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ARTIFICIAL BRISTLE AND METHOD OF MAKING SAME

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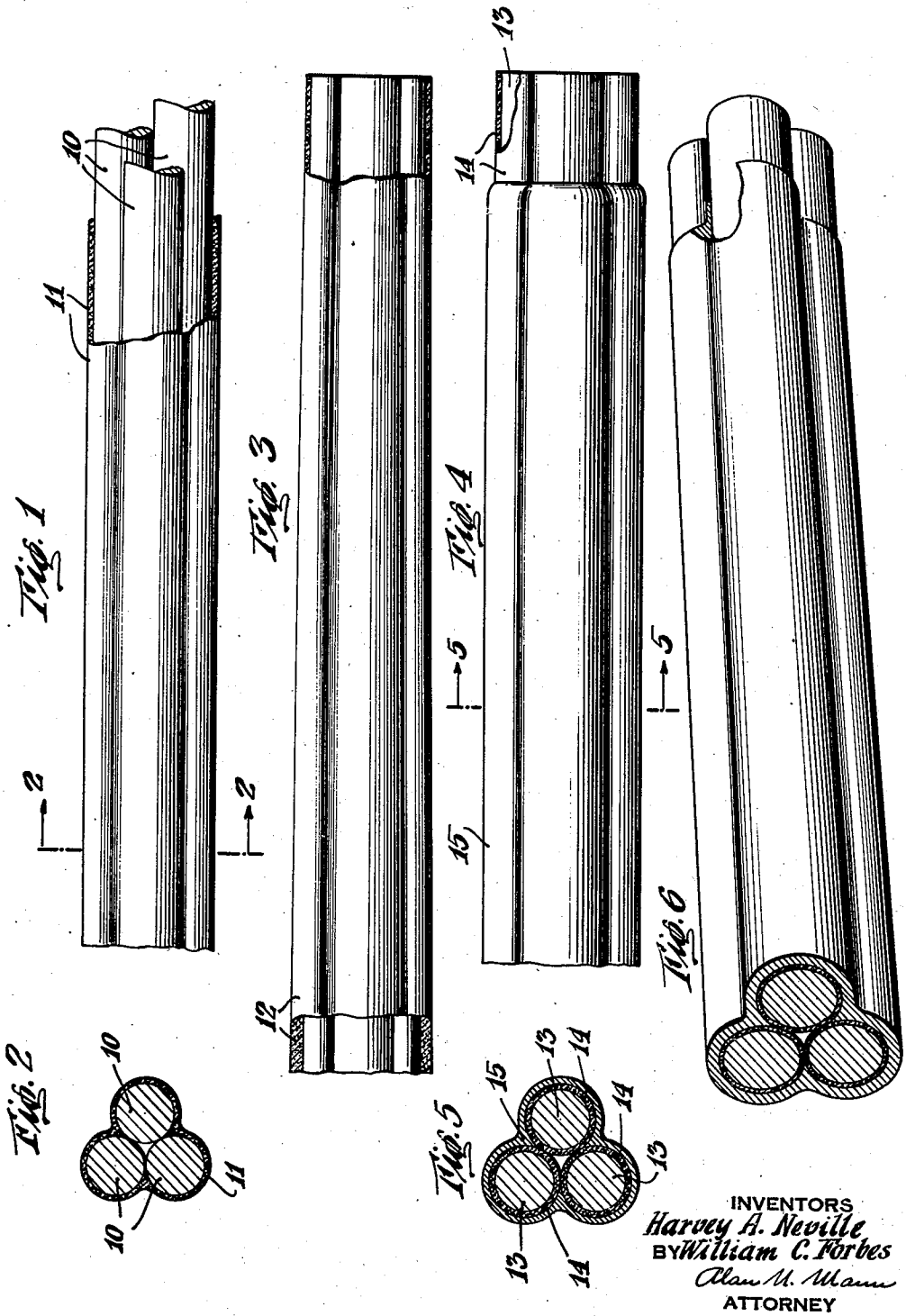



Fig. 1

Fig. 3

Fig. 4

Fig. 6




Fig. 2




Fig. 5

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## ARTIFICIAL BRISTLE AND METHOD OF MAKING SAME

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17 Claims. (Cl. 154—2)

This invention relates to the structure and formation of artificial bristles for use in brushes, particularly paint brushes.

By virtue of their natural properties, animal bristles have long been in use in brushes; the better quality paint brush, for example, generally using hog bristles. The formation of suitable bristles requires that the artificial bristles should at least have the desirable properties found in animal bristles now in use. We may enumerate these properties:

1st. The bristle must resist the action of water, whether normal, slightly acid or slightly alkaline; and also not be unduly affected by lacquer thinners, phenol compounds, turpentine, mineral spirits, vegetable and mineral oils, whether raw or processed, alcohol, esters, etc.

2nd. The bristles must be adapted to be made wet by the substances with which they are used and adapted to hold satisfactory amounts of these substances.

3rd. The bristle must be satisfactorily flexible.

4th. The bristle must withstand repeated flexing without breaking or cracking and without becoming brittle in use.

5th. The wear by end attrition of the bristle must be slow and uniform.

6th. The bristle must be able to withstand the elevated temperatures of baking and vulcanizing.

7th. The structure of the bristle should have a taper from the butt or body end to the flag end or end away from the body (or some feature of design to achieve the same result) to give a graduated degree of flexibility from one end to the other.

8th. The bristle should have a "flag," that is to say, the splitting of one end of the bristle into a plurality of smaller ends to permit the spread of substances without leaving brush marks, to hold paint in the brush and perform other functions achieved by natural hog bristles.

We have discovered that we can produce bristles having the desired flexibility and stiffness by building up a composite structure comprising parallel filaments or strands of a textile fiber encased in a coating of resinous material. In such case the aggregated structure has a truss-like action, for on any given bending strain the resinous material on one side resists compression, yet the aggregate body as a whole will not crack due to the tensile strength of the textile fiber.

In order that the bristle may resist the action of various solvents and vehicles we use for a resinous material a thermo-setting, synthetic resin which when properly hardened as by baking is substantially insoluble under the conditions for which the bristle is intended. In order to give some flexibility to the resinous material it is advisable to use a synthetic resin modified with a drying oil. For example, we get excellent results using oil-modified phenolic resins or the oil-modified alkyd resins. Under some circumstances, it is advantageous to use undercoats or intermediate coats of soluble materials, such as certain of the cellulose esters or soluble resins. Usually such coats will be coated with the resins which can be converted to the insoluble state.

Resin coatings, while resistant to the action of water, are not impervious to it. In consequence, the textile fiber which forms the strands of the bristle should be of a nature not to swell or soften in the presence of water which may permeate the outer resin coatings. We have found that filaments of cellulose acetate or pure silk meet this requirement, as they will not swell or soften in the presence of the water which may penetrate the resin. We have also found it advisable, though not necessary, to use continuous filaments of cellulose acetate or pure silk as distinguished from threads of spun fiber which tend to flex somewhat less readily. Owing to its high melting point, cellulose acetate is particularly suited to withstand the baking temperatures employed in rendering the resin insoluble and the vulcanizing temperature used in setting the bristles, and when protected by the resin is adequate to resist the action of the usual solvents.

The desired taper to the bristle can be controlled by dipping the bristles vertically and repeating the dipping (after air drying) for the parts to be thickened or the shape may be built up from an intermediate coating material which may more or less homogenize with the fiber.

We have found that we can obtain a "flag" or split end to the bristle by first coating individual strands of material such as silk or cellulose acetate and then combining such individually coated strands into a composite structure by a second dipping operation and controlling the second dipping operation so that the tips of the previously coated strands are not cemented together. This is an added advantage of our method of obtaining synthetic bristles though it is not always essential.

Our method of production may be readily understood from the following examples:

*Example No. 1.*—Three strands of 150 denier, 52 filament acetate yarn were drawn through a constricted opening to form a composite bundle of parallel threads. These parallel threads as an

aggregate were wound on a wire frame bent to form a rectangle 8 inches wide, the winding being done spirally around the frame in such manner that each set of strand aggregates was clear of the next adjacent set though joined at the ends. A resin varnish was prepared from 100 pounds of oil-soluble phenolic resin and 12½ gallons of China-wood oil thinned with mineral spirits after cooking to contain 50% solids. This resin was poured into a vessel to a depth of 7 inches and the frame then inserted with one inch of the strands left uncovered. After 2 minutes, the frame was withdrawn quickly to permit the three strands, which were now aggregated, to carry up excess liquid. This liquid gathered into drops and ran down the strands although not entirely to the bottom of them. It was found that the effect of this action was to cause the three strands to arrange themselves in parallel triangular relationship so that the entire body (except at the extreme ends) had a trefoil cross section with rounded vertices. After the flow of resin had slowed up, the frame was reinserted into the liquid and allowed to remain for 5 minutes and then withdrawn very slowly, the speed of withdrawal being regulated to avoid the formation of droplets or beads. After air drying for 2 hours the aggregrates, still carried by the frame, were baked for 1½ hours at 150° C. They were then cut from the frame and it was found advisable to cut first at the bottom and then at the top.

*Example No. 2.*—Three parallel strands of 150 denier 52 filament acetate yarn were drawn from spools up through a bath of 37% linseed oil modified alkyd resin containing 20% of solids. A glass U-tube having a restricted orifice extended down from the bottom of the vessel containing the resin solution and then up above the solution level, and the parallel strands were led into the bottom of the solution through this U-tube. As the strands emerged from the top of the solution, they were wound as aggregrates on a wire frame similar to that described in Example No. 1. This frame was held approximately 3 feet from the top of the vessel during winding. After air drying for three hours the aggregates, still carried by the frame, were baked for 44 hours at 135° C. and then cut from the frame.

*Example No. 3.*—Three separate strands similar to those described in Example No. 2 were drawn through a resin solution and allowed to air-dry thoroughly before winding as a unit on a frame in a manner similar to Example No. 1. The frame was dipped as in Example No. 1, with the dipping not extending all the way to the top of the frame. When cut from the frame, the ends which had not been submerged in the dipping simulated the flag on the end of a natural bristle. Obviously a larger number of filaments might be employed to give a finer subdivision at the flag end.

Possible variations which may be employed include the following:

The separate strands made of a number of filaments may be pretreated with ethyl acetate. This tends to aggregate the filaments in the strands and gives increased stiffness.

A taper may be built upon the bristle by dipping in a solution of a cellulose ester or ether such for example as an ethyl acetate solution of cellulose aceto-butyrate, or (preferably in the case of natural silk) an acetone solution of cellulose acetate. Even in the case of cellulose acetate strands the aggregate can be given a coating of resin and then the taper can be formed by dipping in an acetone solution of cellulose acetate or in a solution of a vinyl resin, which in turn should be recoated with a thermo-setting resin after the solvent has dried out.

When the dipping is carried out in a cast iron closed container, vacuum or pressure can be applied to give better penetration of the resinous material between the filaments.

Where no special treatment is required such as development of a taper or the formation of a flag end, the grouped strands can be drawn continuously through the resin varnish and dried in aggregates of any desired length which subsequently may be cut to bristle length.

The products resulting from these operations were artificial bristles fully meeting the requirements set forth above and obviously these bristles can be made in any desired length or weight and the stiffness can readily be modified by modifying the proportions of resin to fiber or by changing the number of fibers employed, or by varying the use of undercoatings. Also the quality of the bristle may be modified by changing the nature of the resin body employed, particularly the oil length of the varnish (which is preferably a China-wood oil varnish) or by changing the extent of the oil modification of the alkyd resin.

The details of construction of the artificial bristles resulting from the above described operations may be more clearly understood by reference to the accompanying drawing in which:

Fig. 1 is a fragmentary plan view partly broken away of a bristle composed of a group of parallel filaments united by a uniform resinous coating;

Fig. 2 is a cross-sectional view taken along lines 2—2 of Fig. 1;

Fig. 3 is a fragmentary plan view partly broken away of a bristle like that in Fig. 1 except that the coating is tapered;

Fig. 4 is a fragmentary plan view partly broken away of a bristle like that in Fig. 1 except that each of the filaments is separately coated, and the outer coating is omitted at one end to provide a flag construction;

Fig. 5 is a cross-sectional view taken along lines 5—5 of Fig. 4; and

Fig. 6 is an end section-perspective view of the bristle shown in Fig. 1.

The bristles and components thereof in each of the above figures have been enlarged substantially in size so as to make the drawing clear.

In Figs. 1 and 2 there are shown three parallel textile filaments 10 and a protective coating 11 which binds the several filaments together into a unitary bristle. In Fig. 3 the filaments are shown arranged in the same manner but several succeeding layers of coating are deposited thereon to provide the taper indicated at 12.

Each of the several filaments 13 in Figs. 4 and 5 has a protective coating 14. Such a coating may be applied to the filaments separately before they are combined, as described hereinabove. The outer coating 15 is applied so as to bind together the separately coated filaments 13 but it is to be noted that the coating 15 does not cover the tip ends of the filaments 13 which are left free to provide a flag construction. It will also be understood that the outer coating 15, for the bristle of Fig. 4 may be applied in successive layers to provide the tapered effect shown in Fig. 3.

The perspective view shown in Fig. 6 illustrates the trefoil construction resulting from

using three filaments and which has the advantages of relieving stresses as described above. While this is an advantageous form the invention is not limited thereto since a plurality of any desired number of filaments may be used to construct the bristle.

By virtue of this invention, we can now design our paint brushes by control of many variables to a much greater extent than was possible with natural bristles and thus we are able to adapt the type of synthetic bristles and the brushes made from them to the particular use for which the brush is to be employed.

What we claim is:

1. An artificial bristle comprising a plurality of strands of textile filaments, said strands being substantially untwisted and running approximately parallel to one another and bonded together in a protective coating of a resinous substance to form a bristle-like aggregate, said bristle having a stiffness and flexibility characteristic of natural bristles.

2. An artificial bristle as specified in claim 1 wherein the textile fiber is in the form of substantially continuous strands and the resin is a thermo-setting resin selected from the group consisting of the oil-modified phenolic resins and the oil-modified alkyd resins.

3. An artificial bristle as specified in claim 1 wherein the textile fiber consists essentially of cellulose acetate.

4. An artificial bristle as specified in claim 1 wherein the textile fiber consists essentially of pure silk.

5. An artificial bristle comprising a plurality of strands of a textile fiber running parallel to one another and encased in a coating of progressively receding layers of a resinous substance to form a bristle-like tapered aggregate.

6. An artificial bristle comprising a plurality of strands of a textile fiber separately coated with a resinous substance and running parallel to one another and partially encased in an outer coating of a resinous substance to form a bristle-like aggregate having a plurality of strand ends at one end of the bristle.

7. An artificial bristle as claimed in claim 6 wherein the outer coatings of the resinous substance increase in thickness away from one end to form a tapered body.

8. A structure for use as a bristle characterized by a plurality of strands of textile fiber separately coated with a resinous substance and running in parallel arrangement in combination with a binding body of a resinous substance which holds the strands in a single aggregate throughout the greater portion of their length but which stops short of the flag end of the bristle to permit the strands to form a plurality of separated ends to the bristle.

9. A process for forming artificial bristles which comprises dipping groups of strands of a textile fiber into a resinous solution to coat and aggregate them, removing the strands from the solution, allowing the resinous solution to drip down the aggregated strands, drying the coated strands reinserting them in the solution, removing them from the solution, drying and baking the coated aggregate and cutting the same to desired lengths.

10. A process as claimed in claim 9 wherein the strands are dipped under pressure to give better penetration of the solution between the strands.

11. A process for forming artificial bristles as defined in claim 9 and characterized further by quickly removing the aggregated strands from the solution so as to cause the solution to run down the strands and deposit a thickened coating along the butt of the strands and thereby giving the finished bristle a taper.

12. A process for forming artificial bristles which comprises drawing a group of strands of textile fiber through a resinous solution, to form aggregates, winding said aggregated strands on a frame, air drying, baking and cutting the aggregated strands from the frame.

13. A process of producing artificial bristles which comprises separately coating continuous strands of textile fiber with a thermo-setting resinous body, partially drying them, hardening the resinous coating, then collecting a group of such strands into parallel relation in an aggegate and coating at least a major portion of such aggregate with such resinous body to hold the strands together, and hardening the resin with heat.

14. A process as specified in claim 13, in which the strands of the finished bristle are coated with a resinous coating for at least a part of their length to produce a taper.

15. A process for forming artificial bristles which comprises drawing strands of a textile fiber through a resinous solution and winding the strands slightly spaced on a frame, air-drying, arranging the strands in groups, reinserting the strands so arranged into the solution to bind the groups into aggregates, removing the aggregates, air-drying, baking and cutting the aggregates from the frame above the level reached by the resinous solution.

16. A process for forming artificial bristles which comprises arranging a plurality of textile fibers in a group, coating such group of fibers with a resinous body in liquid form, arranging such fibers in substantially untwisted parallel alignment while the resinous body is soft and subsequently causing the resinous body to harden about the fibers.

17. An artificial bristle comprising a plurality of strands of textile filaments bonded together by a tapered coating of resinous material, said strands being arranged in substantially straight untwisted parallel position and said bristle having a stiffness and flexibility characteristic of natural bristles and being substantially free of strains and stresses such that the bristles will not bow or curl when supported at one end as in a paint brush.

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