Nov. 18, 1969 G. SAUTTER ET AL 3,478,756

FORMING ARTIFICIAL NAILS

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FIG. 1.

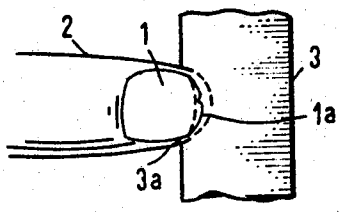
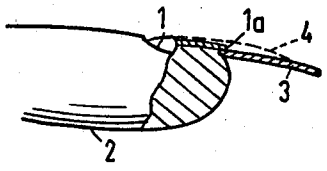


FIG. 3.



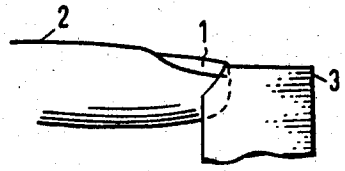


FIG. 2.

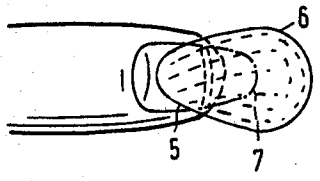


FIG. 4.

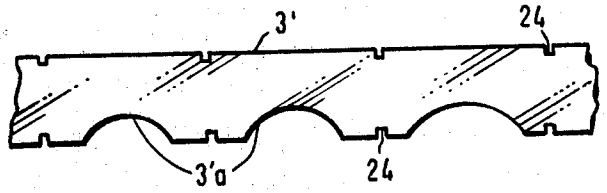


FIG. 5.

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FORMING ARTIFICIAL NAILS

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Continuation-in-part of application Ser. No. 296,831, July 22, 1963. This application July 14, 1964, Ser. No. 382,570
Claims priority, application Germany, Sept. 18, 1962, 1,467,950; Jan. 29, 1964, 1,467,954
Int. Cl. A45d *29/00*; A61k *7/04*
U.S. Cl. 132—73 8 Claims

This is a continuation-in-part of our application Ser. No. 296,831, filed July 22, 1963, now abandoned.

This invention relates to artificial nails for human digits, and more particularly to a method of preparing such nails and to apparatus for performing the method.

In its more specific aspects, the invention is concerned with improving the appearance of fingers or toes carrying short, broken or torn nails which leave a portion of the nail bed exposed.

It is known to provide such fingers or toes with artificial nails which are held in place by lugs placed under the stump of an existing nail. It is also known to provide small shields similar in appearance to a natural nail which are adhesively fastened on the stump of an existing nail.

An object of the invention is the provision of artificial nails which are not readily recognized as such.

Another object is the provision of artificial nails which are securely attached to the finger or toe.

A further object is the provision of artificial finger and toe nails the appearance of which is not unfavorably affected by the growth of a natural nail on the same finger or toe.

An additional object is the provision of materials and apparatus for forming artificial finger nails safely and conveniently.

We have found that naturally appearing finger and toe nails meeting the most exacting requirements can be produced from compositions mainly consisting of synthetic resins. The artificial nail material is applied in highly viscous but plastically deformable condition to a mold which partly consists of the short, broken or otherwise inadequate natural nail and partly of a sheet-like temporary substrate which does not adhere to the resin composition, and which is held in the vaulted shape of a natural nail until the resin composition hardens. The sheet-like substrate is held to the finger or toe during solidification of the resin composition in such a manner that it extends from the nail stump beyond the free end of the digit and covers the exposed portion of the nail bed. An edge portion of the substrate is preferably placed under the free rim of the natural nail during this period. The solidified resin composition forms a unitary film or plate which covers the existing nail and the substrate. The latter may then be withdrawn.

The resin composition may basically consist of a solution of a polymer in a monomer, and may be solidified by polymerization or polycondensation of the latter. After polymerization, there is obtained a film or plate of synthetic resin from which the substrate is readily removed, whereupon the film may be cut to size as desired.

The film of resin material is firmly attached to the natural nail. If the original composition is of adequate viscosity and competently applied, there is no visible mark at the portion of the film which was formed over the border between the natural nail and the temporary substrate. A portion of the liquid viscous composition flows into interstices between the natural nail and the temporary substrate, and the solidified film is thereby interlocked with the natural nail.

Preferred resin materials for the artificial nails of the

invention are synthetic resins which are cured or solidified at room temperature in the presence of catalysts. Polymers of acrylic acid and of its derivatives, and polyesters are typical examples of such synthetic resins. Such a composition may basically consist of polymethylmethacrylate and methylmethacrylate, and should either include an addition agent which improves the adhesion of the solidified polymer film to the natural nail surface, or it is used in conjunction with a primer coating which is applied to the natural nail prior to application of the nail forming composition.

The latter composition is applied to the mold at room temperature or that of the digit as a highly viscous liquid or paste consisting of a solution of a polymeric resin material in a monomer, or as a soft, pliable and plastically deformable semisolid foil of a similar mixture of monomer and polymer. It is rapidly cured in situ by means of a redox catalyst system one component part of which is stored separately prior to its use with the resin-forming ingredients of the artificial nail. The materials of the catalyst are mixed during application only, and may be stored without deterioration for extended and virtually unlimited periods.

The redox catalyst may contain a peroxide as the oxidizing component. The reducing component may be incorporated in the viscous paste and the peroxide may be admixed to a primer coating material which is applied to the nail prior to application of the resin composition, or the peroxide is dissolved in a liquid which is brushed on the primer coating and the substrate. When the viscous liquid or paste containing the polymerizable monomer is deposited on the peroxide containing layer, hardening of the resin composition is initiated by the interaction of the peroxide with the reducing catalyst component.

When the resin constituents are applied to the finger or toe in the form of a pliable foil the foil composition should contain the reducing component of the catalyst, whereas the peroxide component may be incorporated in a primer coating or in a liquid film deposited and dried on the primer coating and the substrate prior to application of the foil.

Curing of an artificial nail applied in the form of a viscous liquid or paste, or in the form of a pliable foil, may be further accelerated by additionally applying a peroxide catalyst to the exposed surface of the nail composition. If the catalyst is incorporated in a lacquer composition, it accelerates hardening of the principal nail forming composition by excluding atmospheric air therefrom.

Materials which improve the adhesion of acrylic resin compositions to a natural nail surface, and which may either be incorporated in the acrylic composition or separately applied as a primer coating, include polymers and copolymers of vinyl chloride, copolymers of acrylic esters, copolymers of acrylic or methacrylic acid derivatives which have polar radicals, such as the copolymers of the amides of these acids with methylmethacrylate, polyvinyl alcohol, and copolymers of butadiene or isoprene or of their halide derivatives, such as chloroprene. A suitable solvent for the peroxide components of the catalysts of the invention is methylene chloride.

Adhesion of the artificial nail material to the natural nail may further be improved by incorporating resinous materials of natural origin, such as rosin, or nitrocellulose and other cellulose derivatives, in the artificial nail composition or in a primer coating.

The mechanical properties of the artificial nail should be as close as possible to those of the natural nail, and the resin composition employed should, therefore, contain solvent type plasticizers or be softened by internal plasticizers. A typical example of an internal plasticizer suit-

able for the purposes of this invention is the copolymer formed by the addition of butyl acrylate to the aforementioned acrylic resin composition, or generally the addition of polyacrylates or polymethacrylates of alcohols having more than three carbon atoms in their molecules.

The visual appearance of an artificial nail produced from a resin composition of the invention in the manner indicated hereinabove is even closer to that of a natural nail when the resin film is made slightly opalescent. Opalescence can be produced by admixing small amounts of polyvinylchloride or of other polymeric resins which are not compatible with polymethyl-methacrylate to a resin composition mainly consisting of polymethyl methacrylate. Finely dispersed pigments, such as titanium dioxide or barium sulfate, produce a similar effect. Other addition agents which may be used to affect the visual appearance of the artificial nail material include dyes and colored pigments, natural or synthetic pearl essence, finely dispersed metal particles, and the like.

The method of producing the artificial finger nails of the invention is illustrated in the attached drawing in which:

FIG. 1 is a plan view of a finger tip and of a temporary substrate used for forming an artificial nail thereon;

FIG. 2 shows the arrangement of FIG. 1 in side elevation;

FIG' 3 shows the finger tip and substrate of FIG. 1 in a side-elevational partly sectional view on a larger scale;

FIG. 4 shows the finger tip of FIG. 1 in plan view after application of an artificial nail, and removal of the temporary substrate; and

FIG. 5 illustrates in plan view a strip of preformed sheet material for preparing the substrate shown in FIGS. 1 to 3.

Referring initially to FIGS. 1 and 2, there is seen a natural nail **1** on the corresponding finger tip **2**. The free rim **1***a* of the nail is broken off in an irregular shape. A strip of resilient, rigid polyvinyl chloride foil is attached to the finger tip **2**. An arcuately recessed edge portion **3***a* of the foil **3** is inserted between the rim of the nail **1** and the nailbed, and the free end portions of the foil **3** on either side of the nail **1** are bent downwardly so that the portion of the foil aligned with the nail **1** is valuted in an upwardly convex arc conforming to the shape of the natural nail.

As best seen in FIG. 3, the foil **3** projects forwardly beyond the finger tip in a direction which is approximately parallel to the direction of elongation of the natural nail **1**, but the foil is offset downwardly by the thickness of the nail **1**. In order to improve the adhesion of the artificial nail to be formed, the free rim **1***a* of the natural nail **1** is filed down in such a manner that an outwardly flaring recess is formed between the underside of the free rim **1***a* and the foil **3**.

When a layer of synthetic resin composition **4** is applied over the exposed top faces of the nail **1** and of the foil **3**, as shown in broken lines in FIG. 3, the resin composition fills the flaring recess and is thereby mechanically locked to the nail **1** after hardening or curing.

In a preferred method of applying the resin composition, a body of the resin mixture is distributed over the surfaces of the nail **1** and the foil **3** so as to gradually taper toward the base of the nail. The layer of resin composition should preferably terminate at a small distance from the nail base, indicated by the border line **5** in FIG. 4, but should cover the foil **3** in a direction away from the finger **2** beyond the desired length of the artificial nail. When the resin composition has sufficiently hardened to retain its shape, the foil **3** is removed, and the resin film which extends to the line **6** may be trimmed back to the desired contour **7** by means of scissors or a file.

The rim **1***a* of the nail **1** does not produce a visible mark on the surface of the hardened or cured resin composition which constitutes the artificial nail if the original viscosity of the composition was high enough. If a step should form in the plastic film **4** over the nail rim **1***a*, it can be smoothed by filing and polishing in the same manner as a natural nail. Similar filing and polishing may be necessary at the border line **5** if the person applying the resin composition is not skilled in this operation.

As the natural nail grows, the border line **5** is shifted forwardly, and the projecting portion of the artificial nail is trimmed as usual until the broken-off nail portion is replaced by new growth, and the artificial nail is gradually removed. The adhesion of the artificial nail to the natural nail remains unimpaired until trimming cuts away the portion of the artificial nail which engages the recess between the free rim **1***a* of the natural nail **1** and the finger tip. At this stage, however, the artificial nail is no longer needed.

The top faces of the artificial nail **4** and of the natural nail **1** may be jointly lacquered or coated with conventional nail polish, and commercial nail polishes will adequately adhere to the artificial nail. Toe nails are provided with artificial extensions in a manner so closely analogous to that described with reference to a finger nail as not to require separate description.

A preferred blank for making the temporary substrate foils shown in FIGS. 1 to 3 is illustrated in FIG. 5. A long strip **3'** of rigid polyvinyl chloride foil has uniformly spaced notches **24** arranged in pairs on the two opposite lateral edges of the strip. The notches **24** are rectangular and their corners are sharp. When the strip **3'** is bent sharply along a line passing through two opposite notches **24**, the strip breaks apart along that line. An arcuate recess **3***a'* between longitudinally adjacent notches **24** has a radius of curvature approximately corresponding to that of the normal human finger or toe nail. Close agreement between the radii of curvature of the recesses **3***a'* and of the nail **1** under which the corresponding section of the strip **3'** is inserted is not necessary.

The strip **3'** shown in FIG. 5 includes three sections equipped with respective recesses **3***a'*, and separated by paired notches **24**. We prefer to make the foil **3'** of sufficient length to include a large number of sections.

While rigid polyvinyl chloride foil is a very satisfactory material for a temporary substrate on which to mold an artificial nail, many other resin materials of suitable degree of elasticity and non-adherent to the resin composition of the artificial nail will readily suggest themselves, Polyethylene and its fluoridated derivatives, such as polytetrafluoroethylene, and other sheet materials coated with the aforementioned non-adhering resins may be employed.

We prefer to hold the temporary substrate in place on the finger by means of a suitable clip in order to avoid relative movement of the substrate and of the natural nail during the polymerizing, hardening or curing period of the resin composition.

The method of the invention will be further illustrated by the following examples, and it will be understood that the invention is not limited thereto.

EXAMPLE 1

A lacquer was prepared to have the following compositions in parts by weight:

Polymethylmethacrylate	10.0
Copolymer of vinyl chloride and vinyl acetate	2.5
Benzoyl peroxide	10.0
Ethyl acetate	77.5

A broken finger nail and a temporary substrate foil of polyvinyl chloride placed under the rim of the nail in the manner described were given a thin primer coating of this highly fluid lacquer. A resin composition of paste consistency was deposited over the primer coating after

evaporation of the solvent. The resin composition had the following composition in parts by weight:

Polymethylmethacrylate	40.0
Titanium dioxide	0.2
N-dimethyl-p-toluidine	0.5
Dioctyl phthalate	5.0
Methylmethacrylate	54.3

The resin composition was additionally coated with a thin layer of the aforementioned lacquer, and was cured to adequate hardness by the redox catalyst system within about 6 to 8 minutes. The polyvinyl chloride foil was withdrawn, and the artificial nail was trimmed to the desired shape with scissors and files.

EXAMPLE 2

A nail equipped with a temporary mold-forming substrate was coated with a fluid primer of the following composition containing 20 parts of film-forming solids (by weight):

Polymethylmethacrylate	10.0
Polyethyl acrylate	5.0
Benzoylperoxide	5.0
Ethyl acetate	50.0
Butyl acetate	30.0

A substantially solid, but soft and plastically deformable foil was placed over the primer coating on the nail and the substrate. The foil was made by shaping the following composition between rolls:

Copolymer of 95% ethylmethacrylate and 5% methyl acrylate	55.0
N-dimethyl-p-toluidine	.3
Styrene	.7
Methyl methacrylate	44.0

After being put in place, the outer face of the soft foil was coated with a thin layer of the lacquer which had been used as a primer coating. Curing was suffiicently completed after 6–8 minutes to make the foil shape-retaining and self-supporting, and to permit removal of the temporary substrate.

The lacquer used in Example 1 may be employed as an outer coating on the foil of Example 2 with substantially the same results.

EXAMPLE 3

A finger nail extended by a temporary substrate of polyvinyl chloride was coated first with a primer lacquer. A resin composition having the consistency of a paste was applied over the dried primer coating on the nail and on the temporary substrate, and its outer face received another layer of the lacquer in the manner of the preceding examples. The compositions of the lacquer and of the resin paste were as follows:

Copolymer of polyvinyl chloride polyvinyl acetate	10
Cellulose acetate butyrate	5
Benzoyl peroxide	3
Methyl ethyl ketone	15
Methylene chloride	67
Polyester resin made from equimolecular amounts of ethylene glycol and dimethyl maleate in the presence of litharge	30
Copolymer of methyl methacrylate and methacrylic acid, 90:10	20
Methyl methacrylate	49.5
N-dimethyl-p-toluidine	9.5

The resin composition was cured within seven minutes to form a satisfactory artificial nail. Acrylic acid may be employed in the copolymer instead of the methacrylic acid.

EXAMPLE 4

A finger nail having a temporary substrate of polypropylene attached thereto was coated with a primer composition of 7 percent chloroprene and 93 percent methylene chloride. The primed surfaces of the nail and substrate were then overlayed with a base lacquer of the following composition:

Copolymer of methyl methacrylate and methyl acrylate, 85:15	7.5
Cellulose acetate butyrate	2.0
Benzoyl peroxide	3.0
Methyl ethyl ketone	15.0
Methylene chloride	72.5

The resin composition from which the artificial nail proper was formed had the consistency of a paste and contained the following materials:

Copolymer of methyl methacrylate and methacrylamide, 80:20	35
Graft polymer made from 50% styrene, 30% acrylonitrile, and 20% butadiene	15
N-dimethyl-p-toluidine	0.3
Methyl methacrylate	49.7

The paste deposit was coated on the outside with the base lacquer and hardened within 6 to 8 minutes.

Instead of the benzoyl peroxide bearing lacquer of the composition shown above, the following lacquer composition may be employed:

Polycondensation product of dimethyl phthalate and propane diol (1:1) prepared in the presence of zinc acetate	15
Benzoyl peroxide	3
Methyl ethyl ketone	12
Methylene chloride	70

EXAMPLE 5

A finger nail equipped with a temporary mold substrate of polyester (Mylar) foil was provided with a primer coating of the following composition:

Copolymer of methyl methacrylate and glycol monomethacrylate (75:25)	15
Methylene chloride	82
Benzoyl peroxide	3

The primer coating on the nail and substrate was covered with the paste composition of Example 1 which in turn was coated with the primer composition.

The artificial nails or nail portions of the invention are thus formed from two compositions of which the first one constitutes a primer or lacquer composition and essentially consists of film-forming resinous material and an oxidizing catalyst inert to the film-forming mateiral, the resinous material and catalyst being dissolved in a sufficient amount of a volatile solvent to make the first composition highly fluid and quick-drying. The first composition is free from monomeric material which could react with the catalyst and which wuold irritate the skin about the nail if the fluid material should flow beyond the nail and substrate surfaces, as will readily happen. The primer composition preferably does not contain substantially more than twenty percent film-forming solids.

The second composition provides most of the solid material for the artificial nail ultimately formed. It consists essentially of a solution of polymeric film-forming resin material in a resin-forming monomer which is capable of being polymerized by contact with the oxidizing catalyst in the primer composition. The second composition need not, and preferably does not, contain any solvent volatile at the temperature of the digit to which the compositions are being applied, and it must not contain any catalyst which would initiate polymerization of the monomeric material. The second composition is sufficiently viscous to prevent its flow under the force of gravity during the period required for setting or curing the composition under the influence of the oxidizing catalyst when the second composition is applied over a layer of the primer composition. Unintentional contact between the

monomeric material in the second composition and the skin surrounding the nail and the resulting skin irritation can thus be avoided with a minimum of skill.

The two compositions are chemically stable as long as they are stored separately. The lacquer composition is preferably stored in a bottle of glass or other material resistant to the solvent action of the composition, and may be applied by brushing. The second composition, if a paste, is preferably stored in a collapsible tube from which it is discharged onto the surfaces to be coated, whereupon it is smoothed in place by a small flat bar or like instrument. If the second composition is so viscous as to form reasonable shape-retaining foils, a supply of foils is preferably interleaved with inert separating sheets for storage, and has an extremely long shelf life when so stored.

The resins employed in the method of the invention are known in themselves and redox catalyst systems for curing the same are also familiar to those skilled in this art. It will be appreciated that known redox catalyst systems other than benzoyl peroxide and N-dimethyl-p-toluidine may be employed with the resin compositions specifically described, and that other resin compositions adapted to be cured by benzoyl peroxide and N-dimethyl-p-toluidine or other redox catalysts may be substituted for the acrylic and polyester resins specifically referred to.

What is claimed is:

1. A plastically deformable composition for forming artificial nails which consists essentially of:

(1) a polymeric resin material;

(2) a monomer polymerizable by a redox catalyst system that has an oxidizing component and a reducing component; and

(3) a reducing component of said redox catalyst system,

said composition being chemically stable, said polymeric resin material and said monomer being present in relative proportions such that said composition is plastically deformable and has at least a paste-like viscosity, said polymeric resin material and said monomer being materals such that by a degree of polymerization of said monomer upon contact of the composition with an oxidizing component of the redox catalyst system the composition can be converted at the temperature of a human digit to polymeric resin material that has shape-retaining and self-supporting properties in the form of an artificial nail, said reducing component being present in an amount sufficient to cooperate with an oxidizing component of the redox system to effectuate said degree of polymerization, said composition being free of an oxidizing component of said redox catalyst system.

2. The composition of claim **1** wherein said monomer is selected from the group consisting of acrylic acid and methacrylic acid; lower alkyl esters, amides, and nitriles of said acids, esters of a polyhydric alcohol with a polybasic acid; styrene; and butadiene.

3. The composition of claim **2** wherein said monomer is an alkyl methacrylate, said polymeric resin material is a polymer of an alkyl methacrylate, and said composition has the consistency of a paste.

4. The composition of claim **3** wherein said reducing component is N-dimethyl-p-toluidine, and wherein said paste contains approximately equal amounts of said monomer and said polymeric resin material.

5. The composition of claim **2** wherein said composition, on the basis of 100 parts by weight of said composition, contains 40 parts of polymer of methyl methacrylate, 54.3 parts of methyl methacrylate, 0.5 part of N-dimethyl-p-toluidine, 0.2 part of titanium dioxide, and 5 parts of dioctyl phthalate, and wherein said composition has a consistency of paste.

6. A set of separate materials for forming artificial nails, said set comprising:

(1) a plastically deformable composition for forming artificial nails which consists essentially of:

(a) a polymeric resin material;

(b) a monomer polymerizable by a redox catalyst system that has an oxidizing component and a reducing component; and

(c) a reducing component of said redox catalyst system,

said composition being chemically stable, said polymeric resin material and said monomer being present in relative proportions such that said composition is plastically deformable and has at least a paste-like viscosity, said polymeric resin material and said monomer being materials such that by a degree of polymerization of said monomer upon contact of the composition with an oxidizing component of the redox catalyst system the composition can be converted at the temperature of a human digit to polymeric resin material that has shape-retaining and self-supporting properties in the form of an artificial nail, said reducing component being present in an amount sufficient to cooperate with an oxidizing component of the redox system to effectuate said degree of polymerization, said composition being free of an oxidizing component of said redox catalyst system, and

(2) a liquid composition consisting essentially of a film-forming resin material, an oxidizing component of said redox catalyst system and a sufficient amount of volatile solvent to dissolve said resin material and said oxidizing component and to make said composition fluid.

7. The set of materials of claim **6** wherein said film-forming resin material in said liquid composition is a mixture of methyl methacrylate polymer and a copolymer of vinyl chloride and vinyl acetate, the oxidizing component is benzoyl peroxide and the volatile solvent is ethyl acetate.

8. The set of materials of claim **7** wherein the liquid composition contains, in parts by weight, 10 parts of methyl methacrylate polymer, 2.5 parts of copolymer of vinyl chloride and vinyl acetate, 10 parts of benzoyl peroxide, and 77.5 parts of ethyl acetate.

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U.S. Cl. X.R.

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