

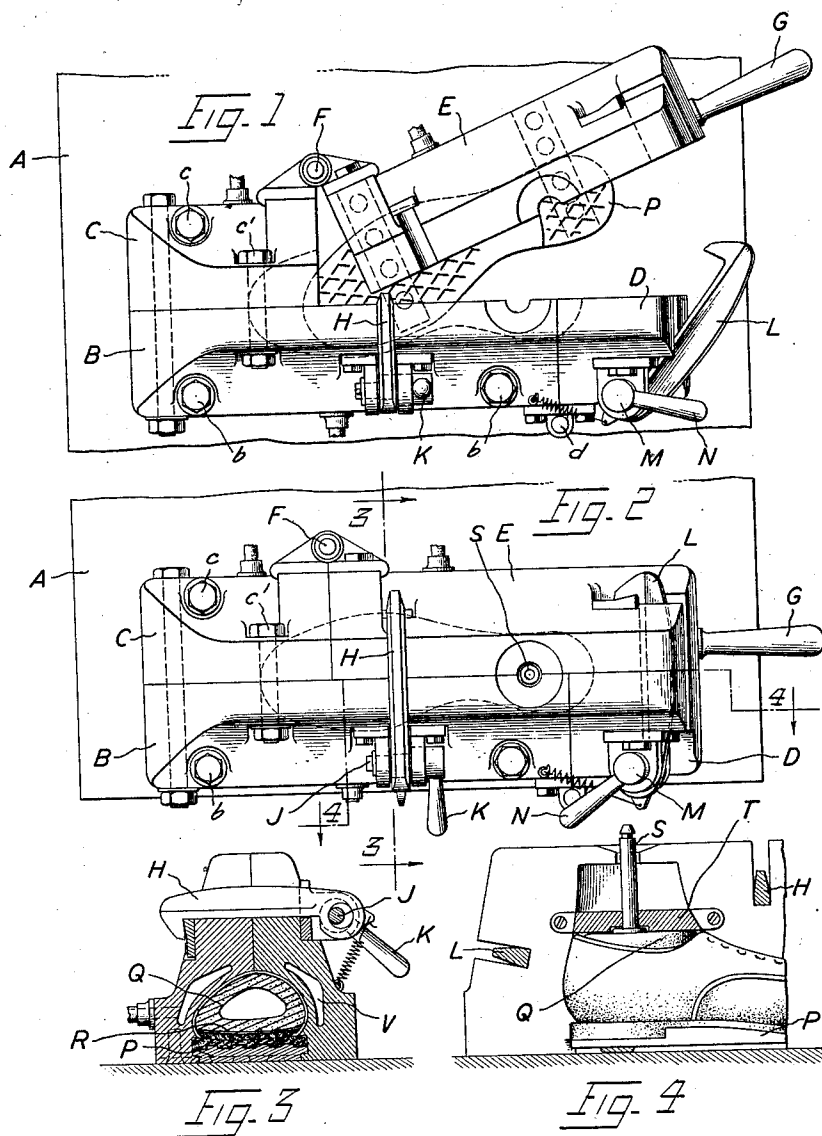
May 26, 1931.

H. MCGHEE

1,807,487

MANUFACTURE OF RUBBER SOLED FOOTWEAR

Filed Feb. 21, 1929



INVENTOR
H. McGhee
BY
Langmuir, Parry, Hard Langmuir
ATTYS.

UNITED STATES PATENT OFFICE

HENRY MCGHEE, OF RUSHCUTTERS BAY, NEAR SYDNEY, NEW SOUTH WALES,
AUSTRALIA

MANUFACTURE OF RUBBER-SOLED FOOTWEAR

Application filed February 21, 1929, Serial No. 341,791, and in Australia June 14, 1928.

This invention relates to shoes and other footwear having a cured rubber sole fixed to the skirt of a leather upper integrally, without stitching, and it includes a process for the manufacture of such footwear.

Heretofore shoes having moulded rubber soles integrally united by rubber with leather uppers were not known, and they are, in effect, a new product in the trade.

Many attempts have been made to produce such shoes by an open cure process, but these attempts have failed because it was found that the leather is curled and hardened in the curing process so that it permanently loses its flexible characteristics and is made liable to crack and break. I have discovered, however, that if the goods are completely enclosed each piece in its own mould and held tightly pressed against the mould and that the temperature of the mould is not allowed to rise too high where it contacts with the leather portion of the shoe, the leather does not suffer the destructive action which occurs in the open cure method above referred to, and it is then possible to obtain entirely satisfactory products. In practice, leather of any class may be used for the uppers. When there is no finish applied to the leather the mould may be allowed to come to a higher temperature without injuring the leather, but it is preferable in all cases to adopt the precautionary measure of circulating water through those parts of the mould which make contact with the leather portions of the goods, the sole portion of the mould through which vulcanization heat is applied to the rubber sole being, of course, heated. Chrome tanned leathers tolerate heat treatment much better than vegetable tanned leathers, and where unsurfaced or unvarnished chrome tanned leather is used for the uppers, air cooling of the mould suffices. It is desirable that the leather portion of the goods shall not be damp or wet when brought into the mould. It is not necessary to resort to artificial drying so long as no water is present other than is naturally contained in the leather in a normal atmosphere. Where a varnished or surfaced leather is used, the varnish or surfacing should be scraped away or otherwise re-

moved from the skirt portion of the upper in order to enable a fully effective bond to be established between the rubber sole structure and the skirt.

In operating with chrome leathers for the production of shoes, boots, or like footwear, full chrome tanned skins or hides are selected. These skins or hides are well washed, and, when necessary, dyed, and they are drummed so as to embody in them a maximum of fat liquor consisting of fish oil and soap and sulphuretted oils. This treatment of such leathers is already known and it is practised with the object of endowing the leather with maximum softness, flexibility and weather proofness. It is not necessary to abstract the fat stuffing from the leather in order to qualify it for adhesion with the rubber sole pieces; the presence of fat and oil in the leather substance is not found to be objectionable when the union of the rubber and the leather is effected by the press cure method as herein described.

In building a shoe, a last is selected of somewhat smaller dimensions than the finished dimensions of the shoe to be produced. Upon the sole of this last an insole piece of fabric or leather is laid down and upon this insole piece a cover sole of rubber dough containing vulcanizing and accelerating ingredients is applied, attachment being effected by wetting the contacting surfaces with a rubber solvent, or a solution of rubber. The skirt portion of the leather upper is served with rubber solution containing also vulcanizing and accelerating ingredients and the upper is pulled over the cover sole and the skirt of it hammered and rolled down on to the cover sole so as to ensure adhesion between the rubberized skirt and the rubber in the cover sole. The toe and heel portions of the skirt are pleated in and a serving of rubber solution or thin rubber paste also carrying vulcanizing and accelerating ingredients is painted over the downturned skirt so as to ensure as complete adhesion as possible and to provide a maximum stickiness to ensure satisfactory attachment of the tread sole to the cover sole and the upper skirt. A tread sole piece (with or without attached

heel lift) is now laid over the work and pressed down so as to adhere it to the underface of the cover sole and to the pleated-in-skirting. No tacking or stitching is required to hold the upper skirt during the lasting process. After the tread sole has been applied in the way described, the thus built up shoe is removed from the last and a hard metal false plate is inserted in it to lie upon the insole. Then, the structure is enclosed in a mould and a rubber inflation bag is set within the shoe and the mould is closed and locked. The mould is of full size dimensions and it is carried on a hot table, or the bed of it is directly heated by steam or may be heated electrically or by gas. The hot table arrangement is, however, the preferable one, as a better control of the temperature is thus ensured. The upper part of the mould, which, like the sole portion of it, is of metal, is exposed to air, and there is consequently a temperature gradient diminishing from the sole plate to the top portion of the mould. Pressure is raised in the inflation to about 100 lbs. on the square inch, and this pressure is maintained during the vulcanization period; the length of that period depends upon the characteristics of the rubber mixture. In order to obtain a satisfactory curing of the rubber, regard is had to the fact that the temperature is a maximum under the sole and that it diminishes rapidly upwardly from the sole. Considerable heat is absorbed in the rubber sole and the temperature of the upper part of the mould does not therefore rise as rapidly as it would do if a shoe were not in the mould. The temperature to which the skirt leather is subjected does not rise to a point so high as to injure the leather goods, much heat is absorbed in the sole substance and the skirt does not therefore attain the temperature of the hot plate. As the tread sole is subjected to a higher temperature than the cover sole and the skirt of the upper, the rubber mixture used in the cover sole should contain a higher proportion of vulcanizing and accelerating ingredients than the tread sole. By appropriately proportioning the ingredients uniform curing is effected. When pressure is applied through the inflation, flatness of the sole is maintained, risk of thinning the sole is prevented, and even distribution of temperature over the whole area of the sole is ensured by the metal false plate which lies between the inflation and the insole. The false plate is removed as soon as the curing process has been completed. The pressure applied expands the upper and brings it to the full size of the mould, and in this expansion the skirt portion of the upper is drawn some distance outwardly from between the cover sole and the tread sole, bringing with it an edging of rubber taken from the tread sole; this edging forms a foxing which fills the welt

seam and offers a not inconsiderable security against risk of burning or otherwise damaging the upper. The adhesion obtained between the upper and the soles is very effective and it is not ordinarily possible to tear away the upper from the sole of a shoe made according to this method. To ensure maintenance of a cool condition in the upper part of the mould, the castings of which the mould is built up may have cellular cavities formed in them and connections are made through flexible pipes to these cavities to enable water to be circulated through them to draw off heat transmitted upwardly from the hot sole plate of the mould.

At the conclusion of the press cure operation the air pressure is released from the inflation, the mould opened out, the cured shoe withdrawn and the inflation and metal false plate are withdrawn from it. The process of construction is substantially identical in the case of boots, shoes, and slippers.

Commercial success is obtainable only when appropriately compounded rubber is used for the tread sole, the insole, and the liquid serving rubber, which is painted on the contacting surfaces in the building up of the soles, and for the impregnation of the skirt portion of the upper to render it adhesive to the rubber sole pieces. The respective mixtures are proportioned to obtain even curing throughout the rubberized structure having regard to the temperature gradient, which is a maximum at the hot table and tapers away towards the top portion of the mould. A reasonable liberty may be taken in varying the proportions of the ingredients and in modifying the filler ingredients. For white finish rubber very satisfactory results have been obtained with the tread sole rubber compounded according to the following formula. For the serving rubber and the cover sole rubber the proportions of activator, accelerator, and sulphur are increased to procure equalization of the cure. The proportion of the filler in the cover sole may be higher than the proportion of filler in the tread sole.

The tread sole formula is as follows:—

Crepe or sheet rubber.....	12 lbs.	115
Magnesia carbonate filler.....	2 lbs.	
Zinc oxide.....	¼ lb.	
Elemental sulphur (vulcanizer)....	1 lb.	
Rapid accelerator.....	1 oz.	120

The serving solution which is applied to the upper skirt for painting on the skirt after it has been hammered down or the cover sole is compounded of:—

Fresh rubber.....	12 lbs.	125
Elemental sulphur.....	2 lbs.	
Rapid accelerator.....	2 oz.	
Magnesia carbonate.....	1 lb.	

The surplus solvent which is contained in 130

the goods is preferably vaporized by exposure in a warm dry atmosphere before the goods are placed in the vulcanizing mould.

The vulcanizing temperature at the hot plate is about 320° F.; the time required for effecting vulcanization varies according to the rubber mixture and ranges between three minutes to twelve minutes.

The leather parts of the structure are not subjected to excessive heat during the press cure. The water jacketing of the mould is a preventive means for keeping down harmful temperature in the upper part of it. If the temperature be allowed to rise too high the leather is liable to suffer injury. It is practicable to cool the upper parts of the mould body by means other than a water jacket. Thus, for instance, the mould may be kept cool by frequent swabbing with damp cloths, or by air blasts directed onto it. The essential point is that the temperature in the body portion of the mould which contacts with the leather is held below a dangerous point, while the bed of the mould through which the rubber sole obtains vulcanizing heat is held at a high temperature appropriate to the cure required.

If no cooling of the mould body is practised there is a risk that it may become gradually hotter in continuous working so that its temperature will soon pass a safe limit. When the uppers are constructed of unvarnished chrome tanned leathers or suedes less attention may be paid to the cooling of the upper part of the mould as these leathers do not suffer notable injury when subjected to heat treatment, though allowance must be made for some shrinkage which is caused by heating.

In order to minimize liability of thin leather splits to stretch, it is in most cases desirable to reinforce them with liners of leather or woven fabric or sheep skin. The joints in the lining should not register with the joints in the upper. A most effective reinforcement is obtained when the liner is continuous under the joints of the upper, and the harshness of the joints is thus also minimized. The liner is secured to the upper around all the marginal portions of it, or may be all over its surface, by adhering it by means of rubber gum which may contain some vulcanizing elements so that a permanent union is obtained in the vulcanizing process; the margins may also be sewn together.

The manipulation practised in the building up of the shoe on the last will be readily understood by bootmakers from the foregoing description. It is to be emphasized that for a shoe of any given size the last must be undersized so that when the goods are subjected to the inflation pressure in the mould the upper will be stretched and expanded so that the skirt portion of it will

draw out from between the cover sole and the tread sole and carry with it a margin of rubber which will form a foxing which will fill the welt seam, closing it effectively and perfecting the attachment of the upper to the sole. The extent of the expansion thus to be provided for should be from an eighth of an inch to a quarter of an inch in the width, and on the length of the shoe. The clearance facilitates the insertion of the goods into the mould. The spreading of the sole piece in all directions laterally ensures a working of the rubber so that a clean full finish is obtained and a perfect bond is established between the sole rubber and the upper skirt. No less important is the perfect shaping of the shoe which is thus ensured as any bagginess or irregularity of make up on the last is compensated in the mould in the stretching of the upper and the spreading of the sole.

The mould in which the press cure is effected is preferably constructed according to the accompanying drawings, in which:—

Fig. 1 is a top plan, showing the mould closure moved to the open position;

Fig. 2 is a top plan of the mould closed;

Fig. 3 is a transverse section on the plane 3—3 Fig. 2; and

Fig. 4 is a vertical section on the plane 4—4 Fig. 2.

A represents the hot table; this table is an ordinary known type of construction having steam cavities in it with means for circulating steam to maintain its temperature at about 320° F. The fixed section B of the mould is bolted down to the table at *b-b* and is immovable on the table. The butt portion C of the movable section is held fixed down to the table A at *c* and it is cross bolted at *c'* to the fixed mould section B. The heel portion D of the fixed member of the mould is hingedly connected at *d* to the mould section B so that it may be swung outwardly to give clearance for the insertion and withdrawal of the goods and minimize risk of grating or chafing the goods. The gate E of the mould is hinged at F to the mould butt C and it is provided with a hand piece G for swinging it to open and closed position. In the closed position, the gate E is locked to the fixed section B of the mould by a swing-over claw H which is tightened up by means of an eccentric pivot J which is fitted with a hand grip K. It is also locked by means of a claw L, which, like the claw H is carried on an eccentric pivot M having a handpiece N for manipulating it. The gate E carries the sole mould plate P which is fixed to it. The lasted goods are set on the plate P when the gate E is thrown fully open; then the gate is in-closed to the position shown in Fig. 2, the inflation bag Q being first placed in the shoe over the metal false plate R. It will be noted that the mould plate P fits into recesses in the sides of the mould section B, C, D and

E, as will be clear on reference to Fig. 3. S is the nipple of the inflation Q, and T is a bridge abutment which carries its button head and takes care of the upward pressure exerted by the inflation Q.

Satisfactory results are not obtainable unless the toe portion of the mould is a non-opening pocket. If the opening side of the mould were to draw away completely from the fixed side of it the uppers would be liable to be pinched in the in-closing movement. By constructing the mould with the toe portion as a solid pocket consequent upon the permanent connection of the sections B and C, the toe portion of the shoe is inserted into this toe pocket of the mould in the closing movement and withdrawn in the opening movement.

V are cellular spaces cored in the lateral and upper portions of the mould sections. Appropriate inlet and outlet water connections are made to these cavities V to permit circulation of water through them for the purpose of cooling off the upper portion of the mould. In practice, the moulds are constructed of aluminium and they are reinforced with hard metal where the claws H and L engage them.

What I claim as my invention and desire to secure by Letters Patent is:—

1. The process of manufacture of footwear having leather uppers and rubber soles, which consists in lasting the upper over a rubber cover sole on an undersized last, applying a rubber tread sole piece thereover and vulcanizing the structure in a mould, the whole of which except the sole plate is maintained at a substantially lower temperature than the point at which injury to the leather results.

2. In a process according to claim 1, the insertion of a withdrawable metal false plate between the insole and a pressure inflation before the vulcanizing operation, to obtain flatness of the insole and equalization of the cure.

3. The process of manufacturing footwear comprising lasting a leather upper upon an insole, rubber covered sole and tread sole, using an undersized last, then inserting a false metal plate over the insole, then placing flexible inflation means within the upper, then enclosing the structure in a mold of normal dimensions, then distending the inflation means, then heating the bottom plate of the mold and then cooling the upper portion of the mold during the vulcanizing operation.

In testimony whereof I affix my signature.
HENRY MCGHEE.