should have an activation temperature below, suit-
able at least about 25° F, below the temperature at which
the sole forming material is introduced into the mold. For
example, where a vinyl plastic sole material is injected at
350° F, the melting point of the adhesive may be
about 275° F. Adhesives with still lower melting points
may be used. Also, with suitable preheating, adhesives
with higher melting points have been employed.

Best adhesive union of the shoe 14 and the molded-on
sole 26 is obtained by preheating the attaching surface
12 of the shoe 14 and the adhesive sheet or web 10. This
optional preheating is carried out conveniently as shown
in FIG. 2 by subjecting the attaching surface 12 of the
laid shoe upper and the adhesive sheet to a radiant heat
source, for example, infrared lamps 30, for a brief period.
A convenient guide as to the extent of this preheating for
adhesive fiber web is to heat until the adhesive web 10
reaches a temperature at which it softens and wills. For
example, with a web 10 of which the adhesive has a melt-
ing point of 280° F, this preheating may involve exposure
to an infrared heater at a space of three inches for a period
of about 15 seconds. It may be desirable, particularly
where a fiber web or finish which is heat sensitive, to provide
an opaque, e.g. sheet metal, mask to restrict the radiant
heating to the attaching area only, and where this is done,
there is even less tendency for spew of molding material
to adhere to the shoe.

When the attaching surface 12 of the upper 14 and the
adhesive sheet 10 have been preheated, the lasted shoe
upper 14 is promptly assembled with a sole-joining mold
32. As shown in FIG. 3, in which the sole mold 32 is the
so-called high bite type in which plastic material is molded
to a substantial height around the sides 34 of the shoe
upper 14, the shoe upper 14 presses against the edge 36 of
the mold 32 to form a seal with the adhesive sheet 10
between the shoe upper 14 and the mold edge 36. Even
where an open sheet such as the fiber web is used the
thinness of the fibers 22 of the web 10 is such that the
presence of the web at the joint 38 between the shoe upper
14 and the mold edge 36 does not disrupt the seal between
them.

Promptly after assembly of the shoe upper 14 against
sole-joining mold 32 hot sole-joining material is forced
into the mold to fill the mold. Most commonly, the sole
forming material is a heat softened plasticized vinyl chlo-
ride polymer or copolymer resin, but other hot flowable
resinous materials or synthetic polymer resins and
synthetic polymer rubbers may be used. The heat of the
sole-joining material completes softening of the adhe-
sive of the sheet to actively adhesive condition in which
the movement of the plastic material within the mold can
wipe it into more complete engagement with the attach-
ing surfaces of the shoe upper.

When all of the sole-forming material has been in-
truded into the mold 32, the molded sole 26 and ad-
hesive from the sheet 10 are allowed to cool and the shoe
14 is then removed from the mold carrying with it the
molded-on sole 26. As shown in FIG. 4 the portions 40 of the adhesive sheet 10 which projected
between the shoe upper 14 and the sole mold 32 remain on the shoe. It has been found that
this projecting portion 40 may be removed by a rotary brush 42 formed of stiff fibers or by a hot knife.

As discussed above, the heat and movement of the
sole-forming material act to melt the adhesive and spread it
into effective engagement with the shoe upper ma-
terial. FIG. 5 is a section taken in the plane of the
junction of the shoe upper 14 and the sole 26 and shows
that where an adhesive fiber web is used individual ad-
hesive fibers have been spread out against the attach-
sing surface 12 and that movement of the plastic has
pushed molten adhesive ahead of it so that an excellent
spreading of adhesive to insure strong union between the
shoe 26 and shoe upper 14 is obtained.

In molding a sole onto a cemented last or other con-
ventional lasted shoe, an adhesive sheet or web 10 may
be held adhesively or mechanically in position to cover
the entire bottom 50 of a shoe upper 52 with portions
54 of the sole extending past the outer edges 56 as
shown in FIG. 6. Molding of a sole to such a shoe
upper involves essentially the same procedure as described
above in connection with the string lasted shoe upper
14. That is, the bottom 50 of the shoe upper 32 with
adhesive web 10 in place is preferably, subjected to a
preheating step, the shoe upper 52 with adhesive web
10 thereon is pressed against sole forming mold and hot
sole-forming material is forced into the mold. The same
advantageous result is improvement in the strength of
union between the shoe upper and the sole is obtained.

Another procedure for locating an adhesive sheet on
the bottom of a shoe upper involves placing a piece of
the adhesive sheet 10 of suitable size on a pad having
a release type surface, e.g., having a layer of release paper
on its surface. The sheet 10 is then subjected to radiant
preheating and the preheated bottom of the shoe upper
is pressed onto the sheet just prior to the time of assem-
by of the shoe upper with a sole forming mold. The ad-
hesive sheet 10 adheres to the shoe upper at least lightly
and is located in proper position to supply adhesive action when the hot sole form-
ing material is forced into the mold.

In a still further procedure (see FIG. 7) for securing adhesive sheet 10 in place, there may be used a center
piece 60 of paper or other inexpensive sheet material cut
so that it can be placed on the bottom of a shoe upper
62 with its edges 64 extending past the inner edges 66 of
the lasted over portion 68 of the shoe upper, but
spaced well within the outer edges 70 of the sole attach-
ing surface 72 of the shoe upper. A strip of adhesive
sheet 10 is secured to the center piece in a manner such
that when the composite of center piece 60 and sheet
10 is secured to the bottom of a shoe upper, portions
of the sheet 10 will extend outwardly beyond the edges
70 of the attaching surfaces of the shoe upper. This com-
posite has the advantage over the overall coverage of
the shoe bottom with adhesive sheet that it is more
economical. In its use of the adhesive sheet and the
center piece 60 will secure to seal the joint between
the shoe insole 72 and the inner edges 66 of the lasted
over portion 68 of the shoe upper 62. Also the center
piece 60 serves as a substantially inextensible reinforce-
ment which makes it easier to locate and hold the strip
of web on the bottom of the shoe upper.

The present process is useful also to improve the
union between inserts and/or facings and the molded
plastic. For example, it may be used to improve shoe constructions formed by disposing a tread member in a sole, e.g. a leather sole piece or heel member in a forming mold, locating a shoe upper to seal the mold and injecting hot fluid plastic material to mold resin in the space between the bottom of the shoe upper and the tread member. That is, improved union between such insert or facing and the plastic material in the final shoe may be obtained by positioning an adhesive sheet such as an adhesive fiber web on the surfaces of the insert or facing member which will be adjacent the plastic.

The following examples are given as of assistance in understanding the invention. It is to be understood that the invention is not limited to the particular procedures, materials or conditions employed in the examples.

**EXAMPLE I**

A crystallizable copolyester from condensation and polymerization of a 5.0:4.1:0.9 mol ratio mixture of terephthalic acid, isophthalic acid and dibutyl sebacate with 1.4 butane diol having a melting point of about 280°F. was melted and extruded from a plurality of spinnerettes as filaments .003 to .005 inch in diameter. The filaments were deposited on a moving carrier in crossing relationship to form a web with the filaments adhered to each other at crossing points. The rate of extrusion and the speed of the carrier were correlated so that the web had a weight per square yard of about 60 grams. On cooling, the web was slit to form strips of about one inch in width.

The strip of resin fiber web was stitched along the listing margin of a string lasted type canvas shoe upper with the web held in place by the stitching which provided a loop for the lasting string.

The shoe upper was placed on a last and conformed to the shape of the last by tightening the lasting string. At this point the strip of web was spread outwardly to overlie the listing margin of the shoe upper. The bottom of the shoe upper was subjected to radiant heat at a distance of 2 inches for a period of about 15 seconds which both heated the bottom of the shoe upper and caused the web to wilt into engagement with the bottom of the shoe upper. The shoe upper was then promptly assembled with a sole-forming mold wherein the engagement between the shoe upper and the edges of the sole mold provided a seal with portions of the web pinched between the shoe upper and the mold edge. Promptly after assembly of the shoe upper, hot, plasticized polyvinyl chloride sole forming material was injected into the mold to fill the mold. The material in the mold was allowed to cool for two minutes and the mold was then opened. The sole formed on the bottom of the shoe upper adhered strongly and was not separable without disrupting the shoe upper material.

**EXAMPLE II**

A 0.003 inch thickness continuous film was formed of the crystallizable terephthalic acid, isophthalic acid and dibutyl sebacate of Example 1 and the film was slit to form strips of one inch in width.

A strip of resin film was secured to the bottom of a cement lasted shoe upper with the edges extending outwardly to overlie the listing margin of the shoe upper. The bottom of the shoe upper was subjected to radiant heat for a period of about 15 seconds. The shoe upper was then promptly assembled with a sole-forming mold where the engagement between the shoe upper, the film and the edges of the sole mold provided a seal with the film pinched between the shoe upper and the mold edge. Promptly after assembly of the shoe upper, hot, plasticized polyvinyl chloride sole forming material was injected into the mold to fill the mold. The material in the mold was allowed to cool for 2 minutes and the mold was then opened. The sole formed on the bottom of the shoe upper adhered strongly and was not separable without disrupting the shoe upper material.

**EXAMPLE III**

A center piece was cut from paper to a size and shape to cover the center portion of a shoe bottom with its edges extending just slightly past the inner edge of the lasted over portion of the shoe upper. A one inch wide strip of adhesive fiber web similar to that of Example I was adhered along the edges of the center piece to project outwardly from the center piece to form a composite unit for assembly against the bottom of a lasted shoe upper with the edges of the web extending beyond the edges of the shoe upper.

An assembly of leather shoe upper and adhesive web-center piece composite was subjected to radiant heat at a distance of 2 inches for a period of about 30 seconds which both heated the attaching surfaces of the bottom of the shoe upper and caused the web to wilt into engagement with those attaching surfaces. The shoe upper was then promptly assembled with a sole-forming mold where the engagement between the shoe upper and the edges of the sole mold provided a seal with portions of the web pinched between the shoe upper and the mold edge. Promptly after assembly of the shoe upper, hot, plasticized polyvinyl chloride sole forming material was injected into the mold to fill the mold. The material in the mold was allowed to cool for two minutes and the mold was then opened. The sole formed on the bottom of the shoe upper adhered strongly and was not separable without disrupting the shoe upper material.

Having thus described our invention what we claim as new and desire to secure by Letters Patent of the United States is:

1. In a shoe making process including the steps of locating a shoe upper in closing engagement with a mold to form a molding cavity, filling said molding cavity with hot, synthetic polymer molding material and cooling said material to solidify it an adhered molded element, the improvement which comprises holding a sheet of normally solid thermoplastic polymeric adhesive on an attaching surface of a shoe component to which said element is to be molded, said adhesive being soft and flowable to wet and adhere to said attaching surface at the temperature of said hot molding material, said sheet providing at least about 30 grams of adhesive per square yard, activating said adhesive by heat from said hot molding material and spreading said activated adhesive into wetting adhesive engagement with said attaching surface by movement of the hot molding material in filling the molding cavity.

2. The shoe making process according to claim 1 in which said adhesive sheet is a network of small cross section elements with substantial open spaces between the elements to constitute a coherent open sheet.

3. The shoe making process according to claim 2 in which said sheet is a nonwoven web of fibers of adhesive and said fibers are self-adhered to adjacent fibers at points of intersection.

4. The shoe making process according to claim 1 in which said adhesive sheet is a film of said thermoplastic adhesive.

5. The shoe making process according to claim 4 in which said film has openings therein.

6. The shoe making process according to claim 1 in which said mold is a sole forming mold and in which said sheet is heated to bring the adhesive to softened but not freely fluid condition before engagement with said mold and said mold is filled with hot plastic sole forming material while said adhesive is still in heated condition.

7. The shoe making process according to claim 1 in which said mold is a sole forming mold, and said adhesive sheet is positioned on the sole portion of said shoe upper and is clamped in and projects past the sealing bite between the mold and the shoe upper to hold said sheet in place during mold filling.
8. The shoemaking process according to claim 7 in which said adhesive sheet is a network of small cross section elements with substantial open spaces between the elements and said sheet and the bottom of said shoe upper are preheated before said shoe upper is associated with the mold.

9. The shoemaking process as defined in claim 7 in which the adhesive sheet is a non-woven web of fibers of adhesive, said fibers being arranged in crossing relation to each other and are self-adhered to adjacent fibers to constitute a coherent open sheet, said fiber web is disposed on the sole attaching surface of the shoe upper and the assembly is subjected to radiant heat to preheat the web and attaching surface of the shoe upper.

10. The shoemaking process according to claim 3 in which said web is secured to the shoe upper by stitching.

11. The shoemaking process according to claim 10 in which said shoe upper is of string lasted construction and said web is secured to the upper by the stitches which hold the lasting string.

12. The shoemaking process according to claim 7 in which said adhesive sheet is a network of small cross section elements with substantial openings between the elements and the adhesive and the attaching surface of the shoe upper are heated separately before assembly and positioning in engagement with the mold.

13. The shoemaking process according to claim 12 in which the adhesive sheet is a web of adhesive fibers and is subjected to radiant heat while supported on a release surface and the preheated bottom surface of a shoe upper is pressed against the web to form an at least limited adhesive engagement between said web and said bottom whereby the web is held on the bottom of the shoe upper when said shoe upper is positioned on the sole forming mold.

14. The shoemaking process according to claim 2 in which a strip of said adhesive sheet material is secured about the periphery of a center piece of sheet material, said sheet material having a size and shape relative to a shoe bottom adapted to cover central areas of the shoe bottom with its edges extending past the inner edge of lasted over portions of the shoe upper but spaced well inside the outer edge of the sole attaching surface of the shoe upper, said strip of adhesive sheet material extending outwardly past the edges of the center piece a distance to overlie attaching surfaces of the bottom of the shoe upper.

15. The shoemaking process according to claim 1 in which said shoe component is a tread member, said thermoplastic polymeric adhesive sheet is held on the attaching surface of said tread member and said tread member is deposited in said mold.

16. The process as defined in claim 15 in which said tread member is a leather sole piece and said adhesive sheet is a non-woven web of fibers of adhesive arranged in crossing relation to each other and said fibers are self-adhered to adjacent fibers at points of intersection.

References Cited

UNITED STATES PATENTS

25 1,970,257 8/1934 Tellow 156—313 X
2,580,245 12/1951 Rollman et al. 156—313 X
2,375,308 3/1965 Werman et al. 1264—244 X
3,076,368 4/1968 Giannone et al. 1264—135

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