Nov. 17, 1942. P. R. AUSTIN 2,302,167

FOOTWEAR

Filed June 14, 1940

Fig. 1.

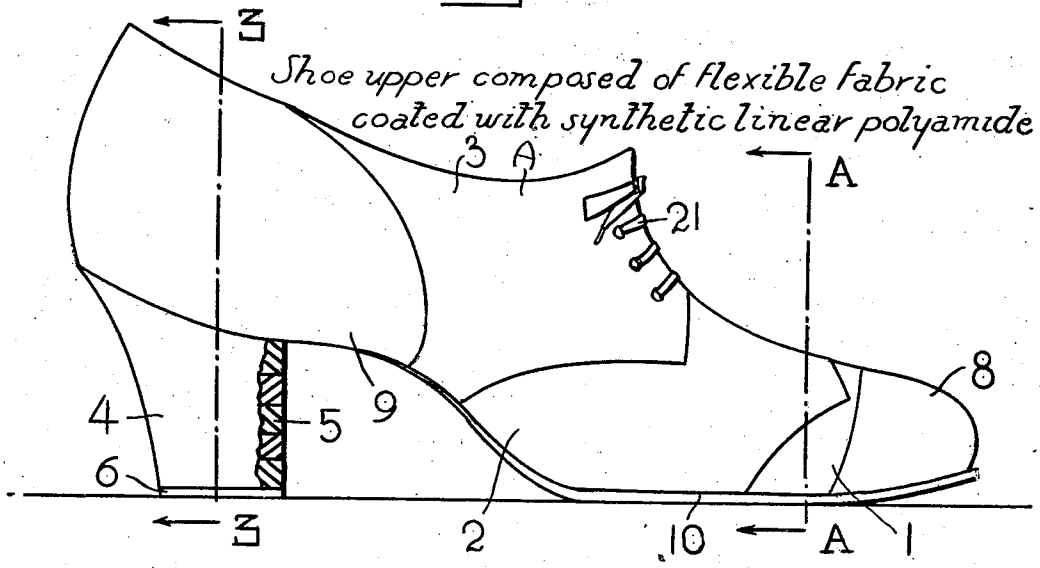


Fig. 2.

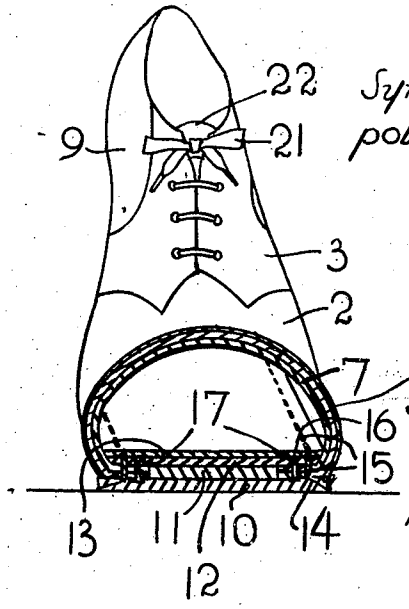
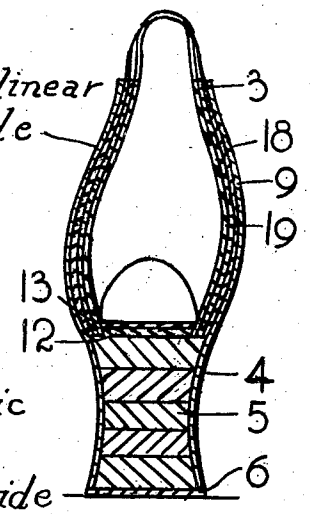


Fig. 3.



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Patented Nov. 17, 1942

2,302,167

UNITED STATES PATENT OFFICE

2,302,167

FOOTWEAR

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Application June 14, 1940, Serial No. 340,594

3 Claims. (Cl. 12—142)

This invention relates to articles of footwear, and more particularly to the manufacture of such articles from synthetic materials.

Heretofore it has been almost universal practice to fabricate footwear from leather, i. e., from tanned animal hides or skins. However, shoes made of leather have certain serious drawbacks. Depending somewhat on the kind of leather used, they are subject to scuffing, the familiar unsightly marring which results when the shoe accidentally is brushed against a rough surface. Furthermore, the repeated flexing to which shoes are subjected in walking results in permanent sharp creasing of the leather into wrinkles resembling "crow's feet," which damage the appearance of the shoe. Most footwear must also be refinished frequently by waxing and polishing. Leather shoes are expensive, due to a number of factors: The conversion of hide into leather requires a considerable number of processing steps, which add greatly to its cost. A large proportion of the hides used are imported, which increases cost and makes the supply uncertain. There is considerable waste in cutting leather into shoe parts, because of the presence of brand marks, briar scratches, scars produced by parasite infestation, and the like. Leather is nonuniform, varying greatly in thickness, strength and resilience from one point to another on the same hide, so that great care is required in cutting leather for shoes which results in relatively high labor costs.

Materials other than leather have found some application in certain parts of shoes such as soles, heels, linings, and innersoles. However, success in the use of synthetic materials in the uppers of shoes and slippers has hitherto been small. The uppers of shoes are subjected to constantly repeated flexing and stretching. The synthetic materials hitherto available have not been sufficiently tough to withstand satisfactorily these conditions, and have failed by cracking and splitting.

This invention has as an object new articles of footwear which have good wearing properties and which retain their initial appearance over long periods of service. A further object is the manufacture of a low cost footwear characterized by freedom from cracking, scuffing and wrinkling. Other objects will appear hereinafter.

These objects are accomplished by fabricating articles of footwear and particularly the uppers of shoes, slippers and the like, from materials comprising high molecular weight synthetic linear polymers containing amide or thioamide groups as an integral part of the main chain of atoms in the polymers. These polymers will be referred to herein as polyamides. By "high molecular weight" polyamides are meant those which have been polymerized to a sufficiently high degree to be capable of formation into tough filaments and films. The polyamides do not in general exhibit these properties unless they have an intrinsic viscosity of at least 0.4, where intrinsic viscosity is defined as in Patent 2,130,948.

The high molecular weight polyamides used in the practice of this invention are of the general types described in Patents 2,071,250, 2,071,253 and 2,130,948. For the most part they are crystalline rather than resinous, their microcrystalline nature being evidenced by the type of diffraction pattern which they furnish on X-ray examination. Since one of the most characteristic properties of these polyamides is their ability to be formed into pliable fibers, they are referred to as "fiber-forming polyamides" or "superpolyamides." Filaments spun from these polyamides, e. g. by extrusion of the molten polymer, yield, upon cold drawing, fibers which show by characteristic X-ray diffraction patterns orientation along the fiber axis.

The polyamides are obtainable from bifunctional polyamide-forming reactants, as for instance from the reaction of diamines and dibasic carboxylic acids, the self-polymerization of monoaminomonocarboxylic acids, and from mixtures of the foregoing reactants. It is to be understood that mention of diamine, dibasic carboxylic acid and monoaminomonocarboxylic acid includes also amide-forming derivatives thereof. Upon hydrolysis with mineral acids, the polyamides yield monomeric bifunctional amide-forming reactants. For example, a polyamide derived from a diamine and a dibasic carboxylic acid, on hydrolysis with hydrochloric acid, yields the dibasic carboxylic acid and diamine hydrochloride. Similarly a polyamide of the amino acid type yields an amino acid hydrochloride on hydrolysis with hydrochloric acid. The polyamides most useful in this invention are those having intrinsic viscosities between 0.5 and 2.0 and melting points between 90 and 300° C.

In the accompanying drawing:

Fig. 1 is a side view of a shoe embodying my invention,

Fig. 2 is a section through the line A—A in Fig. 1, and

Fig. 3 is an elevation of the heel end of the shoe shown in Fig. 1.

The invention is illustrated in its preferred form in the drawings in which the shoe upper, indicated generally by the character A, is composed of a flexible fabric coated with synthetic linear polyamide. This coating, exaggerated in thickness for illustration, is indicated by the numeral 20. That section of the upper designated as 1 is known as the toe cap, 2 is known as the vamp, while 3 is known as the quarter. Further exposed portions of the article of footwear represented in Fig. 1 include 4, the heel covering; 5, the heel; 6, the heel lift; and 10, the outsole. In Fig. 2 the tongue is designated by 22, and the laces by 21. The vamp lining is shown by 7, and the sole construction includes 10, the outsole; 11, the filler; 12, the insole; and 13, the sock lining. In the particular structural embodiment of the invention shown in Fig. 2, the sole portions of the article of footwear are combined and attached to the upper by McKay stitching. Lasting tacks are indicated by 16, and clinched at 17. The stitching 15 is applied through the channel 14, in the outsole 10, and extends through to the insole 12. Structural and lining portions of the upper 1, 2, 3, are shown in Fig. 1 where 8 is a box toe or toe stiffener, while the heel section is stiffened by a counter designated by 9. The position of the counter with respect to other underlying portions of the quarter 3, is shown in Fig. 3 where the quarter lining 19 protects the foot from the counter 9 which in turn is separated from the quarter section of the upper 3 by a lining 18.

In the preferred and most valuable practice of my invention the shoe upper consists of a flexible fabric coated with a high molecular weight interpolyamide. The interpolyamides are formed by the conjoint polymerization of a mixture of polyamide-forming reactants capable of yielding more than one polyamide if reacted in suitable combinations. A typical example is the interpolyamide derived from a dibasic acid, a diamine, and another dibasic acid and/or another diamine, such as the interpolyamide derived from adipic acid, hexamethylenediamine, sebacic acid and decamethylenediamine. A particularly useful class of interpolyamides are those derived from a dibasic acid, a diamine and an amino acid or amide-forming derivative thereof, such as the interpolyamide derived from adipic acid, hexamethylenediamine and caprolactam or from adipic acid, hexamethylenediamine and 12-aminostearic acid.

The polyamide coated fabric forming the upper of the shoe may be obtained by several methods, as for instance, by deposition of the polyamide on the fabric from solution or dispersion, by coating or impregnating a suitable fabric with the molten polymer, by calendering or by pressing with heat and pressure a preformed sheet of the polymer on the fabric. A preformed sheet of the polymer can also be applied to the fabric by means of an adhesive, this method being preferred when the sheet has been cold rolled.

A further method of practicing the invention consists in using as the material for the shoe upper a self-supporting sheet of the polyamide film in suitable thickness. These sheets may be extruded through a slit from the molten polymer and tempered by quenching or otherwise rapidly chilling. Sheets of the desired thickness may also be obtained from solutions or by slicing them from a block of the molded polyamide. These sheets, in order to impart the tensile strength and other properties desired in shoe uppers are preferably cold worked, usually by cold rolling, which consists in applying compressive stress to the solid polymer thereby orienting the crystallites along one or more preferred axes, and are embossed at elevated temperature. In this process the amount of cold rolling should be at least to the extent of 10% elongation.

The following examples, in which parts are by weight, illustrate the invention in greater detail.

Example I

Two hundred parts of an interpolyamide having an intrinsic viscosity of 0.92 derived from 60 parts hexamethylenediammonium adipate and 40 parts caprolactam is dissolved, along with 200 parts of amylbenzenesulfonamide as plasticizer, in 400 parts of a mixture of ethanol and water in the ratio 16:5. Two coatings of the solution are applied to a section of 1.32–53" unsized sateen by spreading the solution on the fabric with a leveling blade and drying the coated fabric in a heated chamber with circulation of air at 65° C. after each application. The resulting coating is termed a "sub-coating."

A "color coat solution" is then prepared consisting of 870 parts of the interpolyamide described above, 356 parts of amylbenzenesulfonamide, 214 parts of butyl phthalyl butyl glycolate, and 16 parts of carbon black in 2602 parts of a mixture of ethanol and water in the ratio of 16:5. A sufficient number of coatings of this color solution is then applied to the sub-coating to build up on the fabric a coating 0.007" thick. The resulting coated fabric is subjected to embossing with a leather grain at 82° C. The upper stock thus obtained is employed in the fabrication of a pair of women's Oxfords of McKay construction. These Oxfords provide foot comfort, retain their original shape and, after extended service, are found to be free from scuffing and cracking. A further sample of the coated fabric just described is employed in the fabrication of a pair of women's Oxfords of cemented construction. These shoes are found to be equally durable and after extended wear show no tendency for separation of the sole.

A high gloss finish of patent leather type, in appearance is obtained on the above described upper stock by applying two coatings of solution of 10 parts of the above described interpolyamide in 90 parts of a solvent consisting of trichloroethylene and methanol in the ratio 15:16. The resulting material is employed in the fabrication of a pair of women's Oxfords of McKay construction, which after extended usage are found to retain their original glossy finish to a high degree.

Example II

A "sub-coating" solution is prepared consisting of 4 parts of the interpolyamide of intrinsic viscosity 0.92 derived from 60 parts of hexamethylenediammonium adipate and 40 parts of caprolactam, 4 parts of amylbenzenesulfonamide, 6.4 parts of ethanol, and 1.6 parts of water. The solution is applied in two coats to a section of 7.00–40" black cotton sheeting using conventional fabric coating equipment which provides for drying between coats at 80° C. In the preparation of the "color coating solution" 5 parts of bone black is mixed with 12 parts of the interpolyamide of intrinsic viscosity 1.05 derived from 60 parts of hexamethylenediammonium adipate and 40 parts of 6-aminocapronitrile, 5.81 parts of amylbenzenesulfonamide, 3.25 parts of butyl phthalyl butyl glycolate, 27.32 parts of ethanol,

and 6.88 parts of water. This mixture is heated and stirred until the polyamide is found to be in solution, and then cooled to room temperature for use in coatings. Coatings of this solution are applied to the sub-coated sheeting until the total weight of solvent-free coating on the fabric corresponds to 7.6 oz./40" yard. The resulting coated sheeting is then backed with a rubber impregnated sheeting using standard textile combining machinery and the product given a leather grain by embossing at 80° C. The adhesive used to yield the double textured product is rubber cement.

The double textured upper stock described above is employed in the fabrication of a pair of child's sport welt shoes having rubber soles and a Goodyear welt construction. This type of footwear, designed for hard usage, is found to be of attractive appearance and outstanding durability.

Example III

The same coating solutions and techniques described in Example II are employed in preparing a coated 1.32–53" unsized sateen. Coatings are applied in such a manner that the final solvent-free weight of coating amounts to 11.4 oz./50" yard.

After the application of a leather grain by embossing at 80° C., the resulting upper stock is employed in the fabrication of men's Goodyear welt shoes which are found to be accurately shaped to the last and show a high degree of scuff resistance during wear.

Example IV

Polyamide sheets ranging in thickness from 0.015 to 0.030" prepared from a composition containing 1600 parts of an interpolyamide of intrinsic viscosity 0.86 derived from equal parts of hexamethylenediammonium adipate and decamethylenediammonium sebacate, 685 parts of a mixture of N-ethyl ortho and paratoluene sulfonamides and 16 parts of carbon black are cold rolled by passing them through chromium faced rolls under sufficient pressure to cause elongations of 50–140%. The sheets are cold rolled in two directions which are at right angles to each other. The cold rolled sheeting obtained in this way is embossed in a plate press with a pin seal pattern at a temperature of 85–88° C. The resulting sheeting possesses a leather-like feel, combined with high strength and excellent drape.

A sample of the polyamide sheeting is then employed as upper material in the fabrication of a pair of child's ballet slippers. Standard shoe fabrication equipment and processes are employed throughout as the upper stock is cut into the component parts of the upper using the usual dies and backed with a light fleece lining using a standard latex adhesive. The various parts of the upper are then assembled and sewn together to smooth seams without buckling or distortion. The uppers are attached to a composition innersole by the customary procedures of first "pulling over," and side, toe and heel lasting. A leather outsole is then attached by stitching on a McKay machine. After attaching the heel, inserting sock lining and completing surface finishing operations, the finished pair of child's ballet slippers are found to be well shaped and to have an exceedingly attractive appearance.

A pair of woman's Oxfords are similarly fabricated using the same upper material and the shoes obtained are found to be highly resistant to scuffing and surface marring during wear.

In an analogous manner white shoes are fabricated from upper material consisting of a cold rolled upper stock containing 65% of the interpolyamide derived from equal parts of hexamethylenediammonium adipate and decamethylenediammonium sebacate having an intrinsic viscosity of 0.86, 25% of a mixture of N-ethyl ortho and paratoluene sulfonamide, and 10% of titanium dioxide pigment.

Example V

To the square side of a section of 1.32–53" unsized high count (108 x 96) sateen are applied two coats, with drying at 88° C. between coats, of a sub-coating solution consisting of 39 parts of an interpolyamide (melt viscosity 3148 poises at 250° C.) derived from 40 parts of hexamethylenediammonium adipate, 30 parts of hexamethylenediammonium sebacate, and 30 parts of 6-aminocaproic acid; 15.6 parts of the product obtained by condensing phenol with 1,12-octadecanediol in the presence of zinc chloride; 10.4 parts of the product prepared by ester interchange of propyleneglycol with castor oil in the presence of potassium hydroxide; 80 parts of ethanol; and 17.5 parts of water. Eleven coats of a color coat solution consisting of 6 parts of carbon black dispersed in 700 parts of solution having the same composition as the sub-coating solution are then applied at about 50° C. to the previously coated surface, with drying at 88° C. between coats. After the application of the sixth color coat, the product is skivered by embossing with a fine kid grain at 93° C. The total weight of the coatings applied is 9.8 oz./50" yd. The final product is again embossed at 93° C. with a fine kid pattern. The upper stock thus obtained is employed in the fabrication of women's sport-type pumps to which outsoles are attached by a pyroxylin cement. Women's sport-type pumps containing the same upper material are also made to which outsoles are attached with the use of a plasticized interpolyamide cement. These shoes are extremely well shaped to the last, and the soles are found to be firmly attached. The high quality of the upper surface in terms of initial appearance and freedom during wear from all damage such as cracking or scuffing is particularly outstanding. The closely woven fabric base to which the polyamide coating is applied in the preparation of this upper stock assures absence of fabric pattern on the coating surface during the vigorous stretching over the last accompanying various fabrication steps.

One of the most valuable embodiments of my invention is a shoe in which the upper consists of a polyamide coated knit fabric. A shoe of this kind is described in the following example.

Example VI

A sub coat solution is prepared consisting of 128 parts of the interpolyamide derived from 60 parts of hexamethyldiammonium adipate and 40 parts of epsilon-caprolactam having a melt viscosity of 4585 poises at 250° C.; 95 parts of 1,12-diphenyloloctadecane; 32 parts of the condensation product of propylene glycol and castor oil; 192 parts of ethanol; and 64 parts of water. The mixture is heated and stirred until a clear solution is obtained. The hot solution is applied in 2 coats by means of a doctor knife to a double textured fabric comprising 2 layers of cotton knit

fabric weighing 7¼ oz./sq. yd. cemented together by means of a nonvulcanizing rubber cement, drying between coats in a heated chamber with circulation of air at 65° C. The color coating solution consists of 686 parts of the interpolyamide described above; 536.8 parts of 1,12-diphenyloloctadecane; 152.4 parts of the condensation product of propylene glycol and castor oil; 24.8 parts of carbon black; 1575 parts of ethanol; and 525 parts of water, heated and stirred until homogeneous. Coatings of this solution are applied to the sub-coated composite fabric until the total weight of solvent-free coating on the fabric corresponds to 10.1 oz./50" yd.

After the application of a leather grain by embossing at 93–99° C., the resulting upper stock is employed in the fabrication of a pair of women's closed Oxfords of McKay construction. These shoes are found to be accurately shaped to the last, and of a most attractive appearance.

A shoe the upper of which is composed of polyamide coated textile fabric, such as cotton, is a particularly desirable embodiment of this invention since this material exhibits especially desirable working properties in the lasting and other fabrication steps involved in the manufacture of footwear. In some instances the use of the polyamides in other forms may be desirable, as for instance in the form of self-supporting sheets as previously mentioned or in the form of spongy polyamides consisting of multicellular sheet containing fine voids or pores and obtained by melting under pressure finely divided polyamide in an inert gas and extruding the molten polyamide containing the entrapped gas bubbles into film and quenching. These porous films, which will in general have apparent densities less than 0.8, are best used when combined with a flexible backing such as cloth by means of a suitable adhesive. A coating having a high degree of porosity may also be obtained by subjecting a coating containing a substantial amount of solvent to heat and pressure. A further method of preparing a porous polyamide coated fabric consists of introducing semi-microscopic holes into the coated fabric by perforation techniques.

Upper material prepared by the described methods is generally given a decorative surface to resemble leather. Various leather grains are readily impressed upon the surface of the upper material by embossing procedures. Effective embossing is readily secured at temperatures substantially below the melting point of the polyamide film or coated flexible material under consideration.

A further type of upper material comprising polyamides, useful in preparing the products of this invention consists of a textile fabric such as may be prepared by weaving or knitting polyamide fibers. A still further type of upper material may be prepared by felting together short fiber lengths of a suitable polyamide.

The polyamide composition may contain selected modifying agents, such as plasticizers, pigments, dyes, antioxidants, and the like. The preferred composition contains polyamide and plasticizer in ratios varying from 90:10 to 50:50. Particularly useful plasticizers are high boiling arylsulfonamides and phenols or mixtures thereof. A wide variety of common dyes may be used to manufacture the polyamide upper material in a large variety of shades.

In the preferred practice of building up a coating on a fabric base by application thereto of a polyamide solution, the coating should have a thickness between 0.001" and 0.030", and preferably between 0.002" and 0.010". Preformed sheets may be bonded to the fabric base by heat and pressures, or after cold rolling these sheets may be combined to the fabric with an adhesive which desirably consists of a solution of the polyamide. The entire upper of shoes can be made of the polyamide coated fabric, or if desired, only a part of the upper, e. g. the vamp.

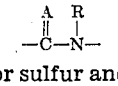
Selection of the textile base depends largely on the working properties and strength desired in the final polyamide coated fabric. Among useful single textured backing fabrics may be mentioned sateens, twills, sheetings, elastic woven fabrics and the like. Nonraveling backings, as represented by rubber impregnated fabrics are especially useful. Multiple textured fabrics are frequently desirable. For example, an upper stock constituted of a polyamide coating on a high count sheeting to which in turn is cemented a loosely woven nonraveling fabric, yields an upper stock which is free of any tendency for clothy appearance on stretching, is strong yet flexible, and provides for a nonraveling edge. Unwoven fabrics, e. g. felts, can also be used as backings or supports for the polyamide coatings.

The manufacture of improved shoes by fabrication from the fiber-forming synthetic linear polyamides of shoe parts other than the uppers is also within the scope of this invention. The heel covering shown in the drawing at **4** and tongue **20** may be prepared of much the same type of material as is employed in the upper. Similarly, lining materials such as **7** and **18** may comprise polyamide, for example, in the form of a textile fabric. Coated fabrics, in which the coating comprises polyamides, are advantageously used in the sock lining **13** and the quarter lining **19**. Toe and heel stiffeners such as the box toe **8** and the counter **9** may be prepared in a number of ways employing polyamide, among which may be mentioned the impregnation of coarsely woven textile fabrics with a soluble polyamide or with a polyamide which may be heat-softened at a convenient temperature. Thus, these stiffeners may then be temporarily softened to conform with the last, either by solvent or heat treatment, respectively. The polyamides may also be advantageously employed in the sole area of the shoe. For example, the outsole **10**, the heel lift **6**, and innersole **12** may be made from films or sheets comprising polyamides. Fillers such as **11** may be conveniently prepared from a felt of polyamide fibers. The heel **5** may be built up of a series of layers comprising polyamide or, further, it may be molded directly in one piece from a composition comprising polyamide. The present invention as embodied in Figure 2 involves the attachment of sole **10** to innersole **12** by means of stitching **15**. It is understood that such stitching may also advantageously be prepared from polyamide fibers. Wire or textile fabrics comprising polyamide may also be used for the lacing **21**.

In addition to the sole illustrated in the drawing the present invention is applicable to the other well known types of shoe construction, for example, the Littleway, turn, stitchdown, nailed and cemented. Among many types of men's and women's footwear which may be fabricated according to the present invention may be mentioned sport shoes, including golf, tennis, track, basketball, baseball, football, riding, bowling, hiking, hunting and skating shoes; work shoes, including safety shoes; boots; waterproof or water-

resistant shoes; dress shoes, including dancing shoes, ballet slippers; business shoes; military shoes; lounging shoes, including bedroom lippers, mocassins and mules; infant's shoes and shoes for growing children. In addition to the upper design shown in Figure 2, a wide variety of other designs are useful in the footwear of this invention, for example, open toe; open heel; cut-out patterns; strap, huarache; perforated; contrasting colors, grains or finishes in component parts of the upper; mocassin; straight toe; wing tip; high top; with lacing, with metal fasteners; and many others.

Examples of additional polyamides useful in the practice of this invention include materials such as polytetramethylene sebacamide, polypentamethylene adipamide, polypentamethylene sebacamide, polyhexamethylene suberamide, polyhexamethylene sebacamide, polyoctamethylene adipamide, polydecamethylene carbamide, poly-p-xylylene sebacamide, polydecamethylene phenylenediacetamide, the polyamide derived from 3,3'-diaminodipropyl ether and adipic acid, polymerized 6-aminocaproic acid, polymerized 9-aminononanoic acid, and polymerized 9, 10, or 12-aminostearic acid. Mixtures of preformed polyamides may also be used. Particularly useful are the interpolyamides which are obtained by polymerization of a mixture of polyamide-forming reactance, e. g., a mixture of hexamethylenediamine, adipic acid and/or sebacic acid, caprolactam and/or 12-aminostearic acid. In the polyamides of this invention the average number of carbon atoms separating the amide groups in the polymer chain is at least two. The term "linear polyamide" as used herein includes not only polyamides and interpolyamides obtained solely from polyamide-forming reactants but also all linear polymers containing a plurality of amide (including thioamide) groups in the main chain of atoms, i. e., groups of the structure



where A is oxygen or sulfur and R is hydrogen or a monovalent hydrocarbon radical. These modified polyamides are obtained by including with the polyamide-forming reactants other linear polymer-forming reactants, such as amino alcohols and hydroxy acids. As examples of such modified polyamides may be mentioned the ester-amide interpolymers, as for instance those derived from diamines, dibasic acids, and amino alcohols; those derived from diamines, dibasic acids and hydroxy acids; those derived from dibasic acids and amino alcohols; and those derived from amino acids and hydroxy acids. Although these products contain ester linkages, they may be referred to as polyamides, since they contain a plurality of amide linkages as an integral part of the main chain of atoms in the polymer, and retain many of the desirable properties of the simple polyamides. Like the simple polyamides, these modified polyamides do not exhibit the fiber-forming properties which give evidence of the toughness and potential durability required in this invention until their intrinsic viscosity is at least 0.4. The term "polyamide" also includes polycarbamates and their sulfur analogs.

The articles of footwear embodied in the present invention present many advantages to manufacturer and consumer alike. The synthetic materials described herein as advantageously employed in the construction of the present invention may be had by the manufacturer in a variety of weights, surface appearances, and physical properties. Since these may be supplied in uniform quality and at moderate cost, shoe fabrication processes are at once broadened in scope and simplified in practice. The appearance of leather footwear is naturally determined by the surface and structure of the animal hide employed, whereas the many and varied operations which are applicable to the preparation and modification of upper stock comprising polyamide open a vista of novel and attractive styles in footwear. Uniformity of supply and cost characteristic of this polyamide upper stock provides for a more constant and reliable raw material source to the manufacturer and permits consideration of novel types of mass production equipment hitherto unusable by shoe manufacturers when only hides of natural leather varying in size, thickness, condition, and the like are available. In contrast to the poor resistance of previously tried leather substitutes to the repeated flexing encountered in localized areas of the shoe upper, the upper stock comprising polyamide used in this invention exhibits excellent durability in this respect. For example, a shoe made as described in Example I has been given normal usage for a period of five months and the upper shows no evidence of cracking or failure of any kind while another shoe containing a good grade of a commercial artificial leather as upper material and given identical wear, is marred by extensive cracking of the upper. Furthermore, the footwear of this invention far exceeds footwear containing upper material of natural leather with regard to scuff resistance when subjected to hard usage. For example, a shoe made as described in Example II, but in the design of Fig. 2 and with a cemented construction, has been given rough usage for a period of two months and the upper shows no evidence of surface marring or wrinkling while a shoe similarly prepared but containing a leather upper and given identical usage has been rendered unsightly due to serious marring of the upper by cuts and scratches as well as by extensive wrinkling.

A shoe in which the upper comprises a coated knit fabric of the kind described in Example VI is a particularly valuable form of this invention because of the great extensibility of this upper stock and because of its freedom from the appearance of a fabric pattern. These polyamide coated knitted fabrics have an unusual resistance to cracking under the severe conditions of flexing which are encountered in localized areas of the shoe upper.

The quality of extensibility is advantageous in the ease with which this upper stock is fabricated into shoes, especially the pulling over step in the lasting operation, in which these preferred compositions compare very favorably with natural leather in their workability. In contrast the artificial leathers heretofore known have been notably lacking in extensibility regardless of the nature of either the coating or backing used.

In connection with the hereinabove-mentioned extensibility of the upper materials of the invention, it may be observed that the application to them of the conventional lasting operations results in at least a 20% average increase in area, the said increase being brought about by a combination of longitudinal and transverse stretching, in the portion of the upper materials directly affected; which increase in area is effected without the development of clothiness.

The above mentioned complete freedom from

the appearance of a fabric pattern which is made possible by the polyamide coated knitted fabric is an important feature in the manufacture of shoes from artificial leather materials. This appearance of a fabric pattern, which is designated "clothiness," often appears in shoes made from coated fabrics in those portions (e. g., the toe) which have been subjected to a severe stretching in the lasting operation. Thus, many coated fabrics, although of initially good surface appearance, show a marked fabric pattern in the coating when fabricated into footwear. Surprisingly, when the polyamide coated knit materials are stretched as in the lasting of shoes, there is no tendency for the design of the fabric to show through.

The footwear of this invention are readily cleaned or polished. Thus, the white shoes described in Example IV are readily cleaned and restored to their original gleaming white finish, even after extended wear, by the use of a cloth and soapy water, while white leather shoes rapidly become gray with wear and must be repeatedly whitened with finishing agents. Conventional shoe polishes such as wax pastes or emulsions are effectively employed on the articles of this invention in producing the high luster desired in many footwear applications.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments thereof except as defined in the appended claims.

I claim:

1. As an integral part of a shoe, a polyamide coated fabric in unitary stretched condition incident to forming said shoe, the coating on said fabric being not greater than 0.03 inch in average total thickness and in said stretched condition substantially completely concealing the fabric pattern of said fabric, said polyamide being that obtainable from a polymer-forming composition comprising hexamethylenediamine, adipic acid, and caprolactam.

2. In a process for producing shoes, the steps which comprise coating a stretchable textile fabric with a synthetic linear polyamide in a solvent therefor, omitting evaporative removal of a substantial amount of solvent during the production of said coating, then subjecting the same to heat and pressure wherein a high degree of porosity is imparted to the coating on said fabric without injury to the filaments thereof, and subjecting the polyamide coated fabric to unitary stretching in incorporating said coated fabric into a shoe.

3. As an integral part of a shoe, a polyamide coated fabric in unitary stretched condition incident to forming said shoe, the coating on said fabric being not greater than 0.03 inch in average total thickness and in said stretched condition substantially completely concealing the fabric pattern of said fabric, said polyamide being that obtainable from a polymer-forming composition comprising hexamethylenediamine, adipic acid, sebacic acid, and caprolactam.

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