June 23, 1953 K. V. HARDMAN ET AL 2,643,157

BRISTLE SETTING

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Fig. 1

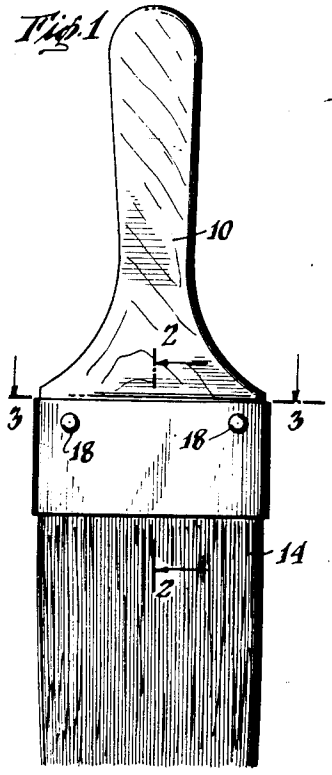


Fig. 3

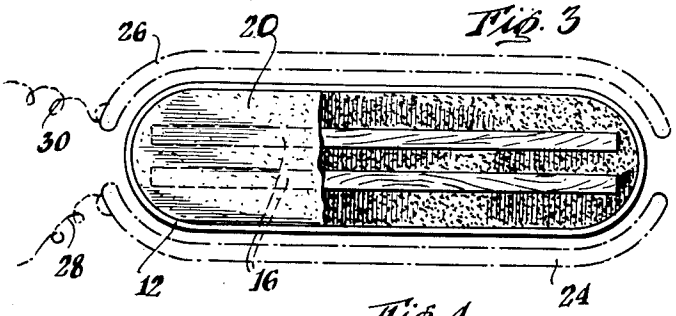


Fig. 4

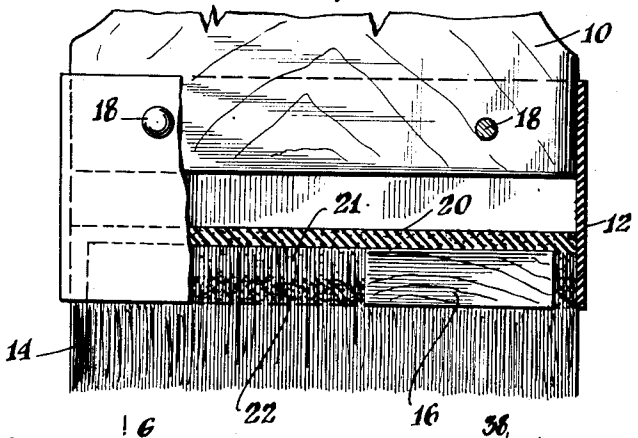


Fig. 2

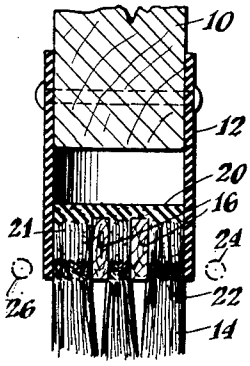


Fig. 5

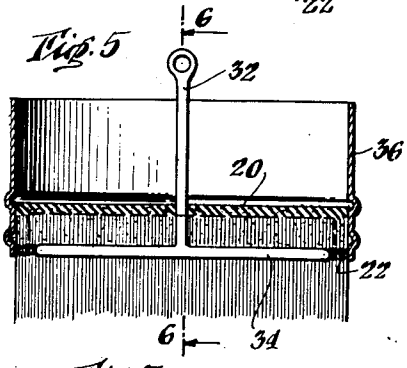


Fig. 6

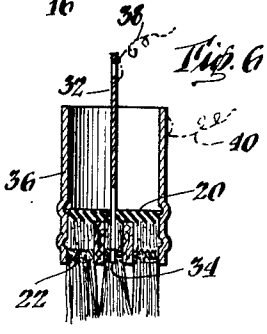


Fig. 7

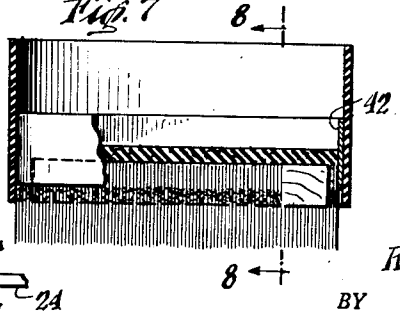


Fig. 8

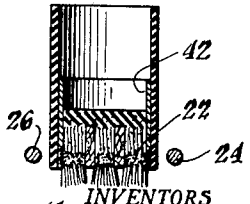
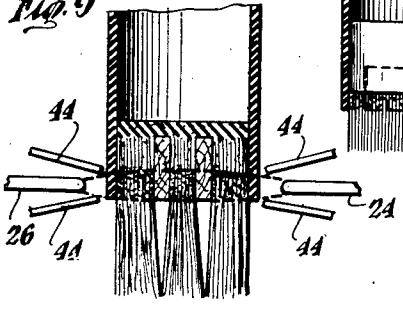


Fig. 9



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Fig. 11

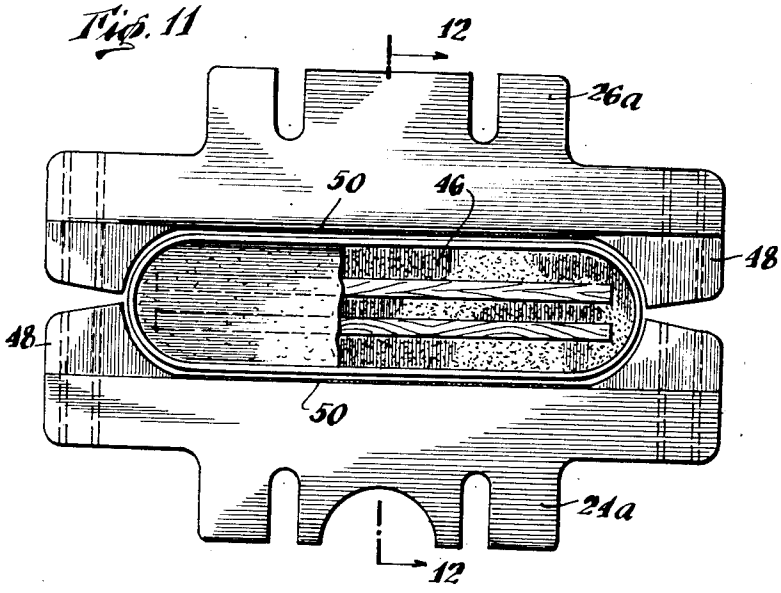


Fig. 10

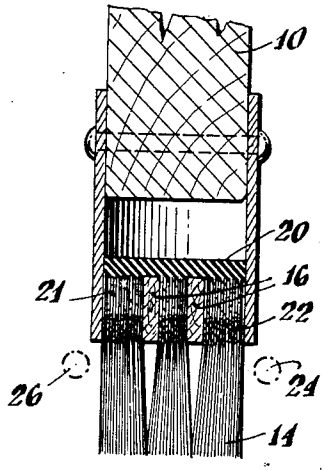
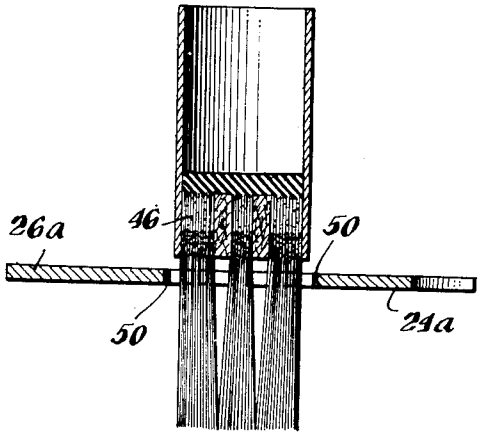


Fig. 12



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UNITED STATES PATENT OFFICE

2,643,157

BRISTLE SETTING

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Application February 27, 1952, Serial No. 273,710

9 Claims. (Cl. 300—21)

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The present invention relates to a method of setting bristles in a brush. This application is a continuation in part of our copending application Serial No. 75,856, filed February 11, 1949, now abandoned, covering the same subject matter.

In setting bristles in brushes in an operation of the general type of our method, it has been customary heretofore to assemble the bristles with their butt ends up and within a ferrule, pour bristle setting cement over the butt ends of the bristles, allow this cement to flow downward by gravity between the bristles, and then to harden the cement, as by heating.

Difficulties have arisen in this operation. As one example of these, the extent to which the cement flows downward between the bristles is difficult to control and variable. When there are crossed bristles in the assembly or loose spacing of some of the bristles due to other causes, then the cement flows relatively rapidly at that point and gives streamers sometimes referred to as "icicles" of the cement.

The present invention provides a method that avoids the objections to the usual methods. It provides a method in which the extent of downward seeping of the bristle setting composition between the bristles is restricted to a certain definite zone or floor, with the prevention of the formation of the icicles or like structures referred to above. It provides a finished brush in which the bristles and cementing composition are firmly united and the composite so made is firmly united to the ferrule.

Briefly stated, the invention comprises the improved method herein described. The method includes the assembly of the bristles within a ferrule, with the butt ends up, pouring over these butt ends a heat thickenable and then heat hardenable bristle setting composition, and establishing the elevated temperature of thickening of the composition within a narrow zone extending across the ferrule at a predetermined level at approximately a right angle to the direction of extent of the bristles. When the composition reaches this zone, the composition thickens quickly and forms a floor below which there is no further penetration. The invention comprises establishing this high temperature zone which is to constitute the floor by means of dielectric heating by high frequency energy.

In the preferred embodiment, the invention comprises also the step of supplying the high frequency energy for heating through the ferrule of the brush, the material of the ferrule preferably being electrically non-conducting.

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In a modification, the invention includes the step of deflecting the high frequency energy as it tends to spread between the electrodes and the ferrule, so as to confine the area of heating to a more limited zone or band.

In another modification the invention includes effecting the heating between a conducting ferrule constituting one electrode and another electrode disposed in the midzone within the ferrule.

The invention will be illustrated in connection with the attached drawings to which reference is made.

Fig. 1 is a face view of a finished brush made as described herein.

Fig. 2 is a sectional view on line 2—2 of Fig. 1, with electrodes added and shown in broken lines.

Fig. 3 is a sectional view on line 3—3 of Fig. 1, with electrodes added and shown in broken lines.

Fig. 4 is a fragmentary enlarged view of a portion of a brush broken away for the purpose of illustration.

Fig. 5 is a sectional view of a modified form of assembly utilizing an inner electrode and a conducting ferrule.

Fig. 6 is a sectional view on line 6—6 of Fig. 5.

Fig. 7 is a view similar to that of Fig. 4 of a modified form of the invention.

Fig. 8 is a sectional view on line 8—8 of Fig. 7.

Fig. 9 is a sectional view of an assembly used in a modification of the method of manufacturing the brush.

Fig. 10 is a modified form of assembly similar to that of Fig. 2 with the electrodes positioned below the ferrule.

Figs. 11 and 12 show a modified form of electrode.

The views on the several section lines stated are in the directions of the arrows. Parts not illustrated specifically are conventional unless otherwise described.

There are shown a brush with handle 10 of conventional type, ferrule 12, bristles 14, spacer strips 16, and fasteners of usual kind such as rivets 18 extending through the ferrule and material disposed therewithin. The bristle setting composition 20 suitably extends as a cap over the butt ends of the bristles as shown in the sectional views. This bristle setting composition also extends downwardly between the bristles to the setting zone illustrated at 22. The cap is shown at 20.

There are shown the electrodes 24 and 26 used in supplying energy during manufacture, with leads 28 and 30 connecting the electrodes to a conventional high frequency energy machine (not

shown). During the high frequency heating operation, these electrodes are brought close to the outside of the ferrule.

In the modification shown in Figs. 5 and 6 a conducting strip **32** is joined, for the step of establishing the floor **22**, at one end to an inner electrode **34** terminating at points about equidistant from the ferrule in all directions. The ferrule **36** in this case is a conductor of electricity. The strip **32** is joined to one pole of the high frequency energy machine by lead **38** and the ferrule is connected by lead **40**.

Figs. 7 and 8 show a modification of the structure in which an electrically conducting strip **42** of sheet metal or the like is disposed within the ferrule as shown, so as to shield a part of the butt portions of the bristles from the high frequency energy.

In Fig. 9 there is shown another modification in which high frequency energy deflectors **44** are disposed adjacent to the ferrule and to the sides of the electrodes **24** and **26** so as to narrow the zone of heating by the high frequency energy, as shown by the broken lines in the figure.

In Figs. 11 and 12 we show a modified form of electrode which is advantageous for producing extremely uniform heating conditions throughout the narrow zone or floor in the ferrule. As shown electrodes **24** and **26** (*a*) are flat and made to extend slightly out beyond the ends of bristle mass **46** and a pair of blocks of non-conducting material **48** such as teflon or the like are interposed between the extended ends of the electrodes. Teflon is also used to coat the inside edges of the two electrodes with a film (**50**) approximately .005 inch thick. These modified electrodes operate in the same way as those described in the primary form of our invention and the non-conducting material provides an even distribution of the high frequency energy so that there is less tendency to overheat and char the setting composition.

Materials of construction of the various parts are those that are conventional for such use unless otherwise stated.

The bristles may be any one of the commercial bristles used in making paint brushes or the like, as, for instance, nylon, hog bristles, horsehair, fibers such as Tampico, or cellulose triacetate. It will be appreciated that nylon and triacetate for this purpose are suitably in the form of the tapered filaments now made for paint brush use. Nylon bristles, although difficult to set properly by usual means, are set satisfactorily and conveniently by our method.

When the method of heating involves the assembly shown in Figs. 2, 3, 4, 7, 8 and 9 the ferrule is preferably non-conducting since it is difficult to achieve the required temperature for hardening the setting composition if a conducting ferrule is positioned between the electrodes. However this difficulty is readily solved by positioning the electrodes just below the metal ferrule as best shown in Fig. 10. In operation high frequency energy passes between the individual electrodes to produce dielectric heating of the bristles and setting composition within the ferrule. This energy establishes the heated zone or floor which prevents further penetration of the heat sensitive cement.

Examples of ferrules that are non-conducting and are used to advantage are nylon in molded form and shaped as shown, a phenolaldehyde impregnated and laminated cloth or paper sheet, plastic organic silica compound (silicone), and rubber and acrylonitrile plastic. Such ferrules should be resistant to organic solvents of kind used in paints, varnishes, and lacquers. Metal may also be used for the material of the ferrule if the method of manufacture is one using the assembly shown in Figs. 5, 6, 10 and 12.

Spacer strips **16** may be of wood, plastic, or like electrically non-conducting material. In any case the material selected is in the shape desired for the ferrule, as in one of the oblong tubular forms shown. When wood strips are used, the strips may be predried, to remove excess moisture.

The bristle setting composition should be one that is heat thickenable and then heat hardenable. Examples are the various flowable plastic compositions of about the consistency of heavy syrup, including phenolaldehyde condensation product, urea-formaldehyde condensation product, and a viscous mixture of styrene and polystyrene. In some cases the setting composition has a tendency to shrink away from the ferrule when it hardens and this results in a poor bond. Such shrinkage may readily be avoided by adding a blowing agent such as diazoaminobenzene, sodium bicarbonate or ammonium carbonate to the setting composition all as described in U. S. Patent No. 2,406,732, issued to Kenneth V. Hardman on August 27, 1946.

The high frequency energy machine used for the heating is selected in accordance with existing knowledge and practice, to give extension of the heating zone completely through the width and thickness of the space within the ferrule, that is, through the bristle butts and setting composition therewithin. The high frequency may be that generated by a standard machine for use in the internal heating of plastics.

We have used to advantage a machine giving energy of frequency above 30 megacycles a second. With a lower frequency than about 20 megacycles, heating initially is somewhat slower than preferred for the present purposes.

The invention will be further illustrated by the following specific examples of the practice of it.

Example 1

The butt ends of tapered nylon bristles are assembled within a tubular nylon ferrule **12**, as illustrated in Fig. 1, but with the handle not yet in position. A bristle setting composition consisting of a phenol-aldehyde mixture with 8% of setting catalyst, such as phosphorous acid, is applied over the upward or butt ends of the bristles in amount to form about a $\frac{3}{16}$ inch layer over the butts. Electrodes in the form of copper tubing of one-fourth inch diameter shaped as shown in Fig. 3 are brought adjacent to the nylon ferrule, on opposite sides thereof, and the high frequency electrical machine attached at its terminals to leads **28** and **30** is then set in operation.

The first effect of the high frequency heating is moderate warming of the bristle setting composition and increase of its fluidity. As a result, the bristle composition flows downward to the zone lying approximately directly between the electrodes **24** and **26** and adjacent to the lower edge of the ferrule. The composition strikes in that zone a high temperature at least equal to that of the quick thickening of the bristle setting composition, as, for instance, about 170°–250° F., the selected temperature being established by proper control of the energy machine. Here the composition becomes non-flowable, concentrates as a layer, and establishes a floor through which

additional portions of the composition flowing downward do not penetrate.

The effect of the high frequency heating on the bristle setting composition became apparent in about 20 seconds after the current was turned on. Bubbles of steam began to rise in various parts of the composition and the composition flowed in substantial proportion quickly to the level of the very hot floor established by the level of electrodes 24 and 26. The energy supply was then turned down slightly so that boiling of water in the cap 20 practically stopped.

After about 60 seconds of this heating, the floor was well established and the limit to which the setting composition penetrates downwardly between the bristles was established. After about another 30 seconds, the heating by the high frequency energy was discontinued and the assembly so made was then delivered at once and without any substantial cooling to a hot air oven of temperature known to cause a commercially satisfactory rate of final cure or setting of the phenol-aldehyde condensation product. There the product was fully cured. It was then removed from the oven, cooled, and supplied with handle 10 in a usual manner.

Example 2

In a modification of the above described method, there is used the construction shown in Fig. 5. Here a metal ferrule serves as one electrode of the high frequency machine and the metal strip 32 as the lead in from the other pole of the machine to the inner electrode 34, suitably of aluminum metal or the like.

When the setting cement has been cured and the assembly is ready to receive the handle 10, the strip 32 is severed near the cap 20 and the free end discarded.

Example 3

The procedure of Example 1 is followed except that deflectors 44 consisting of electrically conducting sheet material such as aluminum, copper or iron are disposed adjacent to and on either side of the two electrodes so as to limit the width of angle through which the energy may arch itself, as it moves to the ferrule and through the materials assembled within the ferrule.

Example 4

The procedure of Example 1 is followed except that a thin band of aluminum foil of thickness 0.005 inch is placed inside the ferrule and outside the bristle butts as shown in Figs. 7 and 8. This narrows the zone of intense heating by screening the area inside the band from the high frequency heating. The band remains in the finished brush. The foil may be copper or iron.

If desired the final curing of the bristle setting composition in a conventional hot air oven as described in Example 1 may be substituted by an additional short heating period with the high frequency energy, the time and temperature of cure being those required to harden the setting composition. The supplemental hot air oven is preferred, however, because its use as supplementary heating means releases the high frequency equipment for use on subsequent assemblies in which the floor of bristle setting composition is to be established. If speed of setting is not required, the setting may be effected at temperatures as low as room temperature. It is necessary, however, that the hot floor 22 be established initially to control the level of penetration.

The plastic ferrules fit tightly around the bristle setting in the finished article. Such ferrules have a relatively high temperature coefficient of expansion. As a result, they shrink tightly around the setting, particularly when the setting composition has been cured by heating.

The use of the high frequency energy heating establishes initially a higher temperature in the bristle setting composition than in the bristles themselves, with the result of giving fluidity and conformance of the cement to the surfaces of the bristles without overheating the bristles. This raising of the setting composition to a temperature above that of the bristles themselves is particularly pronounced in the presence of a small proportion of water such as found in most of the flowable plastic compositions used for bristle setting or generated during the initial stages of the condensation of the resinous materials.

It will be understood that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of illustration which do not constitute departures from the spirit and scope of the invention.

What we claim is:

1. In setting bristles the method which comprises assembling the bristles with the butts up within the ferrule, applying over the butts a bristle setting composition that is flowable, heat thickenable, and heat curing, causing the setting composition to penetrate downwardly between the bristles, introducing high frequency energy into the setting composition, in direction generally perpendicular to the length of the bristles and in a narrow zone at the level at which the penetration of the setting composition is to be arrested, the high frequency energy being regulated to cause an elevated temperature as high at least as the temperature of rapid thickening of the said composition to non-flowable condition and below the temperature of deterioration of the bristles and the result being thickening of the said composition in the narrow zone to non-flowable condition and the establishment of a floor limiting the depth of penetration of the composition between the bristles.

2. The method described in claim 1, the narrow zone being adjacent to the lower edge of the ferrule and the product made as described being then warmed to and maintained at the temperature of curing of the said composition until the composition is cured.

3. The method described in claim 1, the bristle setting composition being a heat hardenable phenolaldehyde condensation product and the temperature established initially by exposure of the said condensation product to the high frequency energy being higher than the temperature within portions of the bristles adjacent to the said composition.

4. The method described in claim 1, the bristle setting composition containing water and the temperature established initially by exposure of the said condensation product to the high frequency energy being higher than the temperature within portions of the bristles adjacent to the said composition.

5. The method described in claim 1 which includes the step of positioning within the mass of bristle butts an electrode which cooperates with the ferrule for introducing high frequency energy into the setting composition.

6. The method described in claim 1 including

placing an electrically conducting shield in the path of a part but not all of the high frequency energy and between the source of said energy and the bristle setting composition so as to limit the width of the zone subjected to direct heating by the high frequency energy.

7. The method described in claim 6, the said shield including a band of electrically conducting metal disposed around the bristles and at the level of a boundary of the zone to be subjected to heating, so as to increase the temperature gradient at this level and restrict the width of the said zone of heating.

8. The method described in claim 1 which includes the step of positioning below the ferrule a pair of oppositely disposed electrodes which cooperate with each other for introducing high frequency energy into the setting composition.

9. The method described in claim 8 in which the electrodes are flat and are extended out beyond the ends of the bristle mass with a pair of blocks of non-conducting material interposed between the extended end portions of the electrodes.

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No references cited.