PATENT SPECIFICATION

712,052

Date of Application and filing Complete Specification Oct. 23, 1951.
No. 24668/51.
Application made in United States of America on Oct. 25, 1950.
Application made in United States of America on Oct. 25, 1950.
Complete Specification Published July 14, 1954

Index at acceptance :—Classes 17(2), B1B2; and 87(2), A1R(22X : 27 : 73), A2C3.

COMPLETE SPECIFICATION

A method and Apparatus for making Footwear with Rubber Soles and Footwear made thereby

We, UNITED STATES RUBBER COMPANY, of Rockefeller Center, 1230, Sixth Avenue, New York, United States of America, a Corporation organised under the Laws of the State of New Jersey, 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 relates to an improved method and apparatus for manufacturing footwear having rubber soles and to the improved footwear made thereby.

It is known to form rubber soles on the bottom of lasted footwear uppers by moulding processes in which the upper is sealed against the rigid rim of a metal mould by forcing the bottom of the upper into contact with the rim. A mould closed by the upper is required to mould the rubber composition into a properly shaped sole. Air is trapped in the closed system and unless it is discharged prior to the vulcanisation of the sole, which is carried out in the mould, the trapped air causes voids or blisters to be formed in the vulcanised sole. The air is eliminated in some cases by moulding the charge of rubber composition under pressure. Due to variations in the bottom sealing surface of lasted uppers, it is difficult to produce a good seal between the upper and the mould rim. Also, the upper is sometimes cut as a result of the pressure of the upper against the mould rim needed to seal the mould cavity.

It is an object of this invention to provide a method of and apparatus for casting a rubber outsole onto an upper comprising a sole foundation whereby the above mentioned disadvantages are eliminated. It is also an object of the invention to provide improved footwear having a latex rubber sole.

According to the present invention a method of casting a rubber outsole onto the bottom of a footwear sole foundation comprises 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 a sole foundation in spaced relation to the walls 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.

According to a further feature of the invention an apparatus for casting a footwear sole of latex rubber onto a footwear sole foundation comprises in combination a mould having a footwear sole moulding cavity therein which has a concave base extending longitudinally from the heel portion to and including the toe portion and has a perimeter lying in one plane and a last with a correspondingly shaped base and having a support adapted to suspend a footwear sole foundation thereon in spaced relation to the walls and base of the mould cavity.

It is an advantage of the method according to the invention that as the outsole foundation is lowered into the latex to the required depth the displaced latex is forced upwards in the mould cavity and the air thus displaced and any air in the latex in the form of bubbles, is free to escape from the free surface of the latex between the rim of the mould cavity and the perimeter of the sole foundation. It is preferable to reduce the possibility of air bubble formation in the latex by deaerating it, i.e. by removing dissolved air, and also by partially vulcanising the latex before adding a gelling agent. Deaeration of the latex may be achieved by merely allowing the latex to stand or by producing a vacuum over the surface of the latex.

Footwear is produced with soles free from undesired mould markings, with

[Price 2/8]

soles which are light and durable. The footwear may have a foxing integral with the outsole and by adjusting the depth to which the outsole foundation is lowered onto the mould cavity it may be arranged that the footwear has a foxing which extends over part of the upper and is bonded thereto.

During vulcanisation and drying of the latex composition shrinkage occurs with consequent production of stresses in the cured outsole which may cause distortion of the footwear. It is preferred to diminish the distortion as far as possible by incorporating in the footwear a reinforcing insole to give added rigidity. This reinforcing insole may be perforated, the perforations preferably diminishing in cross-section to very narrow passages towards the inside of the footwear. Air can then escape through the perforations but the latex will be held back in the narrow passages. The penetration of latex part-way into these perforations also strengthens the bond between the latex rubber outsole and the outsole foundation.

Some deformation will occur even though a reinforcing sole is provided, and for this reason the latex should be cast in a mould of slightly different shape from the desired final shape such that the strains set up on vulcanisation and drying draw the outsole and the foxing (if any) to the desired final shape. For this reason the mould of the apparatus according to the invention is formed with a concave base and the last has a correspondingly shaped convex sole and heel-forming surface.

In making footwear according to the present invention a freely flowable charge of vulcanisable gelable latex is poured into the open mould cavity of the apparatus and the upper of the footwear with the outsole foundation is positioned on the last and then lowered into the liquid charge without closing the mould cavity so that the outsole foundation is lowered into the latex to the required depth. It is thus suspended i.e. not in contact with the sides or bottom of the mould cavity. The displaced latex is forced upwardly, and the displaced air is free to escape from the free space between the periphery of the outsole foundation and the open rim of the mould cavity.

The latex gells and is thereby cast onto the outsole foundation of the upper to form the outsole. A foxing integral with the outsole may be formed on the upper depending upon the distance the upper is lowered into the mould cavity. After the latex has gelled, the footwear is removed from the mould and the outsole is dried and vulcanised. By compounding the latex with vulcanising ingredients including an ultra-accelerator drying and vulcanisation may be brought about concurrently.

The latex composition for making footwear according to the invention may be for example compounded from concentrated natural rubber latex by adding (1) a paste of vulcanising ingredients, e.g. sulphur, zinc oxide, ultra-accelerators, and antioxidant dispersed in water containing a dispersing agent, and (2) a gelling agent, e.g. an aqueous dispersion containing sodium silicofluoride, sodium fluoride and a colloidal clay. Thus a suitable latex composition may be made from a 68% ammonia-preserved natural rubber latex by deammoniating it with formaldehyde and restabilising it by the addition of 0.1 part of ammonia and 0.045 part of potassium hydroxide per 100 parts dry weight of rubber latex. (All parts are by weight). A suitable paste of vulcanising ingredients is one comprising 1.0 part of sulphur 5.0 parts zinc oxide, 1.2 parts of the zinc salt of 2-mercaptobenzthiazole 1.3 parts of zinc diethyldithiocarbamate, 0.5 parts of antioxidant, 0.2 parts of dispersing agent and 6.1 parts of water. A suitable gelling agent composition is one containing 1.0 parts of sodium silicofluoride, 0.02 part of sodium fluoride and 0.02 part of bentonite dispersed by ball-milling for 24 hours in 0.96 part of water and then adding a further 6.5 parts of water. 147 parts of the deammoniated preserved latex are mixed with 15.5 parts of the paste of the vulcanising components and the mixture diluted with 39.7 parts of water. After allowing the mixture to stand for 36 to 48 hours to de-aerate and for the rubber to become partially vulcanised, e.g. so that 0.05 part of the sulphur has chemically combined the gelling agent is added in the proportion of 150 grams of the mixture to 5.8 cc. of the gelling agent composition.

The setting or gelling of the latex may be accomplished by the use of gelling agents other than sodium silicofluoride. For example, a potassium silicofluoride, polyvinyl methyl ether, and an acid or ammonium nitrate may be used. However, a temperature of 95° F. or higher is required to set or gel the latex where potassium silicofluoride is used.

The time required for the latex to gel or set may be decreased by increasing the proportion of the gelling agent or by increasing the temperature of the latex for any selected gelling agent.

The setting time of the latex may also be decreased for a given proportion of the gelling agent used in the latex by either heating the mould or the lasted

upper or both, to raise the temperature of the latex after it has been poured in the mould. It is preferable to heat the lasted upper either by heating the last prior to lasting the upper thereon, or by heating the last after the lasting operation and immediately before lowering the upper into the latex, because the accelerated gelling action due to the supplied heat will not be effective until the lasted upper is placed in position in the mould cavity. By virtue of heating the lasted upper, the heating of the mould may be avoided, and the subsequent cooling of the mould prior to placing the gelable latex therein may also be avoided. The heating of the shoe upper has the further advantage of quickly gelling the latex so as to prevent the staining of a fabric shoe upper due to the capillary attraction of the fabric of the latex, which causes it to rise above the level of the sole or foxing.

Staining of the fabric by the travel of the latex above the level line may be prevented by thinly coating the bottom of the lasted upper and the bottom edge of the upper to the height of the top of the foxing line a latex cement, which is compounded with wetting agents and commonly used for bonding unvulcanised rubber parts to fabric. The cement is permitted to dry but not to be vulcanised prior to placing the bottom of the shoe upper in the mould cavity. If the last is heated to accelerate the setting period of the latex in the mould cavity and a latex cement is also used, the latex cement should have a vulcanising temperature above that to which the upper is heated.

The application of heat to the gelable latex in the mould has the further advantage of permitting the gelling agent to be added to latex in bulk and held available for pouring into the mould as required. In such case it is necessary to hold the gelable latex at a temperature below the active temperature of the gelling agent.

The use of ultra accelerators in the latex compound has the advantage of reducing the total time required for drying and vulcanisng the rubber coagulum in the sole by permitting such processes to take place concurrently. Where accelerators, other than ultra accelerators, are used which are not effective at temperatures below 220° F., the sole of rubber coagulum must be substantially dried before the sole is vulcanised in order to avoid blistering. That practice requires a much longer time than when the processes are carried on concurrently. It has been found that with the use of ultra accelerators and radiant heat, the sole of rubber coagulum may be treated at temperatures higher than 220° F. to dry and vulcanise it concurrently. As a specific example, a rubber sole deposited from latex compounded as above described, was completely dried and vulcanised within 80 minutes in an oven through which air was circulated at 270° F. The thickness of the dried sole was 0.120 to 0.125 inches. A longer time would be required for thicker soles.

The production of a tennis shoe and the apparatus therefor according to the invention is further described in reference to the accompanying drawings in which:—

Fig. 1 illustrates the usual method of lasting a shoe upper over an insole to which an outsole is applied in accordance with this invention;

Fig. 2 is a perspective view of the novel apparatus for casting a rubber composition sole onto the lasted shoe upper, which is shown above the casting position;

Fig. 3 is a side elevation of the apparatus illustrated in Fig. 2, but showing some of the parts in cross-section and with the shoe upper lowered into the latex composition;

Fig. 4 is a top plan view of a detail of the mechanism for adjusting the mould support in a horizontal plane;

Fig. 5 is an elevational view, partly in section, of the adjusting mechanism shown in Fig. 4, taken on line 5—5, and looking in the direction of the arrows;

Fig. 6 is a transverse cross-section through the toe portion of the shoe and the mould in the casting position shown in Fig. 3, and in which the last is shown in full front elevation;

Fig. 7 is a vertical longitudinal cross-section of the elements shown in Fig. 6, excepting the last is shown in side elevation;

Fig. 8 is a perspective view, partly in section, of the improved shoe made in accordance with this invention and by the use of the apparatus illustrated in the foregoing figures of the drawings;

Fig. 9 is a longitudinal cross-section of a shoe and mould for making a modified form of outsole, which is provided with a raised heel; and

Fig. 10 is a side elevational view of the shoe made by means of the last and mould shown in Fig. 9.

Shoes manufactured in accordance with this invention are illustrated in Figures 8 and 19, and the remaining figures of the drawings illustrate the method and apparatus used in the manufacture of the shoes. Referring to Fig. 8, the tennis shoe 15 comprises a canvas upper 16 having its bottom edge 17 lasted in known manner over an insole 18, to which the lower edge 17 is bonded. The bottom of

the upper 16 and the insole 18 forms an outsole foundation onto which the outsole 19 is cast directly from a gelable latex. As illustrated herein the shoe is provided with a foxing 20, which is cast integrally with the outsole 19. The foxing is provided to protect the bottom of the upper 16 from wear, and to strengthen the union between the sole and the upper, however, the foxing 20 may be omitted if desired. In any event a very good bond is formed between the cast outsole 19 and the outsole foundation by the penetration of the liquid latex into the interstices of the upper prior to the gelling of the latex. The outsole foundation is made sufficiently rigid to resist the shrinkage of the deposited latex after being dried. For that purpose the insole 18 is relatively stiff, and it is also provided with perforations 21 into which the latex flows and strengthens the bond between the outsole 19 and the shoe sole foundation. The perforations 21 also prevent blisters or air pockets forming between the outsole and the insole. In order to take advantage of changes due to the shrinkage of the outsole 19 and foxing 20, they are cast into a slightly different shape from the final desired shape of the shoe after vulcanisation. The shrinkage of the outsole and foxing draws these members into the desired final shape.

The outsole as cast is provided with a transversely convex tread surface to take advantage of changes in the exterior contour of the shoe due to the shrinkage of the outsole. As the shrinkage takes place the convex surface becomes flatter without any substantial change in the vertically projected area of the sole. In the casting operation the unconfined surface of liquid latex comes to a level around the lower part of the upper and forms a straight foxing line. The foxing being thinner than the outsole, its change in shape due to shrinkage is minimised by the stiffness of the upper material. However, the foxing shrinks to some extent and draws the toe portion of the shoe upwardly. The longitudinal curvature of the shoe sole tread, as cast, may be so designed that the downward shrinkage pull of the tread surface and the upward shrinkage pull of the foxing results in providing the shoe sole, and the foxing to some extent, with an upward curvature at the toe which gives the shoe toe spring.

The outsole 19 may be cast with a substantially flat bottom as shown in Figure 8, or it may be provided with a raised heel 22 as illustrated in Figure 10. In either case the cast outsole may be provided with an upwardly curved toe portion 23, which provides the usual toe spring to the shoe.

The method of casting the sole 19 onto the bottom of the upper 16 is described in reference to the apparatus shown in Figs. 1 to 7. Referring to Fig. 1, the upper 16 is lasted in known manner with the insole 18 upon the bottom of a last 24, and an assembled upper 16 is slipped over the last. The bottom edge 17 is turned over and cemented to the bottom of the insole 18. The last 24 with the upper thereon is then removed from the stand 25 and affixed to a jig 26 for manipulating the last so that it may be moved accurately downwardly into, and upwardly out of a mould cavity 27 of a mould 28. For most efficient operation of the process, the walls of the mould cavity are coated with a liquid, hereinafter referred to as a lubricant, and liquid gelable latex 29 is then poured into the mould cavity. The lubricant prevents the latex from sticking to the cavity, and acts as a wetting agent for the latex. A suitable mould lubricant for this purpose is the sodium salt of the di-octyl ester of sulfonated succinic acid, preferably mixed with gasoline in the proportion respectively of 100 to 315 parts by weight. Such lubricant also inhibits synæresis of the latex which sometimes causes the fabric upper to be strained. One application of this lubricant is sufficient for four casting operations.

The lasted shoe upper 16 is lowered into the latex 29 and suspended therein in spaced relation to the walls of the mould cavity, as shown in Fig. 3, to form a space between the lasted upper and the walls of the cavity for the gelable latex. Upon gelling, the latex is cast onto the bottom of the lasted upper which forms the outsole foundation. The volume of latex poured into the open mould cavity 27 is selected to produce an outsole of the desired thickness, and a foxing of the desired height when the bottom of the upper has been lowered to a certain level in the mould cavity 27 and preferably when the latex is displaced to the level of the upper rim 30 of the cavity, such rim preferably being located in a horizontal plane. As the bottom of the upper is lowered into the latex 29, it is displaced around the bottom of the upper, and the air in the cavity is free to flow outwardly through the space between the rim 30 of the mould and the upper. The air that may be trapped between the surface of the latex and the bottom of the upper is permitted to pass out through the perforations 21 of the insole 18. Such perforations are conical in shape. Their apexes 31A point upwardly, and form small openings through the top surface of the insole. The larger bases of the perforations 21 at the bottom surface of the insole 18 per-

mits the entry of the liquid latex. The smaller openings at the top surface of the insole excludes the latex but permits the discharge of the trapped air.

The latex 29 is compounded with vulcanising agents prior to adding the gelling agent, which latter addition is done immediately prior to pouring the latex into the mould cavity. A sufficient quantity of the gelling agent is added to cause the latex to gel quickly at a temperature of about 70° F. After it has gelled, the lasted upper 16 with the gelled latex outsole 19 and foxing 20 bonded thereto are raised upwardly out of the mould cavity 27. Where the sidewalls 31 of the mould 28 overhang the mould cavity, they are made of flexible elastic materials, so that they may be spread outwardly by the gelled latex without injury to the foxing and outsole. The overhanging portions of the sidewalls 31 may result from their inward inclination to the top rim 30, or from indentations formed therein to produce decorative surfaces on the sides of the outsole sole and foxing.

The last 24 is removed from the jig 26, and together with the lasted upper 16 and cast latex sole 19 thereon, it is passed through a vulcaniser, where the cast latex sole and foxing are simultaneously dried and vulcanised, which may be for example carried out at a temperature of about 270° F. for 80 minutes depending on the compounding of the latex. After the vulcanising operation, the shoe 15 is removed from the last 24. Any tension stresses set up in the cast outsole during drying and vulcanisation are prevented from distorting the shape of the shoe by the stiff outsole foundation. What little change in the exterior contour of the shoe does take place is compensated for by the design of the outsole, i.e. the outsole is cast with a convex bottom surface which merely become flatter as any adjustment in shape takes place.

To provide for the change in shape of the outsole 19 due to shrinkage of the rubber, the last 24 as shown in Figures 6 and 7 is provided with a decidedly convex bottom 33, that is, its bottom surface is curved both transversely, and longitudinally from heel to toe. The mould 28 is provided with a correspondingly shaped bottom surface 34. The border of the convex surface 33 of the last 24 lies in one plane 35. The borders of the concave curvature of the bottom 34 of the mould 28 also lies in one plane, which is parallel to the plane 35 of the borders of the curvature of the last 24. The insole 18 is preferably lasted to the curvature 33 of the last 24, so that a uniform thickness of rubber will be deposited between the insole and the bottom 34 of the cavity 27 to form the outsole 19. The foregoing construction causes the bottom surface of the outsole 19 to be cast with the convex curvature and of uniform thickness. When the curved surface contracts after the shoe 15 is removed from the last, the convex surface decreases in area, and therefore flattens out. The convexity of the outsole surface is sufficient to ensure that the shoe assumes a normal shape after shrinkage.

When the bottom surface of the outsole shrinks, its side edges contract and the sides of the foxing 20 have a tendency to lean away from the inside of the shoe. In order to allow for the change of the angle of the side edges of the sole and foxing, such side edges are initially formed at an inwardly inclined angle by undercutting the sides of the mould as shown in Figure 3. It is desirable to taper the thickness of the foxing 20 upwardly from the outsole, and for that purpose the last 24 is provided with vertically extending sides 36, which project from the plane 35 of the border of the convex surface 33 to a plane 37 as high as the ~~level~~ of the rim 30 of the mould 28.

The jig for manipulating the last 24 and the mould 28 is provided with an overhanging arm 38, to which the last is attached by means of a hand wheel 39. As shown in Fig. 3, the hand wheel 39 is affixed to a stem 40, which is rotatably mounted in the arm 38 and and held against removal by a screw 41 which is threaded into the arm 38 and extends into a groove 42 in the stem 40 of the hand wheel 39. The stem 40 is provided with a threaded end 43, which screws into a threaded bore in a cap 44 which is attached to the last by the screws 45. Pins 46' secured in the arm 38 extend into bores in the top plate 44 of the last and locate the last in a fixed position in reference to the arm 38.

The arm 38 is carried by a vertically movable slide 46, which is slidably mounted on guide rods 47. The slide 46 is actuated by a screw 48 mounted on a block 49 and operated by hand wheel 50 mounted on the stem 51 of the screw. The block 49 is affixed to a shaft 52, and the previously described system which is carried thereby is pivoted in a fixed journal 53 into which the round ends 54A of the shaft 52 are mounted.

As shown in Fig. 3, an operating arm 54 is attached to the shaft 52 and is adapted to pivot the last 24 in a vertical plane about the axis of the shaft. A latch 55 is slidably mounted on the operating arm 54, and it is provided with a detent 56 which is adapted to engage notches 57

PATENT OFFICE level 9
PATENT OFFICE 24 9

in a fixed arc 58, which is secured to the frame 59 of the jig. Several of the notches 57 are provided for the purpose of holding the last 24 in any one of several elevated positions, which may be selected by operators of different heights. The latch 55 is spring-pressed by a spring 59A held under compression between the latch guide 60 and a pin 61 secured to the latch 55. A handle 62 is attached to the operating arm 54, and a handle 63 is attached to the latch 55. Both handles are placed adjacent to each other so that the latch detent 56 may be withdrawn from the notches 57 by the operator's hand which grips the handle 62 to operate the arm 54.

The downward movement of the arm 54 is limited by an adjustable screw stop 64, which abuts against the stationary bed plate 65, of the jig 26. The stop 64 is threaded into a bracket 66 attached to the arm 54. The lower position of the arm 54 is adjustable to change the angularity of the plane 37 of the last 24 longitudinally, or in the heel to toe direction with respect to the plane of the mould rim 30. Such adjustment is made by the thumb nut 67 which is attached to the stem of the screw stop 64. The stop 64 is also provided with a lock nut 68 which locks it in any adjusted position.

The transverse angularity of the plane 37 of the last to the plane of the mould rim 30 is also adjustable by two screws 69, one in each of the ears 70 on each side of the slide block 46. The overhanging last supporting arm 38 is pivotally attached to the block 46 on a stud 71 which passes through a downwardly extending projection 72 of the last-supporting arm 38 and is secured in the slide block 46 below the laterally adjusting screws 69. The ends of the screws 60 operate upon the arm 38 and pivots it about the stud 71.

The mould is supported on a plate 73, which is adapted to be levelled and to be moved in a horizontal plane for the purpose of levelling the mould 28 and adjusting its position in all directions in the horizontal plane in respect of the last 24. The plate 73 is levelled by three levelling screws 74 which are threaded into the plate. The ends of the screws project through the plate 73 and support it on the horizontal base plate 65. The plate 73 may be adjusted in all directions in the horizontal plane by three thumb nuts 75, which are secured to the stems of horizontally arranged screws 76 threaded into brackets 77 on the plate 73. The adjusting screws 76 are rotatably mounted in notches 78 in brackets 79, which are affixed to the base plate 65. The details of the mechanism for adjusting the plate 73 horizontally are shown in Figs. 4 and 5. The stem of each screw 76 is provided with flanges 81, which straddle the bottom of the notch in the brackets 79 on the plate 65 in order to prevent the screws 76 from moving in an axial direction. The stem 80 of the screw 76 between the flanges 81 is smaller in diameter than the length of the notch 78 so as to permit the screw to move transversely, and the flanges 81 are bevelled to permit them to wobble in the notch 78, and thereby permit the plate 73 to move in any direction within its plane, in response to the individual pressure of each screw without causing the stem 80 or the flanges 81 to bind in the notch 78.

The mould 28 is usually sufficiently heavy to prevent it from being lifted when the cast latex sole 19 is moved vertically upwardly out of the mould cavity 27, but in order to prevent the mould from creeping out of position, it is desirable to secure the mould in a well 82 in a rigid frame 83, which in turn is held in a fixed position on the plate 73. The frame 83 is clamped to the plate 73 by two long bars 84 on opposite sides of the frame and by two short bars 85 placed on the opposite ends of the frame. The bars 84 and 85 are adjustably secured to the plate by means of bolts 86 having T-shaped heads 87 slidably mounted in slots in the plate 73, the slots being undercut as shown at 88. The bolts 86 extend up through the bars 84 and 85 and are affixed in place by tightening the nuts 89 thereon.

In the operation of the jig 26, its operating handle 54 is held in its raised position as shown in Fig. 2 by the engagement of the detent 56 with one of the notches 57 of the fixed sector 58. The last 24 having an upper 16 lasted thereon, as described in reference to Fig. 1, is attached to the overhanging arm 38 by clamping it thereto with the hand wheel 39. The mould supporting plate 73 is leveled by the screws 74, and when that is done the plane of the top rim 30 of the mould will be parallel with the top surface of the plate 73. The mould frame 83 is removed from the plate 73, and the jig operating arm 54 is lowered until the stop 64 carried thereby rests upon the bed plate 65. The bottom plane 35 of the last 24 as defined by the border of its convex curvature is positioned parallel with the top surface of the plate 73 by turning the thumb nut 67 on the vertically adjustable stop 64, and by turning the set screws 69 on the horizontal adjusting screws. The lasted shoe 16 is then raised to its elevated position.

The frame 83 and the mould 28 carried

thereby are placed on the supporting plate 73 underneath the elevated position of the lasted upper 16, and the bars 84 and 85 are released from the plate 73, so that the frame 83 and the mould 28 carried thereby may be moved freely on the plate 73. A layer of material, such as cardboard, having a thickness of the outsole to be cast on the bottom of the lasted upper 16 is placed in the mould cavity as a thickness gauge for the purpose of determining the thickness of the outsole. The jig arm 54 is then lowered, and the mould 28 is adjusted on the plate 73 so that the bottom of the upper 16 is positioned in the mould cavity 27, and the mould rim 30 is evenly spaced from the bottom side edges of the upper around the entire circumference. In such position the stop 64 should be resting upon the bed plate 65, and the bottom of the upper should be slightly spaced from the sole thickness gauge. The vertically adjusting hand wheel 50 is then turned so as to bring the bottom of the shoe upper into contact with the outsole thickness gauge. The securing bars 85 are brought up against the sides and ends of the mould frame 83, and the nuts 89 are turned downwardly on the studs 86 so as to secure the mould and the frame 83 in their located position. The jig arm 54 is then elevated and the sole thickness gauge is removed from the bottom of the mould cavity 27. The jig is now in its adjusted position to begin the casting of integral outsoles and foxings onto the bottom of the lasted upper 16.

A predetermined quantity of gelable latex is then poured into the mould cavity 27 while the jig manipulating arm is in its raised position as shown in Fig. 2. The operator then grasps the handles 62 and 63 of the arm 54 and lowers the bottom of the shoe upper 16 into the latex 29 until the downward movement of the arm 54 is stopped by the screw stop 64 which strikes against the base plate 65. When this occurs the latex should be forced up to the level of the top rim 30 of the mould cavity, and it should flow in between the rim and the shoe upper around its entire circumference, provided the proper amount of latex has been poured into the mould cavity. The latex normally gels in about three minutes, and the shoe with the cast latex sole thereon may be removed therefrom by lifting the jig arm 54 to the position shown in Fig. 2. The last 24 and the shoe 15 are then removed from the jig 26 by turning the hand wheel 39. The last 24 with the shoe 15 thereon is then passed through the vulcaniser for the proper period of time to vulcanise the rubber parts. The time for vulcanising the compound described herein is 80 minutes.

After the removal of the last 24 having the rubber sole cast thereon, another lasted upper is affixed to the jig arm 38. Another batch of gelable latex is poured into the cavity, and the foregoing operations are repeated. It will be found however that there are slight variations in the size of the bottoms of the lasted uppers, and that although the same quantity of latex is poured into the mould cavity in every instance, the latex will not rise to the same level when the bottom of the shoe is lowered thereinto, and the rim of the mould will not be evenly spaced from the upper all around its circumference. Therefore in order to bring the level of the latex up to the level of the top of the mould cavity in every instance it is sometimes necessary to manipulate the hand wheel 50 to raise or lower the last 24, and it may also be necessary to manipulate the horizontal adjusting thumb nuts 75 to move the mould laterally on the base plate 65 to properly space the shoe upper evenly from the rim 30 of the mould cavity 27.

The flexible mould 28 may be prepared from well known materials which set to an elastic deformable solid. A suitable cold moulding compound is a polysulphide synthetic rubber made from a polysulphide liquid polymer, which is admixed with a curing agent comprising a thin paste containing lead peroxide, and which is further admixed with a catalyst comprising a thin light coloured paste containing an organic peroxide just prior to pouring the cold moulding compound into the mould. In the preparation of the mould, a model of the sole, or the sole and foxing to be cast is made. This is conveniently done by lasting an upper on the special last 24 in the manner as described in connection with Fig. 1 and then building onto the upper an outsole and foxing having the shape and decorations of the shoe parts, as cast. A box is then made similar to the frame 83, excepting the depth of the well in the box is equal to the overall height of the mould to be cast from the moulding compound. The last 24 with the model thereon is placed in the jig 26, and the plane 35 of the border of the bottom curvature of the sole is levelled, or made parallel with the top surface of the levelled mould supporting plate 73 in the manner described in reference to the levelling of the lasted shoe upper 16. The hand wheel of the jig 50 is turned so as to raise the bottom of the model above the top rim of the box when it is placed on the levelling plate

73. The jig arm 54 is then raised to its upper position as shown in Fig. 2. The box is placed underneath the shoe, and the prepared moulding compound is poured into the box until it rises to a level which leaves a space in the well equal to the volume of the mould cavity to be formed. Marks are made on the sides of the model at the level of the latex to be cast on the upper to form the sole, or sole foxing. The jig arm 54 is then lowered until the stop 64 strikes the base plate 65, and the hand wheel 50 is then turned down into the moulding liquid in the box until the markings placed on the sides of the model come even with the surface of the liquid moulding compound. The model shoe is then left in that position until the moulding compound firmly sets. It is desirable to so gauge the quantity of moulding compound placed in the box that it rises slightly above the top edge. The excess of the set compound is trimmed off to form a smooth straight and level top rim on the cast mould. The model is then released from the jig 26 by the hand wheel 39, and the model, mould, and box are removed together from the plate 73. The mould is then removed from the box and stripped from the model.

Substantially the preceding procedure is followed in making the last and mould shown in Fig. 9 and in casting the rubber parts on the shoe with a heel shown in Fig. 10. As shown in Fig. 9 the last 90 is provided with a convex bottom 91, which extends from the breast 92 of the heel to the toe. The border of this convex portion of the bottom lies in a plane 93, but the heel portion is provided with a flat surface 94 to receive an insert filler 95, which is placed on top of the insole 96 and affixed thereto.

The bottom of the mould cavity 97 forward of the breast of the heel is concave and conforms to the corresponding convex curvature of the last 90. The bottom of the heel portion of the cavity 97 is depressed and has a concave curvature to cast a corresponding convex curvature on the shoe heel from the gellable latex 98, and thereby relieve shrinkage strains after vulcanisation.

What we claim is:—

1. A method of casting a rubber outsole onto 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.

2. A method of casting a rubber outsole onto a footwear sole foundation according to claim 1 in which the latex is deaerated and partially vulcanised prior to adding the gelling agent.

3. A method according to claim 1 or claim 2 in which said latex is compounded with an ultra-accelerator, and drying and vulcanisation of the latex are conducted concurrently at a temperature above 220°F.

4. A method according to any of the preceding claims of casting a rubber outsole onto the bottom of a shoe sole foundation is suspended in the mould cavity to a depth sufficent to form a foxing around the shoe upper, and the latex is displaced up to the level of the top edge of the mould cavity.

5. A method of casting a rubber outsole onto the bottom of a footwear sole foundation substantially as hereinbefore described with reference to the accompanying drawings.

6. An apparatus for casting latex rubber sole onto a footwear sole foundation comprising in combination a mould having a footwear sole moulding cavity therein which has a concave base extending longitudinally from the heel portion to and including the toe portion and has a perimeter lying substantially in one plane, a last with a correspondingly convex base and a support adapted to suspend a footwear sole foundation thereon in spaced relation to the walls and base of the mould cavity.

7. An apparatus according to claim 6 where the mould cavity has upwardly converging side walls.

8. An apparatus according to either of claims 6 or 7 for making a shoe with a foxing in which the last is provided with vertical sides extending from the plane of the perimeter of the said convex surface to the height of the foxing to be formed on the upper.

9. An apparatus according to claims 6, 7 or 8 wherein the mould is provided with an open mould cavity, means for levelling the top rim of the mould cavity, means for adjusting the angularity of the bottom of the last in respect to the top rim of the mould cavity in the direction from toe to heal, means for adjusting the last support vertically and means for adjusting the mould in all directions in a horizontal axis extending in the heel to toe direction.

10. An apparatus according to any of the preceding claims 6 to 9 in which the sides of the mould are made of flexible

* C L M S *

PATENT OFFICE

in which the sole foundation

73. The jig arm 54 is then raised to its upper position as shown in Fig. 2. The box is placed underneath the shoe, and the prepared moulding compound is poured into the box until it rises to a level which leaves a space in the well equal to the volume of the mould cavity to be formed. Marks are made on the sides of the model at the level of the latex to be cast on the upper to form the sole, or sole foxing. The jig arm 54 is then lowered until the stop 64 strikes the base plate 65, and the hand wheel 50 is then turned down into the moulding liquid in the box until the markings placed on the sides of the model come even with the surface of the liquid moulding compound. The model shoe is then left in that position until the moulding compound firmly sets. It is desirable to so gauge the quantity of moulding compound placed in the box that it rises slightly above the top edge. The excess of the set compound is trimmed off to form a smooth straight and level top rim on the cast mould. The model is then released from the jig 26 by the hand wheel 39, and the model, mould, and box are removed together from the plate 73. The mould is then removed from the box and stripped from the model.

Substantially the preceding procedure is followed in making the last and mould shown in Fig. 9 and in casting the rubber parts on the shoe with a heel shown in Fig. 10. As shown in Fig. 9 the last 90 is provided with a convex bottom 91, which extends from the breast 92 of the heel to the toe. The border of this convex portion of the bottom lies in a plane 93, but the heel portion is provided with a flat surface 94 to receive an insert filler 95, which is placed on top of the insole 96 and affixed thereto.

The bottom of the mould cavity 97 forward of the breast of the heel is concave and conforms to the corresponding convex curvature of the last 90. The bottom of the heel portion of the cavity 97 is depressed and has a concave curvature to cast a corresponding convex curvature on the shoe heel from the gellable latex 98, and thereby relieve shrinkage strains after vulcanisation.

What we claim is:—

1. A method of casting a rubber outsole onto 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.

2. A method of casting a rubber outsole onto a footwear sole foundation according to claim 1 in which the latex is deaerated and partially vulcanised prior to adding the gelling agent.

3. A method according to claim 1 or claim 2 in which said latex is compounded with an ultra-accelerator, and drying and vulcanisation of the latex are conducted concurrently at a temperature above 220°F.

4. A method according to any of the preceding claims of casting a rubber outsole onto the bottom of a shoe sole foundation is suspended in the mould cavity to a depth sufficent to form a foxing around the shoe upper, and the latex is displaced up to the level of the top edge of the mould cavity.

5. A method of casting a rubber outsole onto the bottom of a footwear sole foundation substantially as hereinbefore described with reference to the accompanying drawings.

6. An apparatus for casting latex rubber sole onto a footwear sole foundation comprising in combination a mould having a footwear sole moulding cavity therein which has a concave base extending longitudinally from the heel portion to and including the toe portion and has a perimeter lying substantially in one plane, a last with a correspondingly convex base and a support adapted to suspend a footwear sole foundation thereon in spaced relation to the walls and base of the mould cavity.

7. An apparatus according to claim 6 where the mould cavity has upwardly converging side walls.

8. An apparatus according to either of claims 6 or 7 for making a shoe with a foxing in which the last is provided with vertical sides extending from the plane of the perimeter of the said convex surface to the height of the foxing to be formed on the upper.

9. An apparatus according to claims 6, 7 or 8 wherein the mould is provided with an open mould cavity, means for levelling the top rim of the mould cavity, means for adjusting the angularity of the bottom of the last in respect to the top rim of the mould cavity in the direction from toe to heal, means for adjusting the last support vertically and means for adjusting the mould in all directions in a horizontal axis extending in the heel to toe direction.

10. An apparatus according to any of the preceding claims 6 to 9 in which the sides of the mould are made of flexible

elastic material and overhang the mould cavity.

11. Apparatus for casting a shrinkable footwear sole onto a sole foundation, substantially as hereinbefore described with reference to the accompanying drawings.

12. Footwear whenever made by a method according to any of claims 1 to 5.

13. Footwear when made by casting a rubber outsole onto the bottom of a footwear sole foundation in an apparatus according to any of claims 6 to 11.

14. Footwear in accordance with claim 12 or 13 in which the outsole foundation includes a stiffener member.

15. Footwear in accordance with claims 12 or 13 in which the outsole foundation has openings formed therein, said openings communicating with the bottom of said foundation and filled with latex compound.

16. Footwear in accordance with claim 12 or 13, in which the ~~outside~~ outsole foundation comprises an insole having conical openings provided with walls diverging towards the outsole, the material of said outsole extending into but not through said openings, whereby said outsole is mechanically united with said insole.

17. Footwear substantially as hereinbefore described with reference to the accompanying drawings.

G. W. I. SHEAVYN,
Agent for the Applicants.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1954.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

PATENT OFFICE

* C L M S *