PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Shoes, Lasts and method for making Shoes

We, UNITED STATES RUBBER COMPANY, a Corporation organised under the Laws of the State of New Jersey, United States of America, of Rockefeller Center, 1230, Avenue of the Americas, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention is concerned with shoe-lasts, with a method of making shoes using such shoe-lasts and with the shoes themselves.

The shoe-lasts of the present invention are particularly useful for imparting toe spring to shoes having cast soles thereon when made by a casting operation as described in Specification No. 712,052.

The term "toe spring" as used herein is the upward curvature of the periphery of the bottom of the toe portion of the shoe sole, or the upper edge of the foxing, which curvature takes the form of the normal upward curvature of the foot beyond the ball portion of the foot.

In Specification No. 712,052 there is described a method of casting a rubber outsole on to the bottom of a footwear sole foundation comprising the steps of pouring a rubber latex containing vulcanising and gelling agents into an open footwear sole mould cavity, suspending in the latex the bottom of the sole foundation in spaced relation to the wall and base of the mould cavity, allowing the latex to gel, separating the foundation with the gelled latex thereon from the mould cavity and drying and vulcanising the latex. The periphery of the bottom of the toe portion of the sole in that method lies in a plane parallel to the plane of the level of the liquid material in the mould cavity from which the sole is cast. Accordingly a shoe so manufactured is not provided with toe spring when the sole is cast thereon and so long as the toe portion of the sole remains in the cast position. Such parallel arrangement of the plane of the periphery of the bottom of the toe part of the last is required in order to produce a uniform thickness of sole or uniform height of foxing at the periphery of the bottom of the toe part of the sole by the casting operation.

According to the present invention there is provided a shoe-last adapted to support a shoe upper for casting a flexible sole thereon, said last comprising a heel part and a toe part pivotally connected together about an axis extending across the width of the last in the metatarsal-corresponding portion of the last and means located within the last for effecting pivotal movement of the toe part from a casting position to a toe sprung position, for the purpose of producing toe spring in the formed shoe.

According to a further feature of the invention there is provided a method of casting a flexible sole from a liquid casting material (e.g., a gelable liquid rubber latex) on to the bottom of a shoe upper applied to a last constructed as described in the preceding paragraph, said method being characterised by the step of pivoting the toe part of the last from a casting position to a toe sprung position after the casting material has solidified on said upper but before curing of the cast sole, said curing being effected in the toe sprung position of the last whereby permanent toe spring is produced in the cast sole. The invention also includes within its scope shoes manufactured in accordance with this process.

The invention is further described with reference to the accompanying drawings in which:—

Fig. 1 is a side elevational view of an apparatus with which the improved process may be carried out, and showing the upper portion of the improved last;

Fig. 2 is an elevational view of the improved last;

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Fig. 3 is a horizontal cross sectional view of the top portion of the last taken on line 3—3 of Fig. 2;

Fig. 4 is a bottom plan view of a modified form of the improved last;

Fig. 5 is a cross-sectional view of a shoe in a sole mould taken on a line indicated by the line 5—5 in Fig. 4, and showing a modified form of the last in full side elevational view with the shoe thereon; and

Fig. 6 is a longitudinal cross section of a toe portion of a further modification of a shoe embodying this invention.

Referring to Figs. 2 and 3, the last 10 comprises a toe part 11 and a heel part 12, which are hinged together with a hinge joint 13 located in the metatarsal-corresponding portion of the last. The last 10 may be made of any suitable material, preferably metal, which is cast in the form of a hollow shell 14 in accordance with the usual practice, as shown in Figs. 1 and 3.

Any suitable form of hinged joint may be used for pivotally connecting the toe part 11 to the heel part 12, but as shown herein the joint 13 comprises a cylindrical projection 15 on the toe part 11, which fits into a cylindrical socket 16 in the heel part 12. The joint 13 is held together by a bow spring 17, which is located within the shell 14 and is held under tension between a pin 18 in a toe part 11 and a pin 19 in the heel part 12. One end of the spring 17 is hooked around the pin 18 which passes through the toe part 11 from one side of the shell to the other, and the other end of the spring 17 is hooked around the pin 19 which passes through the heel part 12 from one side of the shell to the other. The toe part 11 is shown in full line position in Fig. 2, which is the sole casting position of the toe part. In that position, the centre of the pin 18 in the toe part is located on a line 20 passing through the centres of the pins 18 and 19 and below the centre 21 of the hinge joint 13. The toe part 11 is adapted to be pivoted from its full line position, or sole casting position to a toe sprung position as shown by the dot-and-dash lines. When in the toe sprung position, the line 20 passing through the centres of the pins 18 and 19 moves to a position 22 above the centre 21 of the hinge joint. In the operation of this construction, when the line 20 passes over the centre 21 of the hinge joint in either direction, the toe part is snapped by the spring 17 from the sole casting position to the toe sprung position, or vice versa. Such action is referred to hereinafter as snap action, which is produced by the snap acting spring 17.

The toe part 11 of the last 10 is moved from its sole casting position to its toe sprung position, or at least over the dead centre of the hinge joint (which is that position of the toe part 11 when the line 20 between the pins 18 and 19 intersects the centre 21 of the hinge joint 13), by the longitudinal actuation of a rod 23, which is pivoted at one end to a pin 24 passing through the toe part 11 from one side of the shell to the other, and at the other end to a crank pin 25, as shown in detail in Fig. 3. The crank pin 25 comprises a screw which is threaded into the end of a shaft 26 at a point which is eccentric to the axis of rotation of the shaft 26, which is rotatably mounted in a bearing formed in a bushing 27 threaded into a cylindrical web 28 cast into the shell 14 of the heel part 12 of the last 10. The shaft 26 is provided with hexagonal socket 29 for the reception of a wrench, or key, which is adapted to be used to manually turn the centre of the crank 25 from the forward position shown in Figs. 2 and 3 to the rearward position, so as to pivot the toe part 11 from the full line position to the dot-and-dash line position. When the crank pin 25 is turned through 90° from its forward or rear position, the line 20 between the pins 18 and 19 passes over the dead centre point of the hinge joint, and the spring 17 snaps the toe part to its final upward or downward position, which may throw the crank the remaining 90° over to a 180° position, where the crank pin 25 is on dead centre, that is in line with the centre of the shaft 26 and the pin 24, and tends to maintain the toe part 11 positively in either the sole casting or toe sprung positions.

In order to compensate for the shrinkage in a sole which may be cast on the bottom of a shoe upper, the bottom 30 of the last 10 is made in a convex shape, as indicated by the curved line 31 extending from heel to toe. The bottom 30 is also curved in the transverse direction, as indicated by the space between the lines 31 and 32, which latter line represents the plane of the periphery of the bottom of the last. In the performance of the operation of casting a sole on a shoe of the type shown in Fig. 1, in order to provide a uniformly thick sole or a uniformly high foxing at the periphery of the sole, the periphery of the bottom of the last should lie in a single plane, as indicated by the line 32, and when the sole is cast upon the lasted upper, such plane is arranged parallel to the liquid level of the casting material in the sole moulding cavity. In other types of shoes the thickness of the cast tread surface may vary in the instep and heel portions, and the bottom of the instep and heel portions of the last may be shaped to accommodate an arch support and a raised heel, as described in reference to Fig. 5. However, in all types of shoes made in accordance with this invention, the periphery of the bottom of the toe part of the last must lie in a single plane, and such periphery must be arranged parallel to the liquid level of the sole casting material in the mould for the

Fig. 3 is a horizontal cross sectional view of the top portion of the last taken on line 3—3 of Fig. 2;

Fig. 4 is a bottom plan view of a modified form of the improved last;

Fig. 5 is a cross-sectional view of a shoe in a sole mould taken on a line indicated by the line 5—5 in Fig. 4, and showing a modified form of the last in full side elevational view with the shoe thereon; and

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purpose of producing the desired uniformly thick sole and uniformly high foxing at the toe part of the shoe. In the event a foxing is cast integrally with the cast sole, the last 10 is preferably provided with a vertical peripheral side portion 32*a* extending upwardly from the periphery 32 of the bottom of the last a distance equal to the height of the foxing to be produced. As shown in Fig. 2, the top periphery 33 of the side portion 32*a* terminates in a plane parallel to the plane of the periphery 32 of the bottom of the last, as represented by the line 33.

The method of casting a flexible sole from a liquid casting material on to the bottom of a lasted shoe upper, and producing toe spring in the cast sole, is illustrated in Fig. 1, in which an apparatus is shown for carrying out the process with the use of the last shown in Figs. 2 to 5. Referring to Fig. 2, the last 10 is provided with the usual lasting stand pin recesses 34 for securing the last to a lasting stand (not shown). The last 10 is placed on the lasting stand, and a shoe upper 34*a* is lasted thereon over an insole in the usual manner or otherwise applied thereto in the conventional slip lasting process. The last 10 with the lasted upper thereon is then placed in a sole casting jig 35, while it is elevated to the dot-and-dash line position, as shown in Fig. 1. The liquid casting material is placed into a sole forming cavity 36 formed in an elastic flexible mould 37, which is secured to a base 38 in a fixed position. The lasted shoe upper 34*a* is then lowered into the mould cavity until the casting material rises therein to the level of the top edge of the outer periphery of the shoe sole, or to the top edge of the foxing to be cast thereon. Preferably the mould cavity is so designed that the top rim of the mould cavity is level with the liquid level of the casting material after the shoe is placed in the mould cavity to the desired depth, with the lower side walls of the upper equally spaced from the side walls of the cavity and with the bottom of the lasted upper substantially parallel to the bottom of the mould.

At the time the bottom of the lasted upper is lowered into the mould cavity, the toe part 11 of the last is pivoted to the full line position as shown in Fig. 2, and the periphery of the bottom of the last as represented by the line 32 is arranged parallel to the liquid level 39 of the casting material. The shoe remains in the mould cavity until the casting material solidifies thereon and forms the outsole 40 and foxing 41 thereon. The casting material is preferably gelable rubber latex as described in said Specification No. 712,052. After the sole has congealed on to the upper and becomes sufficiently tough, the last 10 with the upper and sole cast thereon is removed from the mould cavity by elevating the casting jig 35 to the dot-and-dash line position shown in Fig. 1. The last 10 may then be removed from the jig, and the toe of the shoe is pivoted upwardly to its toe sprung position either before or after removal by inserting a key into the socket 29 of the shaft 26. The key is turned through 180° and the shoe sole 40 is pivoted to its upward or toe sprung position, in which it is given a final set to impart permanent toe spring thereto. The set or cure may be produced by the usual vulcanising process, or heat treatment while the shoe remains on the last in a hot air oven at atmospheric pressure, and without confining the sole in a mould.

As described more fully in the foresaid prior application, a sole cast from gelable rubber latex is caused to shrink as a result of the extraction of the liquids during the casting, drying, and curing of the sole. In order to resist shrinkage of the outsole and cause the shoe to retain its toe spring after the sole has been cured, a stiff layer of material is incorporated in the bottom of the shoe. As illustrated in Fig. 1, the stiff layer may be incorporated in the shoe in the form of an insole 40′. The upper 34*a* may be lasted over the insole 40′, and at the time of the lasting operation, the insole is mouldable and it is caused to conform to the shape of the bottom of the last during the lasting operation, and to the upwardly curved shape of the toe part of the sole when it is subsequently sprung from the sole casting position to the toe sprung position. The insole is heat-curable and is converted from its mouldable state to its permanently fixed stiff state during the cure of the outsole and thereby assists in causing the shoe to retain its final toe sprung position. It has been found that an insole made of uncured vulcanisable rubber rag stock, which is adapted to vulcanise during vulcanisation of the cast outsole, is suitable for this purpose.

The jig 35 is provided with a hand wheel 42 which is rotatably mounted in the jig arm 43. The hand wheel 42 is provided with a stem 44, which is rotatably secured to the arm by a pin 45 extending through the arm 43 into a groove 46 in the stem 44. The lower end of the stem 44 is provided with screw threads, which are threaded into the threaded bore 47 of the last 10 to secure it to the jig arm 43. Locating pins 48 anchored in the arm 43 extend into the lasting stand pin recesses 34 of the last 10 to orient it on the jig 35.

The jig arm 43 of the jig 35 is affixed to a shaft 49 pivotally mounted between two bearings brackets 50, one of which is provided with an arcuated plate 51, having recesses 52 and 53 for receiving the end of a manually operable spring pressed rod 54 slidably mounted on the arm 43 of the jig. When the end of the rod 54 is received by

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the recess 52, the lasted shoe is retained in the sole casting position in the mould cavity 36, and when the rod 54 is in the recess 53, the lasted shoe is held in the elevated position as shown by the dot-and-dash lines, where the last 10 is secured to and removed from the jig.

A modified form of the last 10 is shown in Figs. 4 and 5. The modified last 55 is provided with a toe part 56 and a heel part 57 which are hinged together at or near the ball portion of the foot by a hinged joint 58, which is constructed and operated in the same manner as described in reference to Figs. 2 and 3. This last is provided with a recess 59 in its bottom surface for the reception of an arch support 60, such as shown in cross-section in Fig. 5. In this modification it will be noted that the plane of the periphery 61 of the convex bottom 62 of the last is cut by the depression 59 formed for the arch support 60. In this case, and others concerning the application of a heel to a cast latex sole, the plane of the periphery of the bottom of the last may be cut at the longitudinal arch and in the rear of such area to accommodate such constructions but the plane of the periphery 61 of the bottom of the toe part of the last will remain as shown in Fig. 5, and such plane 61 of the toe part 56 must be arranged parallel to the liquid level 63 of the casting material in the mould cavity 64 in order to form a uniform thickness of the cast sole and uniform height of foxing thereon around the outer periphery of the toe part of the cast sole.

As shown in Fig. 5, the arch support 60 is placed in the recess 59, and the shoe upper 65 is lasted on the last 55 over a mouldable, heat-curable, perforated insole 66, which is placed between the arch support 60 and the outsole to be cast thereon. The same type of insole may be used in the shoe made in accordance with Figs. 1 to 3, heretofore described. The perforations 67 in the insole 66 are provided to permit the escape of any air or gas which may be trapped between the top surface of the liquid latex and insole.

After the shoe upper 65 is lasted over the insole 66 on the last 55 as shown in Fig. 5, the last 55 is placed on the jig 35 as shown in Fig. 1 and dipped into the mould 68 containing the liquid casting material, which forms the outsole 69 thereon. From this point on the shoe and sole is treated in the same manner as described in reference to Figs. 1 to 3 of the drawings.

As shown in Fig. 6, a midsole 70 may be incorporated in the shoe 71, as shown in the longitudinal cross-section of a toe portion of the shoe. Such shoe is built up on a last having a pivoted toe part, as heretofore described, the shoe upper 72 being lasted over an insole 73 comprising an under layer of sponge rubber 74 bonded to a top layer of fabric 75. The midsole 70 is then applied to the bottom of the lasted upper 72, and it comprises a top layer of sponge rubber 76, and a bottom layer 77 of perforated rag stock. The perforated layer 77 is adhered to the sponge rubber layer 76 and this composite midsole is adhered to the bottom of the lasted shoe upper. The outsole 78 is then cast over the midsole 70 and on to the shoe upper 72, as heretofore described. The sponge rubber layers 74 of the insole 73 and 76 of the midsole 70 are cured or vulcanised before they are incorporated in the shoe and are porous, soft and flexible, whereas the layer of rag stock 77 is uncured mouldable and plastic, but is adapted to be vulcanised to cause it to retain its shape and become stiff and resistant to bending. The vulcanisable layer 77 is cured simultaneously with the cure of the outsole 78, as heretofore described, with, or without toe spring being imparted to the shoe.

As shown in this modified form of shoe, it is desirable to use a relatively flexible soft insole 73 to complement the softness of the sponge rubber layer 76 in the midsole, and place the bottom layer 77 of the midsole 70 adjacent to the outsole 78 so that the rag stock layer 77 will become relatively stiff when vulcanised and will be more effective in resisting the shrinkage of the cast outsole, and also so that it will be more effective in permitting any air that may be trapped between the upper surface of the liquid casting material and the midsole to escape through the perforations 79 of the bottom layer 77 of the midsole 70 and pass upwardly through the porous sponge rubber layers 76 and 74 of the midsole 70 and insole 73 during the vulcanisation of the outsole 78. Blisters, and air cells are thus prevented from being formed in the cast outsole, and between the several layers of material in the bottom of the shoe.

The sponge rubber layer 76 of the midsole and 73 of the insole is cured prior to being assembled in the shoe in order to prevent expansion and the formation of gases during the cure of the outsole 78 and bottom stiffening layer 77 of the midsole, and thereby prevent the outsole from being deformed.

What we claim is:—

1. A shoe-last adapted to support a shoe upper for casting a flexible sole thereon, said last comprising a heel part and a toe part pivotally connected together about an axis extending across the width of the last in the matatarsal-corresponding portion of the last and means located within the last for effecting pivotal movement of the toe part from a casting position to a toe sprung position.

2. A shoe-last in accordance with Claim 1 wherein the bottom of at least the toe part of the last is convex and the periphery of

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the bottom of the toe part lies in a single plane.

3. A shoe-last in accordance with Claim 1 wherein the entire bottom of the last is convex, the periphery of the bottom of the last lying in a single plane when the toe part is in the casting position.

4. A shoe-last in accordance with Claim 2 or 3 wherein the heel and toe parts are united by a hinge joint having an axis extending transversely to the length of the last and substantially parallel to the plane in which the periphery of the bottom of the toe part of the last lies.

5. A shoe-last in accordance with Claim 4 wherein the means for effecting pivotal movement of the toe part about the hinge joint includes a rod pivotally connected to the toe part and extending into the heel part.

6. A shoe-last in accordance with Claim 5 wherein there is provided a manually operable crank means located at the upper portion of the heel part for imparting longitudinal movement of the rod.

7. A shoe-last in accordance with any of the preceding claims having in addition a snap acting mechanism for pivoting the toe part to, and maintaining it in, its two extreme positions.

8. A shoe-last in accordance with Claim 7 wherein the snap acting mechanism comprises an over-centre device having a tension spring anchored to the toe and heel parts.

9. A shoe-last adapted to support a shoe for casting a flexible sole thereon substantially as herein described with reference to Figs. 2 to 6.

10. In a method of casting a flexible sole from a liquid casting material (e.g., a gelable liquid rubber latex) on to the bottom of a shoe upper applied to a last which is constructed in accordance with any of Claims 1 to 9, the step of pivoting the toe part of the last from a casting position to a toe sprung position after the casting material has solidified on said upper but before curing of the cast sole, said curing being effected in the toe sprung position of the last whereby permanent toe spring is produced in the cast sole.

11. A method of casting a flexible sole in accordance with Claim 10 wherein the plane of the periphery of the bottom of the toe part of the last is maintained parallel with the liquid level casting material in an open sole-forming mould into which the lasted upper is dipped during the casting operation.

12. A method of casting a flexible outsole in accordance with Claim 10 or 11 wherein a layer or inner sole of mouldable heat-curable material is applied to the base of the lasted upper before casting and heat curing of the outsole and the mouldable layer or insole is effected simultaneously until sufficient stiffening is imparted to the layer or insole to retain its toe sprung shape.

13. A method of casting a flexible outsole in accordance with Claim 12 wherein the layer applied to the bottom of the lasted upper consists of a top layer of soft flexible porous material and a bottom layer of mouldable heat curable perforated material.

14. A method of casting a flexible outsole in accordance with Claim 12 or 13 wherein the mouldable heat-curable material is perforated rag stock.

15. A method of casting a flexible outsole in accordance with Claim 13 or 14 wherein the soft flexible porous material is sponge rubber.

16. A method of making a shoe having a flexible cast outsole thereon employing a shoe last constructed in accordance with any of Claims 1 to 9, substantially as herein described.

17. A shoe comprising a flexible cast outsole when made by the method of any of Claims 10-16.

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