Aug. 20, 1935. R. MITCHELL 2,012,172

HALF-SOLE OR HEEL LIFT AND PROCESS OF FORMING SAME

Filed June 25, 1934

FIG. 1

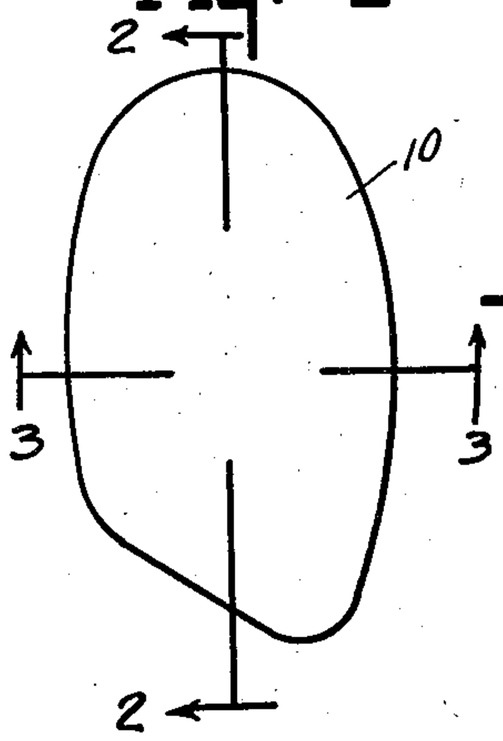



FIG. 2

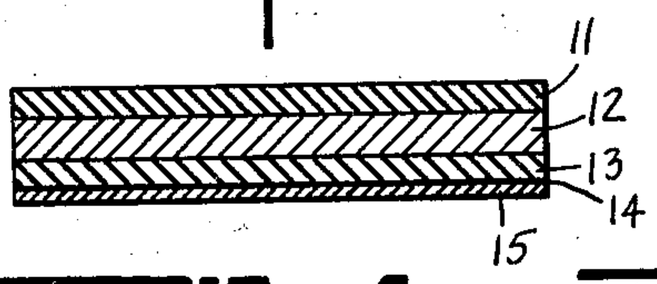



FIG. 3

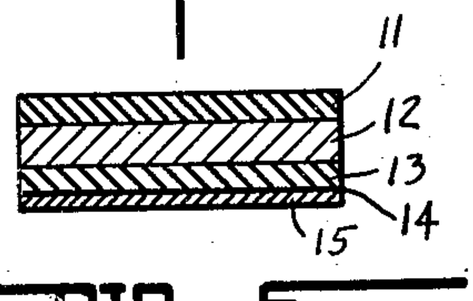



FIG. 4

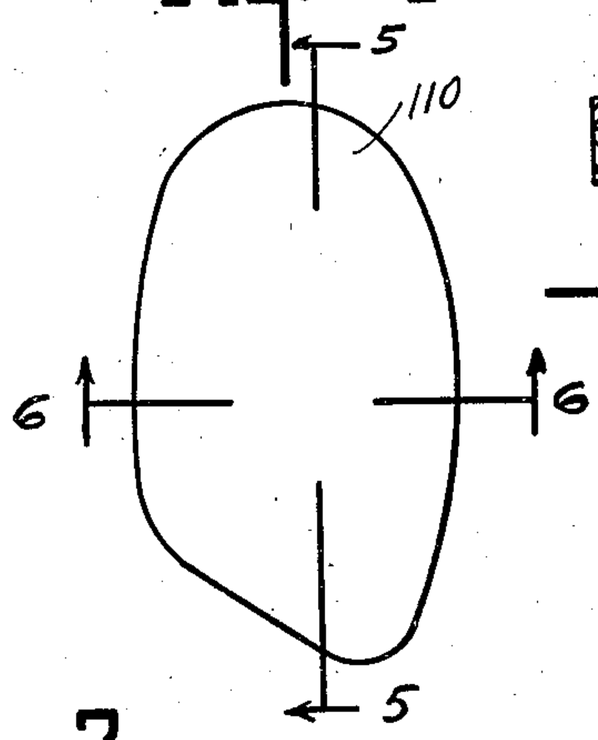



FIG. 5

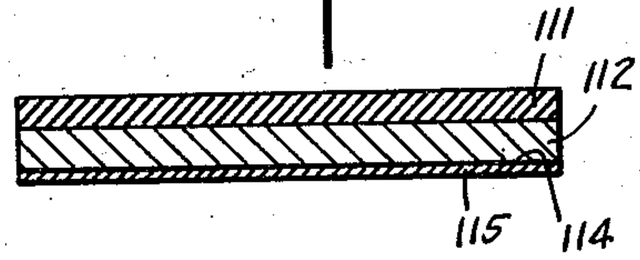



FIG. 6

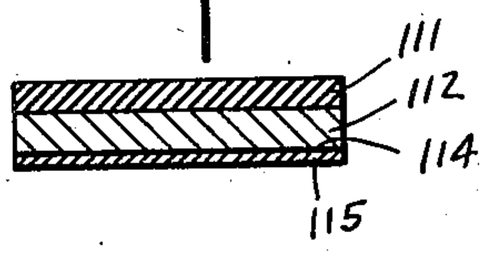



FIG. 7

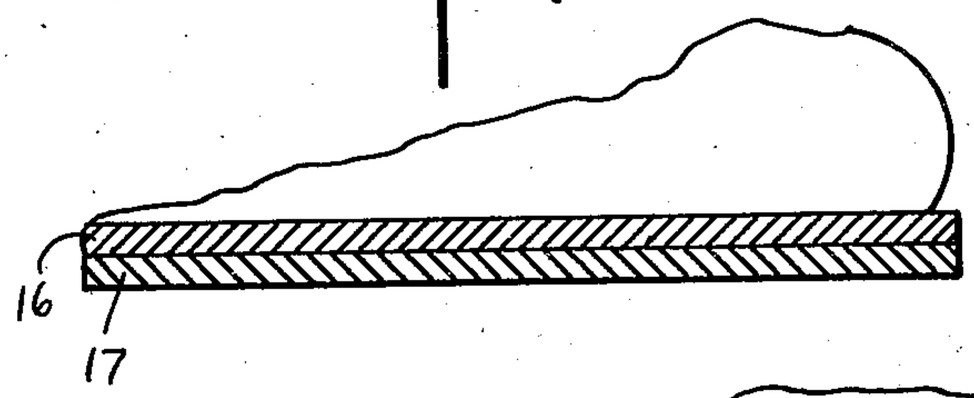



FIG. 8

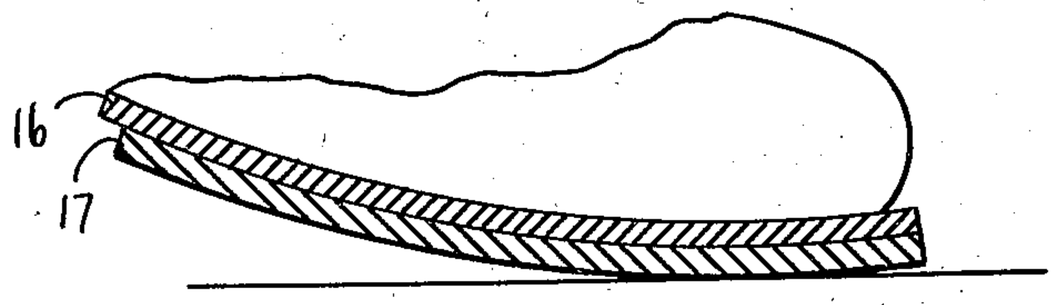
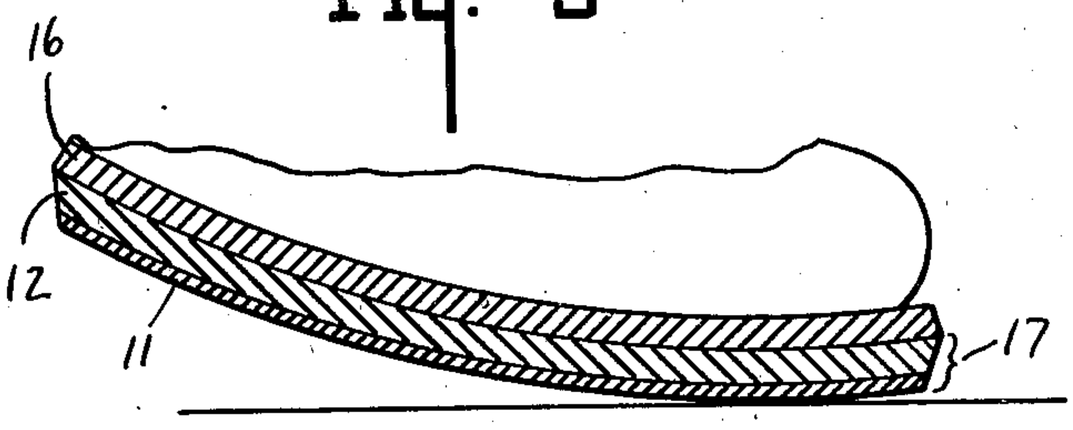



FIG. 9

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# UNITED STATES PATENT OFFICE

2,012,172

## HALF-SOLE OR HEEL LIFT AND PROCESS OF FORMING SAME

Randolph Mitchell, La Fayette, Ind.

Application June 25, 1934, Serial No. 732,336

9 Claims. (Cl. 36—32)

This invention relates to half-soles for shoes, commonly known as "shoe bottoms", and particularly to that type of half-sole applied to the shoe by means of an adhesive and the method of forming said sole.

The invention also is applied to heel lifts and throughout the subsequent description, whenever applicable, it is to be understood the term "shoe bottom" or "half-sole" also applies to heel lifts although the latter is not subject to the extreme flexing action that the bottom is subjected to.

The chief object is to provide a sole and/or heel lift that has—(1) greater wear resisting properties, (2) greater comfort for the wearer in walking or standing, (3) improved power of adhesion, and (4) improved or greater flexibility when the sole is applied to the bottom of the shoe.

The chief feature of the invention consists in providing in the production of a shoe sole (and/or a heel lift) a dense rubber tread or wearing surface layer and suitably securing thereto a cushion layer, preferably of sponge rubber, to which may be suitably secured, if desired, a relatively non-vulcanized or but partially vulcanizing third layer, the exposed surface of the layer opposite the tread layer being capable of being secured by a cement union to a shoe bottom for renewing the surface thereof, which sole (and/or heel) has all of the desirable characteristics previously set forth herein.

The full nature of the invention will be understood from the accompanying drawing and the following description and claims:—

In the drawing, Fig. 1 is a plan view of a half-sole of triple layer construction.

Fig. 2 and Fig. 3 are sectional views of the half-sole taken on lines 2—2' and 3—3', respectively of Fig. 1, and in the direction of the arrows.

Fig. 4 is a plan view of a half-sole of dual layer construction.

Fig. 5 and Fig. 6 are sectional views of the sole illustrated in Fig. 4 and taken on lines 5—5' and 6—6' respectively of said figure, and in the direction of the arrows.

Fig. 7 and Fig. 8 are diagrammatic sectional views of the standard half-sole applied to a shoe bottom, Fig. 7 illustrating the same when flat and Fig. 8 illustrating the same when the shoe bottom is bent or flexed as in walking, the difference between the figures representing the change in tension endured by the half-sole when flexed.

Fig. 9 is a diagrammatic sectional view of the invention shown in Figs. 4 to 6 applied to a shoe sole and subjected to stretch or strain, and for comparison with Fig. 8.

Fig. 1 illustrates a three layer half-sole 10, the construction of which is shown more fully in Figs. 2 and 3. In said Figures, 11 indicates a layer of dense vulcanized rubber designed to withstand wear. This may be called the tread or wear layer. 12 indicates an adjacent vulcanized sponge rubber layer designed to add greater comfort, to increase wear, and to improve adhesion. 13 indicates a layer of unvulcanized or partially vulcanized rubber designed to improve adhesion to the bottom of the shoe. This layer may have a normally tacky surface 14 which is usually protected by a holland sheet or parchmentized paper 15.

The wear resisting properties of a rubber half-sole may be increased or decreased by different combinations of materials that go into the rubber compounds of the tread layer. In the form of the half-sole, shown in Figs. 1 to 3 inclusive, the wear resisting properties of any such compound have been greatly increased by interposing between the bottom of the shoe and that part of the half-sole which comes in contact with the surface on which the wearer of the shoe walks, to wit, the tread layer, a soft yielding member, such as sponge rubber, very soft yielding rubber, felt, or the like.

The introduction of such a soft yielding member, as above described, also very materially improves the power of adhesion of the half-sole to the shoe bottom, because the tread is relatively non-yielding, so that in the act of walking, the flexing of a relatively hard rubber tread layer tends to cause separation between the shoe sole, usually leather, and the tread. With this invention, the stress introduced by the flexing action is absorbed in the cushion layer without appreciable transmittal to the adhesive union, resulting in a relative permanence in the adhesive connection.

It is generally known that an unvulcanized or partially vulcanized sheet of rubber, such as indicated by 13, is more receptive to cement than a fully vulcanized sheet of rubber, and no claim is made to the application of this principle as being new or novel except in this combination.

It is believed that the reason that the tread layer 11 has greater wear resisting power when it has interposed between it and the shoe a backing of soft yielding material indicated by 12, is that the cushioning or yielding property of layer 12 permits the maximum amount of surface contact of the tread layer 11 with the surface on which the wearer of the shoe walks. This increase in wear resisting quality has been fully and adequately determined by a long series of experiments, including use of the invention by policemen, and mail carriers. The cushion layer seems to compensate for each individual's pecularities in walking so that localized wear is distributed over a greater area of the tread layer, resulting in a longer wearing life of the tread as a whole.

Reference to Figs. 8 and 9 will show why layer 12, shown in Fig. 2 and in Fig. 3, improves the

power of adhesion to the bottom of the shoe. In Fig. 7 the shoe bottom or sole is indicated by numeral 16 and 17 indicates an ordinary rubber replacing half-sole—both being shown in the approximate position they take when the wearer of the shoe is not walking. Fig. 8 shows what happens when the wearer of the shoe walks and the bottom of the shoe flexes and bends. The half-sole 17 tends to take the position shown in Fig. 8 which clearly shows that there is a tendency at each step to pull the rubber half-sole from the bottom 16 of the shoe. By interposing a soft yielding layer 12 or 112 between the outer or wear resistant layer or tread 11 or 111 and the bottom 16 of the shoe, the adhesion is improved because this cushion member absorbs most of the strain produced when the bottom of the shoe bends or flexes. Thus, the total flexing strain is fully transferred to the adhesive connection between the shoe bottom and the rubber half-sole 17 in Fig. 8.

As shown in Fig. 9, the invention when subjected to stress in walking, yields in the cushion layer 112 and the tread layer 11 floats or gives relative to the shoe bottom 16.

Unvulcanized or partially vulcanized rubber, as previously stated, is more receptive to a cement or rubber adhesion than a smooth or nearly smooth, fully or nearly completely vulcanized rubber, because the solvent in the rubber cement partially dissolves the unvulcanized or partially vulcanized surface and the raw rubber in the cement unites therewith and the leather fibres to form the bond. A surface of vulcanized sponge rubber contains many open cellular spaces which the rubber in the cement fills to form a tacky surface.

Said surface is thus mechanically interlocked by reason of the cellular structure as well as adhesively secured to the raw rubber layer deposited by the cement. With a single layer sole of vulcanized dense rubber, the surface is comparatively smooth and the rubber cement solvent cannot successfully dissolve the skin thereon, so that a sufficiently strong union can be effected.

In Figs. 4 to 6, inclusive, a modified form of the invention is illustrated and said form comprises a two layer half-sole construction. The outer layer consists of a wear resisting vulcanized layer 111 and the inner layer consists of a soft yielding sheet 112, such as sponge rubber. In this form of the invention, the third layer of partially or unvulcanized rubber, shown in Figs. 2 and 3, is omitted.

As previously set forth, the cellular surface of the sponge rubber or soft yielding layer is readily receptive to the addition of rubber cement.

The following is a typical compound, which, when vulcanized, will produce the desired dense wear resisting properties in the tread layer.

*Dense tread layer*

| | Pounds | Ounces |
|---|---|---|
| Smoked sheets | 32 | 0 |
| Whole tire reclaim | 16 | 0 |
| Carbon black | 34 | 0 |
| Mineral rubber | 5 | 0 |
| Stearic acid | 0 | 12 |
| Sulphur | 1 | 8 |
| Aldehyde-amine accelerator | 0 | 8 |
| Clay | 8 | 10 |
| Zinc oxide | 1 | 10 |
| | 100 | |

A cure that is satisfactory for the above and similar compositions is 90 pounds of steam pressure applied for 10 minutes at the usual temperature.

It is clearly understood that the satisfactory results of this invention are not dependent on the exact use of this compound but the same is illustrative only of the type of rubber composition desired.

The soft yielding member when of sponge rubber, and indicated by numeral 12 in Figs. 2 and 3 and by numeral 112 in Figs. 5 and 6, consists of the ingredients and in the approximate amounts recited.

*Cushion sponge layer*

| | Pounds | Ounces |
|---|---|---|
| Smoked sheets | 25 | 0 |
| Sulphur | 0 | 12 |
| Mercaptobenzothiazola (Captax) | 0 | 5 |
| Zinc oxide | 1 | 4 |
| Carbon black | 6 | 0 |
| Whiting | 8 | 14 |
| Stearic acid | 3 | 0 |
| Lime | 0 | 2 |
| Sodium bicarbonate | 5 | 0 |
| Petroleum | 2 | 8 |
| Di-beta-napthyl-para phenylenediamine (agerite) | 0 | 4 |
| | 53 | 1 |

A cure that is satisfactory for the above and similar compositions is 50 lbs. of steam pressure applied for 12 minutes at the usual temperature.

The aforesaid composition is given merely by way of illustration.

Layer 13 in Figs. 2 and 3 may be a sheet of crude rubber with the addition of no compounding ingredients, or may be a sheet of rubber with some compounding ingredients but with an insufficient amount of vulcanizing material necessary to produce complete or substantially complete vulcanization, when subjected to the ordinary heats and pressures of vulcanization commonly employed.

One method of producing the form of the half-sole illustrated in Figs. 1 to 3, inclusive, is to vulcanize separately the layers indicated by the numerals 11 and 12 and to partially vulcanize the layer indicated by the numeral 13, when such operation is necessary or desired. An adhesive, such as rubber cement or liquid latex, is then applied to the surfaces of layers 11, 12, and 13 that are to remain in contact with each other, and then pressure is applied to form the three layers into a completed half-sole.

An alternative method is to produce members 11 and 12, as above described, and then use for layer 13 a sheet of unvulcanized rubber. Adhesive of the aforesaid character is then applied to the surfaces thereof that come in contact with each other, and then pressure is applied to unite the three layers into a completed half-sole. The outer surface of layer 13 preferably should be protected by a sheet 15 of holland fabric or a paper like material performing a similar function to prevent the surface from coming in direct contact with the air, which in time, would result in oxidation of this surface without such protection. Such oxidized surface has the same resistance to dissolving under the action of solvent of the rubber cement, as the vulcanized tread surface unless great pressure is applied.

When layer 13 is composed of a sheet of unvulcanized rubber, it may be applied to layer 12 by pressure without the use of the adhesive and a satisfactory union therebetween will result. This mechanically effected union is improved if

the members are warm when the pressure is applied.

Another method of producing the half-sole, as shown in Figs. 1 to 3, inclusive, is to assemble in the order illustrated, layers 11, 12, and 13 in their natural or unvulcanized state, and then place the same in a form or mold and subject it to heat to produce a complete half-sole in which layers 11 and 12 are completely vulcanized and layer 13 remains unvulcanized or partially vulcanized as desired. In this case, it is not necessary to apply any adhesive to the contacting surfaces of the several layers.

Another method of producing the half-sole shown in Figs. 1 to 3, inclusive, is to assemble the material for layers 11 and 12 together in the order named, then place same in a form or mold and vulcanize by the application of heat. No cement or adhesive is necessary between the contacting surfaces of layers 11 and 12. After the vulcanization of members 11 and 12, cement is applied to the contacting surfaces of layers 12 and 13 and pressure is applied. When layer 13 is composed of unvulcanized rubber, the placing of the proper surfaces in contact and subsequent application of pressure, preferably is accomplished when one or both of the layers are warm in which case no cement is required.

It may be questioned as to why a cement union between layers is satisfactory, whereas heretofore, it has been set forth that a vulcanized surface could not be satisfactorily secured by adhesive to the shoe bottom. The reason is that the layers are cemented together in the sole manufacturing plant and great pressure, uniformly distributed and in a common plane, is utilized in the one case, while in the other since the shoe bottom 16 to be resoled is not flat, (Fig. 7 to the contrary) the pressure is applied by the sole purchaser intermittently over the sole, and not simultaneously all over, and the pressure applied by the sole purchaser is materially less than that the manufacturer can and does utilize in cementing the layers together.

Furthermore, the tread stock (vulcanized) is fresher when the cement is utilized, than when the ultimate purchaser would use the same. Such vulcanized stock has a cement resisting surface, the resistance of which increases with age.

The form of half-sole illustrated in Figs. 4 to 6, inclusive, can be produced by vulcanizing separately layers 111 and 112, applying an adhesive to the contacting surfaces and then uniting by pressure, or can be produced by assembling layers 111 and 112 in their unvulcanized state, then placing them in a form or mold and then vulcanizing by the application of heat. In the latter instance, no adhesive need be utilized.

In any one of the half-soles embodying the invention, the dense rubber or tread layer may be smooth on the outer or wearing surface or may be molded with any design or imprint desired to increase its attractive appearance or non-skid qualities. The thickness of any of the layers of the half-soles illustrated also may be varied as necessary to produce the desired results.

In the claims the terminology "adhesive connection" includes a connection formed with adhesive (such as cement) accompanied by pressure, if and when desired, and to the desired degree, and the terminology "cohesive connection" includes a connection formed without adhesive or without initial vulcanization and which usually results from a pressure application and the tackiness in one or both of the surfaces of the contacting stocks or layers.

The invention claimed is:—

1. A shoe sole structure adapted for adhesive application to a shoe bottom arrangement, including a wear resisting tread layer of dense vulcanized rubber, a layer of vulcanized sponge rubber suitably secured to the dense rubber layer and acting as a cushion for the foot, and a third layer of unvulcanized or but partially vulcanized rubber suitably secured to the opposite side cf the sponge rubber layer to facilitate adhesive attachment of the sole structure to a shoe bottom.

2. A shoe sole structure adapted for adhesive application to a shoe bottom arrangement, including a wear resisting tread layer of dense vulcanized rubber, a layer of vulcanized sponge rubber suitably secured to the dense rubber layer and acting as a cushion for the foot, a third layer of unvulcanized or but partially vulcanized rubber suitably secured to the opposite side of the sponge rubber layer to facilitate adhesive attachment of the sole structure to a shoe bottom, and a cohesive connection between the third and sponge rubber layers.

3. A shoe sole structure adapted for adhesive application to a shoe bottom arrangement, including a wear resisting tread layer of dense vulcanized rubber, a layer of vulcanized sponge rubber suitably secured to the dense rubber layer and acting as a cushion for the foot, a third layer of unvulcanized or but partially vulcanized rubber suitably secured to the opposite side of the sponge rubber layer to facilitate adhesive attachment of the sole structure to a shoe bottom, and a vulcanized connection between the tread and sponge rubber layers.

4. A shoe sole structure adapted for adhesive application to a shoe bottom arrangement, including a wear resisting tread layer of dense vulcanized rubber, a layer of vulcanized sponge rubber suitably secured to the dense rubber layer and acting as a cushion for the foot, a third layer of unvulcanized or but partially vulcanized rubber suitably secured to the opposite side of the sponge rubber layer to facilitate adhesive attachment of the sole structure to a shoe bottom, and an adhesive connection between the tread and sponge rubber layers.

5. A shoe sole structure adapted for adhesive application to a shoe bottom arrangement, including a wear resisting tread layer of dense vulcanized rubber, a layer of vulcanized sponge rubber suitably secured to the dense rubber layer and acting as a cushion for the foot, a third layer of unvulcanized or but partially vulcanized rubber suitably secured to the opposite side of the sponge rubber layer to facilitate adhesive attachment of the sole structure to a shoe bottom, a vulcanized connection between the tread and sponge rubber layers, and a cohesive connection between the third and sponge rubber layers.

6. A shoe sole structure adapted for adhesive application to a shoe bottom arrangement, including a wear resisting tread layer of dense vulcanized rubber, a layer of vulcanized sponge rubber suitably secured to the dense rubber layer and acting as a cushion for the foot, a third layer of unvulcanized or but partially vulcanized rubber suitably secured to the opposite side of the sponge rubber layer to facilitate adhesive attachment of the sole structure to a shoe bottom, an adhesive connection between the tread

and sponge rubber layers, and a cohesive connection between the third and sponge rubber layers.

7. The method of producing a multiple layer tread structure for adhesive application to an arrangement such as a shoe bottom, including forming a unitary multi-layer product with substantially parallel outer surfaces and having one layer of dense vulcanized rubber and another layer of vulcanized sponge rubber, providing a layer of unvulcanized or but partially vulcanized rubber the outer surface of which is relatively tacky, and then cohesively securing to the sponge rubber outer surface the last mentioned layer with its tacky surface exposed and in parallelism with the tread rubber outer surface.

8. The method of producing a multiple layer tread structure for adhesive application to an arrangement such as a shoe bottom, including forming a vulcanized dense rubber layer, forming a vulcanized sponge rubber layer, adhesively securing the layers together, providing a layer of unvulcanized or but partially vulcanized rubber, and then cohesively securing the third mentioned layer to the outer surface of the sponge rubber layer.

9. The method of producing a multiple layer tread structure for adhesive application to an arrangement such as a shoe bottom, including forming in a single vulcanization operation a vulcanized rubber arrangement having a dense vulcanized rubber layer, a vulcanized sponge rubber layer and a vulcanized union therebetween, providing a third layer of but partially vulcanized or unvulcanized rubber, and then cohesively securing the third mentioned layer to the outer surface of the sponge rubber layer.

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