Dec. 23, 1941. H. A. NEVILLE ET AL 2,267,597

METHOD AND APPARATUS FOR MAKING ARTIFICIAL BRISTLES

Filed Sept. 13, 1939

Fig. 2

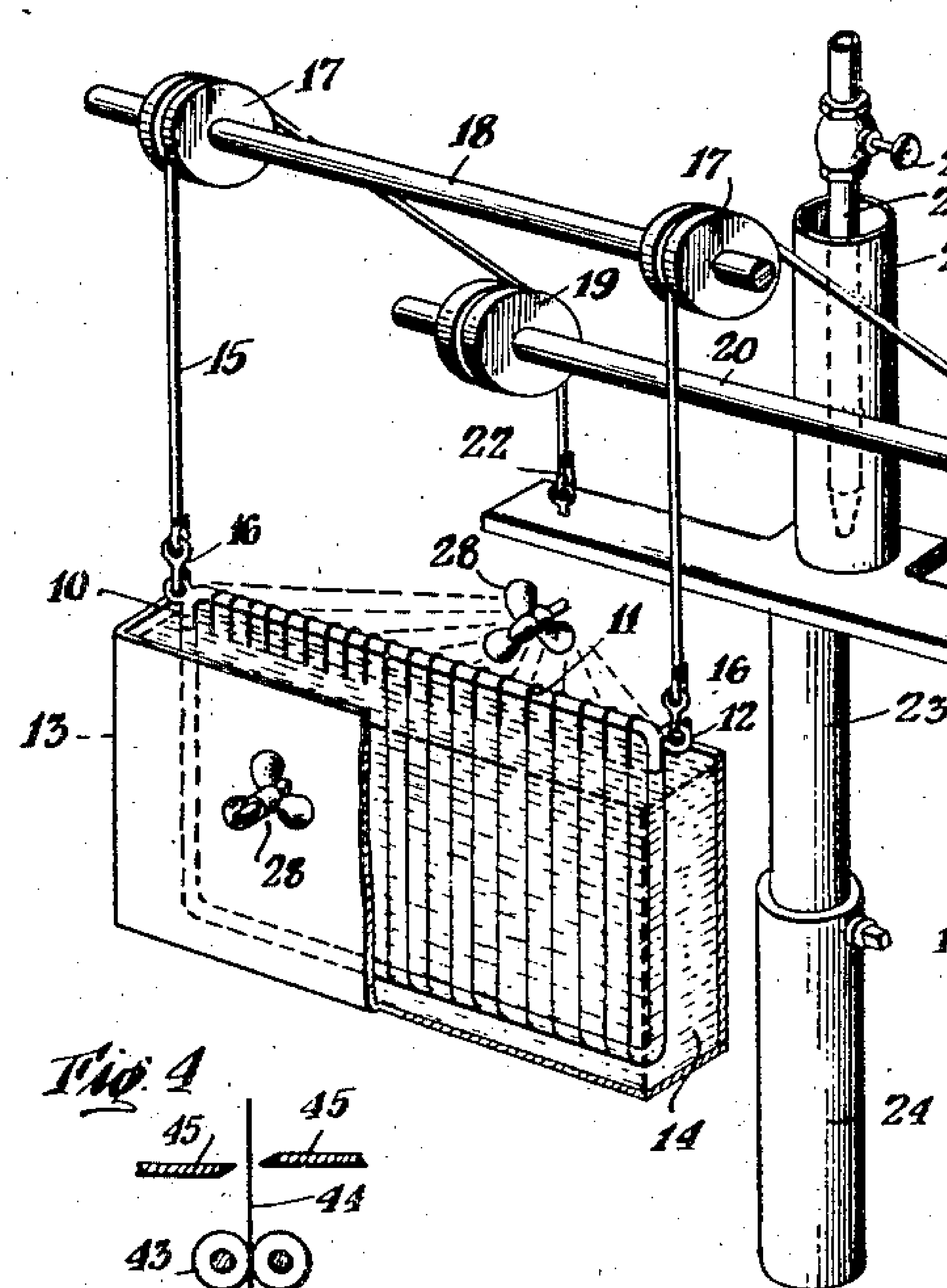

Fig. 1

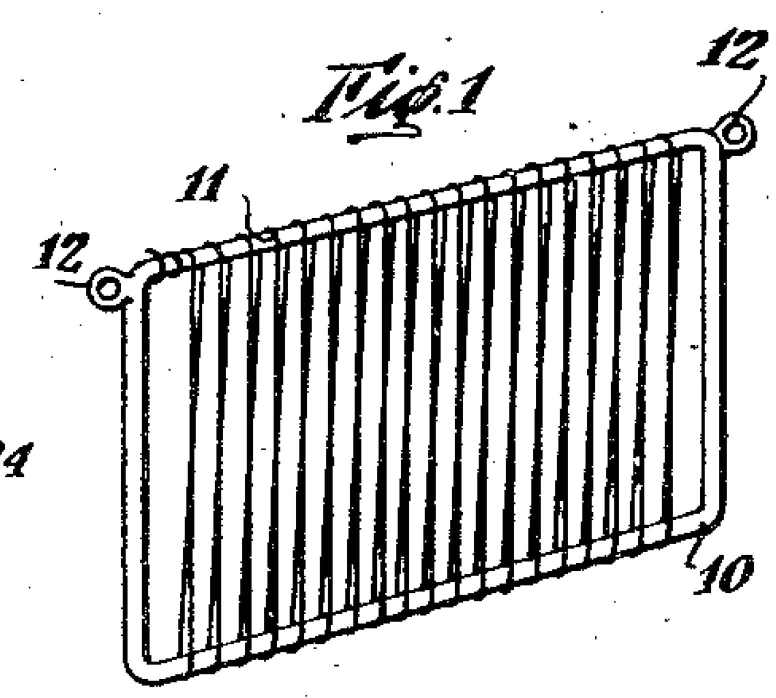

Fig. 4

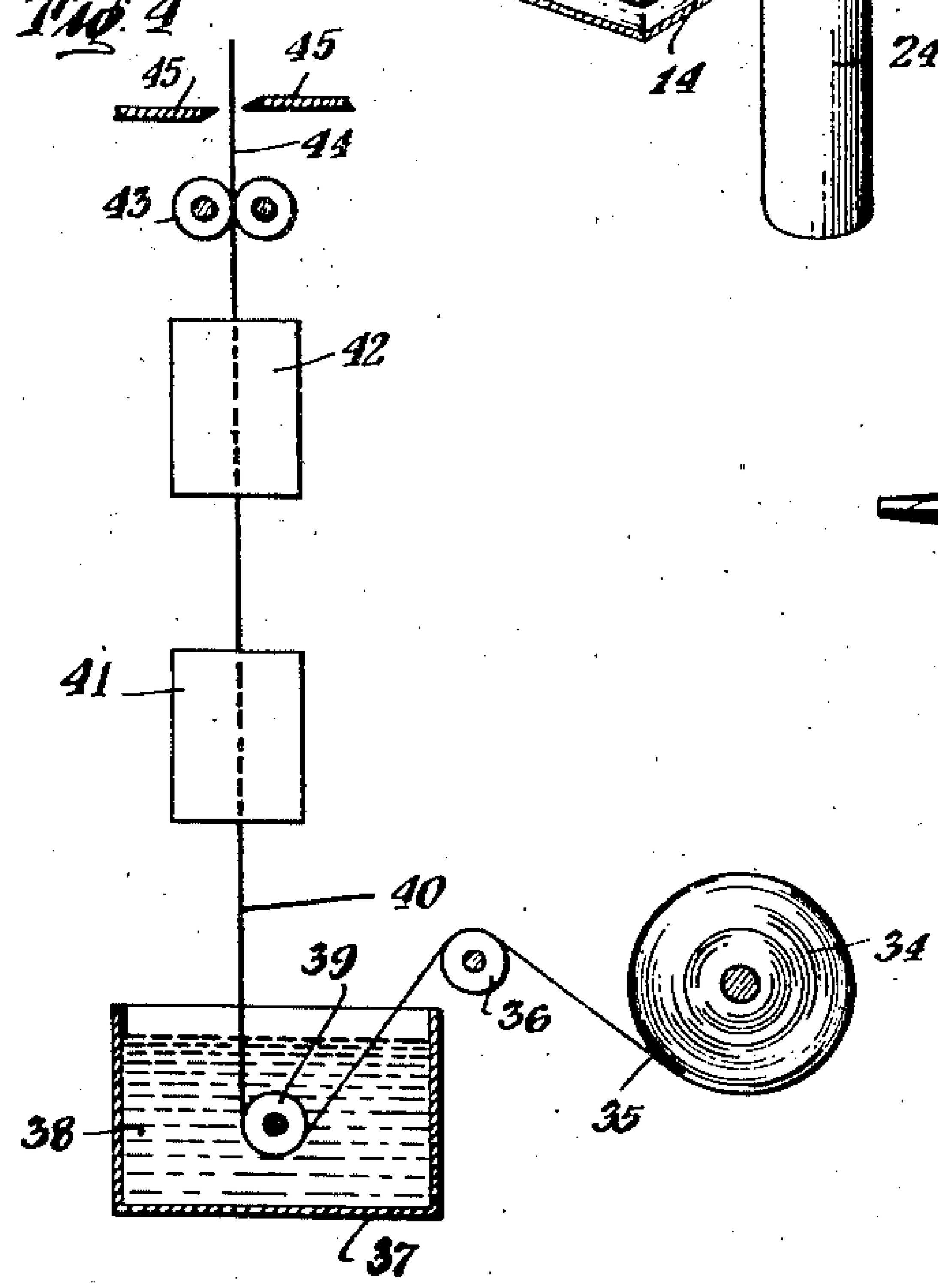

Fig. 3

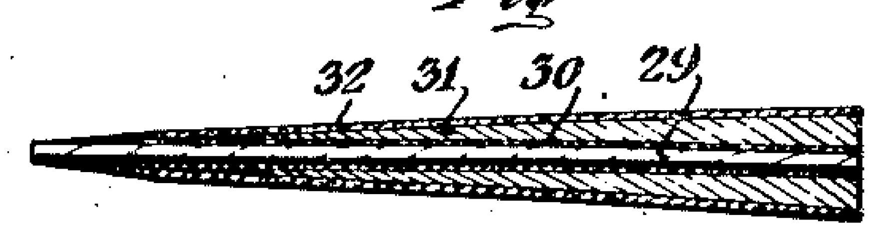

Fig. 5

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METHOD AND APPARATUS FOR MAKING ARTIFICIAL BRISTLES

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Application September 13, 1939, Serial No. 294,572

14 Claims. (Cl. 91—46)

Our invention relates to artificial bristles and more particularly to methods and apparatus for the production of tapered artificial bristles so that they have the general tapered form of natural bristles and are useful in brushes, especially paint brushes.

This application is a continuation in part of our application Serial No. 243,318, filed December 1, 1938, and claims the method and apparatus for making the artificial bristles of that parent application.

In our copending application Serial No. 147,312, filed June 9, 1937, we have described certain forms of artificial bristles made from a composite of textile fibers bonded together into trefoil form by a protective resinous coating, and have suggested tapering the bristles by repeated dipping in the coating solutions. Based upon extended research work and tests along this line we have now discovered new and improved coating methods and means for making the tapered bristles either in one or multiple stage operations. We have found that our new development is applicable to a variety of base materials and may be applied to separate lengths of filaments or may be used to produce a continuous coated filament of varying cross-section.

In accordance with our present invention we have found that tapered artificial bristles having superior properties may be produced by immersing a filament in a relatively viscous coating solution and withdrawing the filament from the solution at a changing rate of withdrawal, increasing or decreasing. The filament, as withdrawn, has a coating of variable thickness of the coating material. The more rapid the rate of withdrawal of the filament the greater the amount of viscous solution retained on the filament and accordingly the thicker the layer of adhering coating. Decreasing the rate of withdrawal produces the opposite effect, namely, a decrease in the thickness of the coating. Because of these phenomena we are able to produce upon a filament a coating of uniformly decreasing thickness, which is in effect a taper, by gradually increasing the rate of withdrawal of the filament from the coating solution in which it is immersed. The form of the coated filament is like that of an animal, (e. g. hog) bristle, in that it has a butt end of relatively large diameter and a tip end of relatively small diameter, with proportionately varying diameters in between the butt and tip ends.

To produce the desired type of taper on the coated filament as above described, we have found that it is desirable to have present certain conditions, as follows:

The coating solution, which is to be applied to the filaments for increasing its resistance to water, solvents, alkalis, acids, etc., and which in some instances may also be used for tapering the filament, must be substantially prevented from flowing along the filament core after the coated filament is withdrawn from the solution. Otherwise, the material would build-up in places and be too thin in other places causing non-uniformity of coating thickness as well as non-uniformity of taper. The same is true where a separate solution is used for tapering. We have found that any substantial amount of flowing may be prevented by one or a combination of the following methods:

A. Using a very volatile solvent, e. g. acetone, in the coating material solution so that as soon as the coated filament is withdrawn from this solution the solvent will evaporate rapidly and cause gelation or other solidification of the coating material about the core filament. This rapid solidification of the coating upon exposure to the atmosphere will cause it to retain its desired position on the filament. The rate of evaporation may be accelerated by partial evacuation of the space surrounding the coated filament or by providing a current of air to carry away the vapors.

B. Rapidly decreasing the temperature of the fluid coating material on the filament immediately after it leaves the reservoir of coating solution, so that the material gels or solidifies before it has an opportunity to flow on the filament. Suitable refrigerating means such as a current of cold air or an artificially refrigerated enclosure for the coated filament might be used to hasten the solidifying or gelling of the coating.

C. Rapid solidification of the fluid coating material on the filament may also be obtained by using the coating material in the form of a thixotropic dispersion that will set to a gel very quickly upon application to the filament.

Unless one or more of these several methods of producing rapid gelation or their equivalent is utilized, the fluid coating will tend to flow along the filament or will be drawn into droplets or beads on the filament by the forces of surface tension. Slow evaporation of the solvent or slow cooling, either of which will produce a gradual increase in viscosity, are not sufficient to avoid entirely the flow of the coating or its collection into droplets.

If the entire filament to be coated is wound upon a frame and is immersed in the coating solution and withdrawn, whether it be of a length adequate for making one bristle or several, the withdrawal of the frame and filament from the solution would be at a predetermined rate of acceleration or deceleration to effect the desired taper. Such an operation would be used where it is desired to produce in batches one or several bristles at a time, and then repeating the operation for each subsequent batch of bristles. However, if it is desired to produce the bristles continuously, especially on a large production scale, a continuous length of filament stock would be used and would be withdrawn continuously but the rate of withdrawal would be intermittently accelerated or decelerated. By this procedure a continuously coated filament having thick and thin sections at regular intervals will be produced. The rate of taper and the length of the tapered portions of the filament may be controlled by the withdrawal cycle such that the continuously coated filament having alternately thick and thin portions may be cut at points of maximum and minimum thickness to produce individual bristles, the length and degree of taper of each such bristle being determined, as mentioned above, by the nature of the withdrawal cycle.

The filament core materials that may be used in our invention vary widely in their characteristics and may be selected from one or more of the following classes of materials: textile fibers, such as natural silk; or certain artificial silks, such as that disclosed in Carothers Patent No. 2,130,948, issued September 20, 1938, or certain vinyl polymers extruded into fibers, cotton, regenerated cellulose, cellulose acetate, other cellulose esters and ethers, glass; metals such as steel, copper, copper alloys, aluminum, aluminum alloys and silver, the non-ferrous metals being preferred because of their resistance to rust; and any other similar suitable materials that can be spun or drawn into continuous filaments which have the flexibility and strength required for brush bristles. The choice of these materials depends somewhat upon the use to which the final bristle is to be put and is dictated by such factors as tensile strength, resistance to solvents, flexibility and stiffness of the materials. The core filaments may be individual filaments or may consist of a strand or thread made up of a number of filaments. We have found that threads composed of a plurality of continuous filaments substantially parallel or with a slight twist are desirable and offer advantages over threads made of spun fibers. Different sizes of yarns may be used so that a better filling of the voids is obtained on blending the resulting bristles. As an example, a coarse product is obtained by winding frames with one strand, (composed of many individual filaments), of 150 denier cellulose acetate yarn. An intermediate product is obtained from frames wound with one strand of 100 denier cellulose acetate yarn and a fine product from frames wound with one strand of 45 denier cellulose acetate yarn. These yarns may be wound in multiple. For example, if three strands of 45 denier are wound as a unit, a product comparable to that from one strand of 150 denier yarn is obtained. However, there is some improvement in stiffness, due to the trefoil structure.

The word "filament" as used in the specification and claims herein is used in a generic sense and is intended to include the various forms of fibers, filaments, strands, threads, etc. made up of one or more of suitable core materials such as those described above.

The coating materials used for coating or tapering the filament cores may be selected from a large class of different substances and are normally used in the form of solutions or dispersions. These materials include thermoplastics such for example, as cellulose acetate or other cellulose derivatives; oleo resin varnishes; alkyd varnishes, urea-formaldehyde varnishes; phenol-formaldehyde resin; vinyl resins such as polymerized vinyl chloride and vinyl acetate or copolymerized mixtures thereof; vinyl acetates and polyamides such as for example hexamethylene adipamide, tetramethylene sebacamide.

The solvents to be used in the coating solutions may vary widely in their characteristics, and their selection will depend somewhat upon the procedure adopted for gelling or solidifying the coating material on the filament promptly upon withdrawal of the filament from the coating mixture. Where the gelation or solidification is dependent solely or primarily upon the volatility of the solvent such rapid vaporizing solvents as acetone, methyl acetate, ethyl acetate, methyl formate and benzene and the like, and certain of the chlorinated solvents such as chloroform and dichlorethylene may be used. Where one of the other means above described is used for accelerating the gelation or solidification of the coating on the filament slower drying solvents such as for example certain of the refined petroleum and coal tar distillates, e. g. xylene, varsol and high-flash naphtha may be used.

In accordance with our invention the artificial bristles may be made by applying one or several coatings to the filament core material. For example, where the filament core material consists of metal, only one type of coating will be required for giving the bristle the desired resistance to water, acid, alkalis, etc., and also for effecting the desired taper of the bristle. In such a case the coating material may advantageously be selected from the above mentioned classes of resins or varnishes which would give the filament the desired resistance to attack by liquids and the necessary tensile strength where required. This varnish or resin coating may be applied in one application, that is, one immersion of the core material in the coating solution and withdrawal therefrom, or several of such treatments.

In the case of certain other filament core materials, particularly some of the textile fibers which are not resistant to the common lacquer solvents such as acetone and the like, we have found it advantageous to apply several different types of coatings to the filament core. Some of these coatings serve principally the purpose of giving the filament the desired resistance and strength and the other coatings the desired taper required to simulate natural bristles.

The method of and apparatus for making the tapered coated filaments of our invention may be more clearly understood from the following detailed description taken in conjunction with the accompanying drawing in which

Fig. 1 is a diagrammatic representation of the filament core material wound upon a frame preliminarily to dipping in the coating material;

Fig. 2 is an elevational perspective view, partly in section, of the coating and tapering system illustrating the coated filament being withdrawn from the coating container;

Fig. 3 is a longitudinal sectional view of a piece of filament coated by the system shown in Fig. 2;

Fig. 4 is a diagrammatic representation of a system for continuous coating and tapering of the filament; and

Fig. 5 is a longitudinal sectional view of a portion of a tapered coated bristle having a metal core and one layer of coating.

Referring now to the several figures in the drawing, generally in the order in which they occur, there is shown in Fig. 1 a frame 10 with the filament 11 wound thereon, the filament in this specific but non-limiting embodiment of the invention being a cellulose acetate fiber. The filament is wound on the frame 10 by clamping the frame in a mechanical winder (not shown) with a traveling guide so that as the frame is rotated the guide moves from one end of the frame to the other and thereby produces a spiral wind of the filament on the frame. An example of the pitch of this winding is ten turns to the inch. The ends of the filament may be fastened to the frame in any suitable manner such as by tying to a cross member of the frame.

The textile fiber filament, i. e., cellulose acetate in this example, being wound on the frame, the next step is to dip the wound frame in a bath containing a suitable varnish or resin solution to coat the textile filaments. A system suitable for that purpose is shown in Fig. 2. As shown in that figure a dipping tank 13 is approximately filled, for example, within one-half of an inch of the top of the tank, with a resin solution indicated at 14. In this specific arrangement the dipping tank is of sufficient capacity to accommodate only one frame, (a laboratory size being 13 inches long, 7½ inches high, and ½ inch wide), but it is to be understood that in commercial production larger tanks would be used, such as to accommodate two or more rows of frames. In such an arrangement the filaments may be dipped and coated and after coating may be cut at the top and bottom to form the individual bristles; and the plurality of frames may be held in parallel and dipped together in one operation. To facilitate handling of the filaments after coating the uppermost portion of the filaments, e. g. ½ inch, is not immersed in the coating material and this uncoated portion is cut off when the filament is cut into individual bristles.

The means for withdrawing the frame and coated filament from the dipping tank 13 comprise two cords 15 having hooks 16 for engaging the eye extensions 12 on the frame 10. The cords 15 extend and are movable over pulleys 17 rotatably mounted on an axle 18. The cords 15 also extend over a second pair of pulleys 19 rotatably mounted on an axle 20. The cords are joined at the ends remote from the dipping tank, to a member 21 by means of the hook and eye arrangement shown generally at 22. The member 21, which is in the form of a flat, narrow board or metal strip is attached to or is integral with a plunger 23 which is adapted to work in an oil cylinder 24. The cylindrical container 25, which is attached to the top of the plunger 23, and the inlet pipe 26 with valve 27 are not used in this preliminary coating process but are used in the tapering treatment described below.

The coating solution 14 in the dipping tank 13 may be selected as above noted from a large number of resin solutions, examples being straight and drying oil modified phenol formaldehyde resins; drying oil modified alkyd resins; vinyl resins, e. g. vinyl chloride-vinyl acetate resin; cashew nut shell oil varnish; and straight or plasticized urea formaldehyde. We have produced very satisfactory results with a China-wood oil modified phenol formaldehyde enamel which is made up according to the following formulae under Example I:

EXAMPLE I

Varnish composition

	Per cent
China-wood oil	25
Phenol-formaldehyde resin, e. g. XR—821 Bakelite	25
Hi-flash naphtha	25
Solvent naphtha	25

Viscosity G—H (Gardner-Holt tubes)

Enamel composition

	Per cent
Carbon black (medium grade)	2.65
and	
Varnish (composition as above)	17.70
Ground on roller mill and reduced with	
Varnish (composition as above)	72.50
and	
Solvent naphtha	7.15
	100.00

Another example of a coating composition that we have found to give entirely satisfactory results is as follows:

EXAMPLE II

	Pounds
Uformite F-225 (a urea-formaldehyde resin dissolved to 60% solids in xylol and butanol)	55
Castor oil modified alkyd resin (50% solids and 50% oil modified)	35
Xylol	10
	100

In the specific case being described, we use for the coating material, the enamel composition shown above under Example I. The frame 10 with filament 11 wound thereon is immersed in the coating solution 14 for a short time, for example 1–2 minutes.

The withdrawal of the filament and frame from the coating composition 14 shown in Fig. 2 is carried out by raising the plunger 23 to its full height and connecting the cords 15 with the frame 10 by means of the hooks 16. The plunger 23 is then permitted to travel downward in the oil cylinder 24. In this example the time of withdrawal was about 1 minute and 15 seconds, and the frame is withdrawn at a constant or steady rate of withdrawal as the plunger slowly drops through the oil. To facilitate drying of the coating on the filament during the withdrawal operation, additional means such as electric fans 28, as shown in Fig. 2, may be used. These fans will blow a current of air against the coated filament as it emerges from the coating tank and it is desirable to have these fans blow the air upward at an angle of about 45° along the front and back edge of the top of the tank 13. These two streams of air meet at the frame and follow it upward during the withdrawal.

The coated filament still wound on the frame and after air drying to permit the major portion of the solvent to evaporate, is baked in an oven at about 150° C. for a period of about 45 minutes to 1 hour. The resinous enamel coating thus produced on the filament serves as a protection of the textile fibers of this filament, e. g., cellulose acetate, from the solvent action of the tapering solution which is next to be applied as follows:

The coated filament still wound on the frame is allowed to cool after the above baking treatment and is then again dipped in the tank 13, from which the resin solution has been removed and a suitable tapering solution substituted. In this case the tapering solution consisted of cellulose acetate with acetone solvent and a plasticizer. When using cellulose acetate we have found that the low viscosity type cellulose acetate is desirable and a satisfactory example is the type LL-1 made by the Hercules Powder Company. The purpose of using low viscosity cellulose is to provide as high solid content as possible for a given viscosity; the range of solid content used was about 15% to 30%. Another specific example of a suitable cellulose tapering solution is cellulose aceto-butyrate in acetone solution.

We have found that it is important to have good control of the viscosity of the tapering solution, and we have determined the permissible viscosities by testing such solutions in a tube having two marks eight inches apart. The test is made by noting the time required for a steel ball (in this case having a diameter of ⅛ inch) to fall between the two marks in the cellulose acetate solution and we have obtained satisfactory results with solutions tested in this manner having variations in viscosity from about 6 seconds to 15 seconds on this arbitrary scale. We prefer a range of approximately 8 to 12 seconds; a 10 second solution being a good average. If the viscosity is too great or the speed of withdrawals of the filament too fast as above explained, the solution fills in and forms a web between adjacent threads. Also if the viscosity is too low there is a tendency to produce a wavy coating which has in effect a modified droplet formation.

In carrying out the tapering process we have found it necessary to have the tapering solution, e. g. cellulose acetate, come as near the top of the container 13 as possible. In this connection we have obtained satisfactory results by filling the container to about ¼ inch from the top with the tapering solution. If the solution is not near enough to the top the coating material starts to flow down along the filament when the latter is withdrawn and a poor taper results. This is apparently caused by the atmosphere just above the solution in the container being saturated with the solvent vapor, which prevents rapid evaporation of the solvent contained in the coating material on the filament core.

The frame with coated filament wound thereon as described above, is immersed in the tapering solution now contained in the tank 13 and then promptly withdrawn from this tapering solution at a steadily increasing rate. This withdrawal is accomplished by the same procedure described above for the first coating except that a stream of mercury or other suitable liquid is fed through the pipe 26, controlled by valve 27, into cylindrical container 25. Instead of a liquid, a suitable solid, which will pour, such as for example sand, may be supplied to the container 25. The accumulating increase in weight on the plunger 23 produced by this increasing amount of mercury in the container 25 causes the speed of descent of the plunger 23 to steadily increase and thereby increase the speed of withdrawal of the frame from the tapering solution. This speed may be so adjusted as to effect the withdrawal of the frame from the tapering solution in a period of about 30 to 35 seconds depending upon the size of the frame. By steadily increasing the rate of withdrawal, no droplets of excess material are formed on the filament and the desired taper is produced by the varying amount of cellulose acetate material retained over the length of the filament. The current of air from the electric fans 28 or other suitable means may also be used in this instance to facilitate drying of the tapering solution if desired.

After the frames, with tapered coating on the filament, are air dried to remove the major portion of the acetone solvent, requiring about 1 hour at room temperature, the frames are given another dipping in the resin solution, the same or similar to that used for producing the first coating described above. It will be understood for this operation that the tapering solution is removed from the container 13 and substituted by a resin solution such as described above under Example I for effecting the final protective coat on the tapered filament. To avoid filling and refilling of the tank 13 with the above solutions separate dipping tanks may be employed for the coating and tapering compositions.

After the tapered and coated filament is withdrawn from the final coating solution it is again baked for a period of about 2 hours at about 120° C. This baking treatment will vary of course with different types of coating and tapering solutions. The above example of temperature and time is based upon use of the black phenol formaldehyde enamel described under Example I, and the use of cellulose acetate plasticized with the plasticizer known as Santicizer M—17 for the tapering solution. If the cellulose acetate is not plasticized and a urea formaldehyde resin is used, the baking time would be about 45 minutes at about 150° C.

When the final baking operation above described has been completed the individual strands are cut from the frames at top and bottom, the cutting at the top being from about ⅛ of an inch to $\frac{3}{16}$ of an inch above the limit of the cellulose acetate coating, that is the tapering solution. For making one type of brush bristle the bundle of tapered filaments is cut to a length of about 5½ inches and is now ready to be blended with others of the same and different sizes to make up the paint brush formula.

Measurements of the tip and butt ends of the coated and tapered filaments described above are given below to show the extent of taper over a length of about 5½ inches:

Tip diameter—	Butt diameter
.006″	.017″
.005″	.015″
.0035″	.015″
.0036″	.012″

The coated and tapered section of filament shown in Fig. 3 is an example of the type of filament produced by the above described process. In this showing the diameter of the bristle has been greatly enlarged and is out of proportion with respect to the length shown, for the sake of clarity of illustration. As shown, this filament consists of the filament core material 29, the inner resinous protective coating 30 covered by the tapered coating 31 and finally an outer protective resinous coating 32. When using very small diameter filament cores the applicants have found it advantageous to start the tapered coating a short distance back from the end of the filament core which forms the tip end of the bristle, as indicated at the left end of the bristle in Fig. 3. As shown there the very tip end of the filament core 29 is covered with the protective coatings 30 and 32 but is not covered with the tapered coating 31 since the latter begins a short distance away from the tip end. While practically advantageous because it gives a finer tip to the bristles, this procedure is not essential and if desired the tapered coating may be applied to the entire length of the bristles. It is usually desirable to have the tip end of the filament covered with at least one layer of protective coating material and in cutting the filament into bristles the top uncoated portions described hereinabove are cut off and discarded.

An alternative procedure to that described above, in which the filament is given three coats of material, is to apply directly to the textile filament core, such as for example natural silk, the cellulose acetate tapering solution using a solvent that will not damage the textile filament; and then cover the cellulose acetate tapered coating with an outer protective coating of resinous or other coating material. This procedure eliminates the use of the inner protective coating.

In Fig. 4 there is illustrated diagrammatically a system that might be used for carrying out in a continuous manner the coating and tapering operations described above. This system comprises a reel **34** having wound thereon the filament core material **35** which during operation is unwound from this reel and first run over a guide roller **36** and into a coating bath **37**. The coating material shown at **38** in this bath may be any of the coating or tapering solutions described above. The filament is guided through this bath by means of the guide roller **39** and the coated filament **40** upon leaving the bath is pulled upward into a solvent vaporization chamber **41**. This drying chamber causes volatilization of the major portion of the solvent from the coated filament. After this treatment the coated filament next passes through a baking chamber **42** wherein the coating is heat treated to produce the desired hardness.

The filament is drawn through the system above described by means of friction rollers **43**, which are driven by any suitable means (not shown). When the filament is being given a resinous or other type of protective coating at a constant rate of withdrawal from the coating solution the rollers **43** will be so actuated as to cause the filament to be drawn through the system at a constant rate. However, when the filament is being tapered the mechanism is so arranged as to withdraw the filament from the tapering solution at an intermittently accelerated and decelerated rate of withdrawal. This may be effected through the intermediary of elliptic gears or similar well known conventional means which, per se, are not a part of this invention. The coated or tapered filament **44** upon leaving the withdrawal mechanism **43** is guided between the cutting blades **45** for cutting the filament into any desired lengths.

In Fig. 5 there is shown an example of a bristle containing only one layer of coating and tapering material. This bristle consists of a metal filament core **46** and a tapered resinous coating **47**. This type of bristle may be produced by the same process described above but omitting the application of an inner and outer coating of uniform thickness. In this case the resinous or other suitable resistant coating material is used as the tapering material, that is, the metal filament core is withdrawn only one time and at a varying rate of withdrawal from the coating material so that the material will be deposited upon the filament core in tapered form. This type of coating and tapering with one material may also be applied to other core materials than metal, examples of which are given hereinabove.

The term "thermosetting" used herein in connection with certain of the resinous coatings indicates a resin material that is chemically hardened into a permanent infusible form by curing, that is, heating the material until it hardens into this form. The term "thermoplastic" indicates a resinous material that hardens upon cooling but may be softened again by heating. The term "hardened" as used in the claims applies generically to both types of resinous materials or other coatings hardened in place on the filament core.

For purposes of general identification the artificial bristle of this inveniton is defined in the claims as one having an external shape and size approximating that of a natural bristle. It is to be understood that this refers only to the general order of size and shape and is not restrictive to the exact dimensions or proportions of natural bristles. Also, the taper of the coating of the artificial bristle may vary appreciably from the taper of natural bristles.

Various modifications and changes may be made in the processes, materials and equipment described hereinabove without departing from the scope of our invention. For example, the oil cylinder and mercury supply arrangement depicted in the drawing for effecting a varying rate of withdrawal of the filament from the coating bath may be substituted by other known methods and means for producing varying speed such as increasing air pressure or a variable speed motor.

Some of the novel features of our invention are defined in the appended claims.

We claim:

1. A method of making an artificial tapered bristle comprising immersing a filament in a coating solution and withdrawing said filament from said coating solution at a varying rate of withdrawal while maintaining the viscosity of the solution substantially constant to cause a varying amount of coating material to be retained over the length of the filament and thereby produce a tapered coating of such thickness and taper that the external shape and size of the bristle approximates that of a natural bristle.

2. A method as defined in claim 1 in which the tapered coated filament is immersed again in a coating solution and withdrawn therefrom at a uniform rate of withdrawal to produce a protective coating of substantially uniform thickness on said tapered coating.

3. A method as defined in claim 1 in which the filament is uniformly coated with a protective coating before the tapering coating is applied and the tapered coating is uniformly coated with a protective coating.

4. A method as defined in claim 1 in which the coating solution contains a solvent that evaporates relatively rapidly when the coated filament is withdrawn so that the coating rapidly solid-

ifies upon the filament without substantial flowing along the filament.

5. A method of making an artificial tapered bristle as defined in claim 1 in which the tapered coating comprises a resinous material.

6. A method of making an artificial tapered bristle as defined in claim 1 in which the tapered coating comprises a thermoplastic resin.

7. A method of making an artificial tapered bristle as defined in claim 1 in which the tapered coating comprises a vinyl resin.

8. A method of making an artificial tapered bristle as defined in claim 1 in which the tapered coating comprises a vinyl formal.

9. A method of making an artificial tapered bristle as defined in claim 1 in which the tapered coating comprises a vinyl acetal.

10. A method of making artificial bristles as defined in claim 1 in which the filament is a textile filament.

11. An apparatus for producing tapered coatings on artificial bristles comprising a frame for supporting the bristle core filament, a container for the filament coating solution and means for withdrawing said frame and filament from the coating solution comprising a plunger connected to said frame, an oil cylinder, in and out of which said plunger is adapted to move, a container mounted on said plunger and a supply of material adapted to flow into said container and progressively increase the weight on said plunger whereby the rate of withdrawal of said filament by said plunger is varied.

12. An apparatus for making an artificial tapered bristle comprising means for immersing a filament in a coating solution to produce a coating on said filament and means for withdrawing said filament from said coating solution at a varying rate of withdrawal, including means whereby the change in rate of withdrawal is mechanically controlled, to cause a varying amount of coating material to be retained over the length of the filament and thereby produce a tapered coating on said filament.

13. An apparatus for making an artificial tapered bristle as defined in claim 12, in which the filament withdrawing means comprises an oil cylinder and a plunger adapted to move in and out of said cylinder.

14. An apparatus for making an artificial tapered bristle as defined in claim 12 in which the means for varying the rate of withdrawal of the filament comprises an oil cylinder and a plunger adapted to move in and out of said cylinder and a supply of mercury adapted to vary the weight of said plunger and progressively increase the speed of its movement into said oil cylinder.

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