March 8, 1966 V. K. CHARVAT 3,239,276

METHOD OF MANUFACTURING COMPOSITE BRUSHING TOOLS

Filed Feb. 26, 1964 2 Sheets-Sheet 1

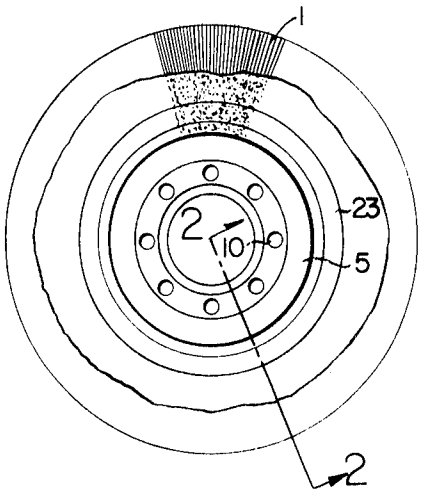

FIG 1

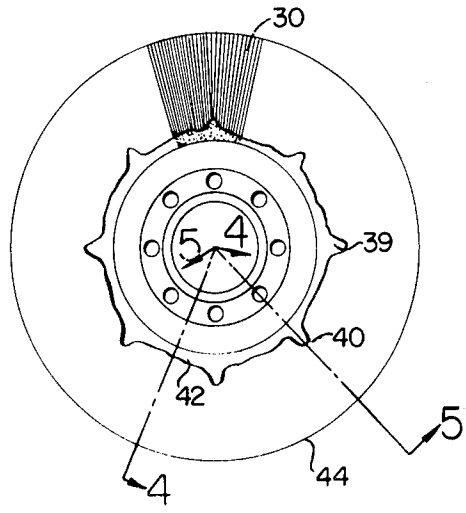

FIG 3

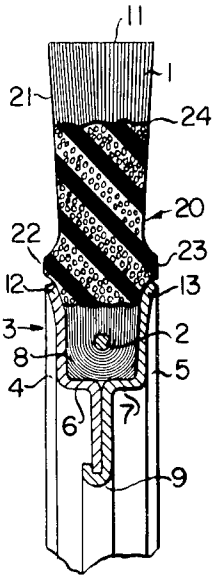

FIG 2

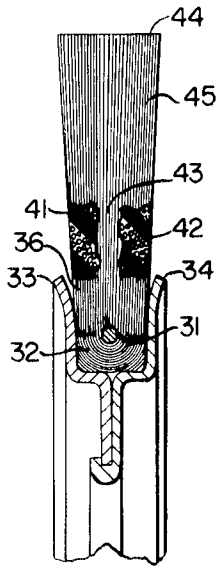

FIG 4

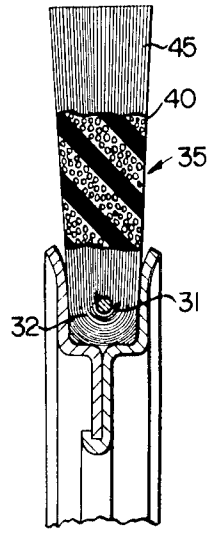

FIG 5

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METHOD OF MANUFACTURING COMPOSITE BRUSHING TOOLS

Filed Feb. 26, 1964 2 Sheets-Sheet 2

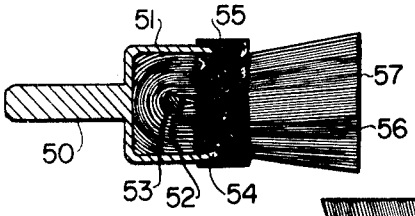

FIG 6

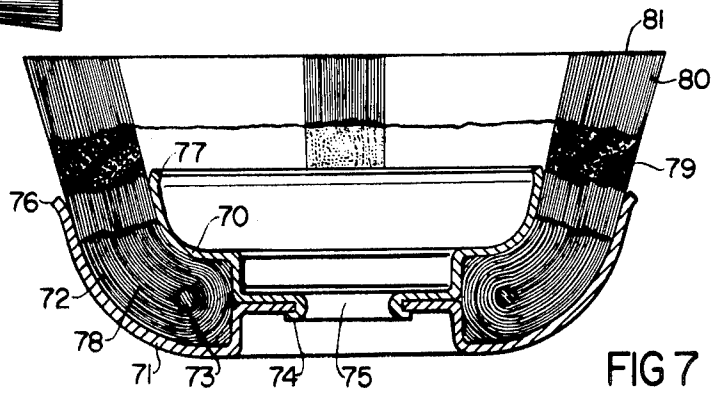

FIG 7

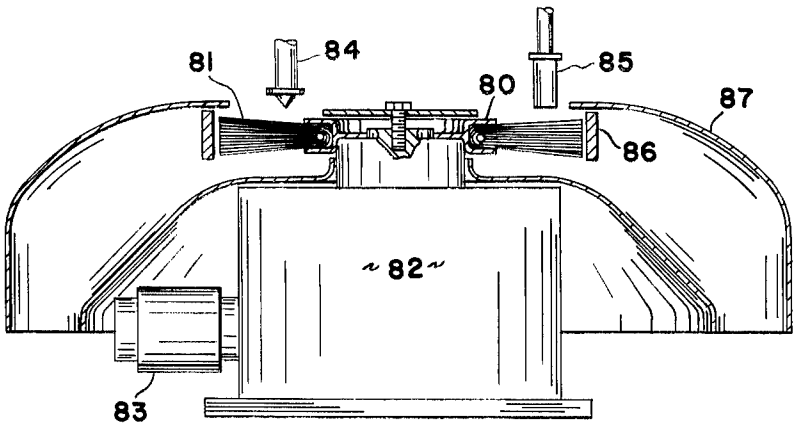

FIG 8

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3,239,276

METHOD OF MANUFACTURING COMPOSITE BRUSHING TOOLS

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6 Claims. (Cl. 300—21)

This invention relates, as indicated, to a method of producing composite brushing tools, and more particularly to a method of manufacturing power driven rotary brushes having much improved brushing characteristics.

This application is a continuation-in-part of my copending application Serial No. 140,345, filed Sept. 25, 1961, entitled "Modified Brushing Tool," now Patent No. 3,147,503.

Various brushing tools have been commercially produced wherein the inner ends of the bristles are seated in an appropriate support by means of elastomeric material embedding such ends. Also, rotary brushes have been produced in which the bristles are substantially entirely embedded in a body or matrix of elastomeric material (see, for example, Stingley patent, 2,950,495), and these brushing tools have proved quite satisfactory for certain types of operations. It is generally desirable, however, particularly in wheel type brushing tools, to pack as much brush bristle material as possible in the channel-form back or other support in order that the brushing face of the tool may have as many working points as possible and therefore be capable of rapid and efficient action on the work. This is difficult to achieve when the inner ends of the bristles are mounted in elastomeric material which itself occupies considerable space within the brush back. Furthermore, when the brush bristles are substantially entirely embedded in an elastomeric body with only the extreme outer end portions protruding therefrom, the type of abrading action obtained is very substantially different from that of the usual brush in which the bristles extend individually a considerable distance from the support.

It is known that the rapid cutting action of a power driven rotary brush utilizing wire bristle material, for example, may be much enhanced if unusually hard wire (e.g. having a Knoop hardness of 700) by employed although such hard bristles, of course, have relatively little fatigue strength and therefore evidence a tendency toward long fracture, much reducing the useful life of the brush. It is an important object of the present invention to provide a method of manufacturing a modified brushing tool which may satisfactorily utilize such hard bristle material without substantially entirely embedding the same in a body or matrix of elastomeric material, the bristles being allowed a considerable amount of individual movement.

It is a further object to provide a method for producing a brushing tool in which such hard bristle material may be used without undue long fracture of the latter in use.

Another object is to provide a method of making a brushing tool in which the action of the bristles is regulated and controlled by the employment of a minimum of elastomeric material so that the desired brushing characteristics of the tool are maintained and a maximum quantity of the brush bristle material may be secured in the support or base.

Another object of this invention is the provision of a novel method for manufacting power driven brushes of various types from any of the brush materials hereinafter described.

It is an additional object to provide an improved method for producing brushing tools in which the brush material can be substantially entirely embedded in a matrix of elastomeric material.

Other objects of the invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention the comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustraive embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a side elevation of one form of rotary brush in accordance with the principles of the present invention;

FIG. 2 is a transverse section of such brush taken substantially on the line 2—2 of FIG. 1;

FIG. 3 is a side elevation of another form of rotary brush in accordance with the invention;

FIGS. 4 and 5 are transverse sections of the embodiment of FIG. 3 taken substantially on the lines 4—4 and 5—5 of FIG. 3;

FIG. 6 is a longitudinal sectional view of an end brush in accordance with the invention;

FIG. 7 is a transverse section of a cup brush in accordance with the invention; and

FIG. 8 is a side view partly in transverse section illustrating the method of this invention.

As the power brushing art has developed, there has arisen an increasing demand for precision rotary brushes adapted to be driven at high speeds and having carefully trimmed and often ground brush faces adapted to produce predetermined specified effects upon a workpiece. When using bristle fill material wires, plastic coated wires, or plastic filaments, it has been conventional to crimp the filaments for a variety of reasons including the dampening effect achieved due to the interengagement of the filaments one with another along their length. This assists in the prevention of localized concentrations of stress which tend to produce long and short fracture of the bristle. Crimping of the brush bristle has also been employed in an effort more uniformly to space the bristles at the brush face since radially extending fill material is less dense at the brush face.

Crimped brush bristle material also has certain disadvantages, however, in that it tends to elongate due to centrifugal force, producing an uneven brush face; the inclination of the brush tips is, of course, irregular and certain bristle tips will gouge the work whereas others will merely drag or wipe across the work surface; and the interengagement of the bristles through the crimp may result in localized stress concentrations producing a substantial amount of long fracture. Hard wire brush bristles are also very difficult to crimp properly with any constant curvature and this, of course, affects the precision obtained in the brushing face.

With the present invention, it then becomes possible to utilize straight wire brush bristle material or bristles having a very shallow crimp.

Referring first to the FIG. 1 embodiment, it will be seen that a rotary brush is illustrated comprising radially extending wire fill material 1 which may be wrapped around a retaining wire 2 within a brush back 3. Such brush back includes side plates 4 and 5 which are provided with shoulders 6 and 7 to form a channel shape annular enclosure for the base portion 8 of the brush bristle material where the latter is wrapped around the retaining wire 2. The side faces 4 and 5 of the brush back may extend radially inwardly and be joined as shown at 9, and additionally may be riveted or spot welded at a number of circumferentially spaced points as shown at 10 in FIG. 1. In the manner indicated, the

brush bristle material extends radially outwardly from the hub 3 which is adapted to be placed upon a brushing lathe spindle for the desired work application.

It is usually much preferred that the base portion 8 of the bristle material around the retaining wire 2 and within the confines of the side portions of the base plates 4 and 5 be packed as tightly as possible to obtain the highest possible brush fill material density and it will be understood that the higher the density in the base portion of the brush, the higher the density obtainable at the brushing face 11. The side plates of the brush base 4 and 5 extend radially outwardly and flare axially as shown at 12 and 13 presenting outwardly curved supporting surfaces to the radially extending brush material. In this manner, any sharp or high pressure contact area between the brush retaining faces and the brush bristle material is avoided. Since the brush fill material will be packed tightly together within the region 8 within the confines of the base, there will be little movement afforded the bristle material in such region during the brushing operation. During brushing action, the stress concentrations generally occur in an area adjacent the tightly packed base portion 8 and adjacent the edges of the side plates 4 and 5. In order to cushion and dampen any vibrations which would result in stress concentrations in this area, there is provided an annulus of elastomeric material 20, preferably cellular elastomeric material, which extends from a position adjacent the tightly packed base portion 8 and also the outer edges 12 and 13 of the retaining plates radially outwardly to enclose a substantial portion of the brush fill material while yet allowing the brush bristle material freely to project therebeyond as shown at 21. In this manner, the fill material will be available at the brushing face in a substantially unrestricted condition to effect a normal brushing action on the work. The annulus 20 of cellular elastomeric material is provided with laterally extending projections 22 and 23 which overlie the flared edges 12 and 13 of the side face plates, providing in this embodiment firm lateral support between the side faces and the brush material. The outer periphery 24 of the elastomeric annulus may extend somewhat irregularly but substantially uniformly circumferentially of the brush and the exact line of demarcation between such annulus and the freely projecting bristles therebeyond need not be too accurately defined.

In FIGS. 3, 4 and 5, there is illustrated another form of brush quite similar to the one shown in FIG. 1 wherein brush fill material 30 is secured about a retaining wire 31 in a very densely packed base region 32. A brush back identical in form to the brush back shown in FIG. 2 may be employed having outwardly flared annular edges 33 and 34. These edges of the brush back form the outer peripheries of the U-shape channel back which confines the very densely packed brush bristle material in the region 32. Again, adjacent the peripheral edges of the brush back and adjacent the region 32 of the tightly packed brush bristle material, an annulus 35 of foamed elastomeric material may be provided impregnating such region and the portions of the brush bristles in which long fracture stress concentrations are most apt to occur. In this embodiment, the annulus may expose a certain portion of the bristle therebeneath in the tightly packed region 32 as shown at 36. In the particular annulus shown, the elastomeric material may be intruded through the side faces of the brush bristle material and only in certain regions as shown by the section of FIG. 5 will the elastomeric material extend completely transversely through the brush. In these regions, the radial extent of the elastomeric material may be somewhat greater than in the portions shown by the section of FIG. 4. Here the elastomeric material will be intruded inwardly from the sides to form in essence an internal bridle which embeds the bristle material only for a certain distance inwardly from the side faces of the brush. In this manner, the rotary brush is, in effect, provided with a series of internal bridles which group the bristle material into certain tufts, i.e., those portions of the brush face between adjacent projections or extensions such as 39 and 40. Such radial extensions which extend completely transversely through the brush may be joined by cellular elastomeric intrusions 41 and 42 which only partly extend through the brush leaving a certain portion of the bristle material free as shown at 43. In any event, the annular elastomeric bridle extends from adjacent the region 32 in which the brush fill material is very densely packed to a radially outwardly spaced region which is yet substantially spaced from the working face 44 of the brush. In this manner, the bristle fill material 45 extending beyond the elastomeric annulus will be afforded a substantially normal or free brushing action on the work. Again, the annulus of elastomeric material is provided only adjacent the base of the brush to protect the same against the stress concentrations apt to occur in that area. It will, of course, be understood that a complete elastomeric annulus extending entirely through the brush may be provided and the same need not be supported by the flaring peripheral edges 33 and 34 of the brush side plates. In this manner, lateral flexibility may be obtained and certain portions of the bristles beneath the annulus will be exposed as shown at 36.

As seen in FIG. 6, an end brush may also be provided in accordance with the present invention, such end brush having an arbor 50 which may be secured in a chuck or the like for driving the brush and an integrally formed cup portion 51 in which a tuft of densely packed bristle fill material 52 is secured by a transverse retaining member 53. The outer annular edge 54 of the cup 51 may be provided with inwardly pressed edges adapted to enclose and confine the bristle material densely packing the same within the cup 51 and assisting in retaining the same. Here also, a disc or layer of cellular elastomeric material 55 may be provided extending entirely through the end brush in a region adjacent the densely packed region 52 of bristle fill material and such may enclose the edge 54 of the cup 51 tying the bristles to such cup in the manner shown. The bristle fill material 56 will extend without further support from the disc of cellular elastomeric material permitting a normal brushing action to be obtained at the brush face 57. Again, the outer demarcation between the disc 55 and the freely extending bristle fill material 56 may be locally irregular, but generally uniform. Consequently, there will ordinarily be no very abrupt transition from the bristle supporting region to the free bristle region.

FIG. 7 illustrates a further form of brushing tool in accordance with the present invention generally similar to the rotary brushes illustrated in FIGS. 1 to 5. As shown in FIG. 7, a cup brush is made with top and bottom retaining plates 70 and 71 which enclose bristle fill material 72 by means of a retaining ring 73. These top and bottom retaining plates may be secured together as shown at 74 and are provided with an aperture 75 adapting the brushing tool to be secured to a tool spindle or the like. The outer edges of the retaining plates flare slightly outwardly as shown at 76 and 77, confining the bristle material 72 in a densely packed region 78 adjacent the retaining ring 73 between plates 70 and 71. Outwardly adjacent this densely packed region of bristle fill material there is provided an annulus 79 of cellular elastomeric material which is also adjacent the flared peripheral edges 76 and 77. This annulus extending entirely through the bristle fill material for a relatively short longitudinal distance and permits the brush fill material to extend for a substantial distance therebeyond as shown at 80 and the annular brush face 81 may be trimmed as shown to the desired shape. It can now be seen that in the FIGS. 6 and 7 embodiments, the generally axially extending brush fill material is provided with an elastomeric impregnation in the region next adjacent the highly compacted region of the brush fill material within the brush back. Since it

is this area in which the long fracture stress concentrations are prevalent, it has been found that brushing tools of much longer life can be provided without, however, reducing the density of fill within the back or holder.

With the present invention, it is possible to use hard straight wire bristles or wire bristles of rather shallow crimp and this has been found to perform longer and more brushing work. With the straight or shallow crimped wire, it is possible substantially to avoid stress concentrations at successive bends thus also reducing the short fracture found in conventional crimped wire brushes. It will, however, be understood that any brush fill material may be employed with the present invention and plastic coated wire bristles, horse hair, and plastic coated glass fiber filaments, such as disclosed in Peterson patent, 2,682,734, for example, may be employed.

One excellent type of brush bristle fill material that may be employed with the present invention is a mixture of straight wire fill and a high grade Tampico. For example, a fill material of a mixture of .008" diameter straight wire fill of approximately 700 Knoop hardness and a top grade Tampico may be employed. Such mixture may be in the ratio of 2½ to 1 of wire to Tampico and, for example, a 12" diameter brush having a 7¼" inside diameter may contain approximately 32 ounces of wire and 13 ounces of Tampico. It will be understood that the wire and Tampico will be uniformly mixed and distributed.

Hard straight wire brush bristles employed in the present invention and especially steel wire will generally have a Knoop hardness of at least 600. The Knoop hardness test is a U.S. Bureau of Standards test which is particularly suited to measure the hardness of fine filaments. In some cases, the filaments may have a hardness of at least 800. Stainless steel wire brush bristles may be employed coated with a thin outer plastic coating having beads therein, as shown, for example, in my co-pending application "Brush and Brush Material," Serial No. 86,378, filed February 1, 1961, now Patent No. 3,090,461.

The elastomeric cellular annulus employed with the present invention may be formed from any number of materials, suitable examples being neoprene, polyurethane, polyvinylchloride or certain of the epoxy resins. Preferably, cellural polyurethane may be employed and specifically the the material used to impregnate the base portion of the brush may be Nopco Chemical Company's resin F–202. This base resin may be mixed with a silicone such as Dow-Corning 200 at the rate of 1.89 grams per pound of resin which is approximately. 4%. A deodorant for the polyurethane manufactured by Rhodia Inc. called Alamask DW (RLT–483) at the rate of three drops per pound of resin which is approximately .4%. A deodorant well-known epoxy paste organic dye, at the rate of 2.83 grams per pound of base resin, may be added making a total of approximately .6% addition. Reference may be had to Stingley Patent No. 2,950,495 for a disclosure of a cellular neoprene or polychloroprene which may be employed with the present invention. A primer may be placed on the bristle material prior to the intrusion of the cellular elastomeric material to hold adhesively the elastomeric material to the bristle fill material. In this manner, should be the elastomeric material separate between the individual bristles, each bristle will still be provided with a protective coating which will preclude nicks or scratches from further concentrating the stresses along the bristle length in that particular area.

Reference may be had to my co-pending application, Serial No. 834,501 entitled "Abrading and Finishing Tool" for a disclosure of polyurethane compositions that may be employed for the preferred elastomeric cellular annulus of the present invention.

The manner of application of the elastomeric material to the brush may preferably be accomplished after the brush has been completely asembled and even after the face plates are assembled. When the brush is completed, the highest fill material density obtainable will preferably be within the holder or brush back and the cellular elastomeric material, as, for example, polyurethane, which may be intruded into the body of brush material in liquid form, may be placed therein by use of mold rings clamping the annular brush section adjacent the desired outer limit of the elastomeric annulus. The elastomeric fluid may then be intruded internally of the mold rings and the density of the brush fill material in the region 8 of FIG. 2, for example, will preclude the elastomeric material from entering substantially into such region. If desired, radially spaced annular clamping rings may be employed at the desired radial positions to form the elastomeric annulus. The clamping pressure exerted by the rings, by compacting the brush material, can thus fairly closely define the outer extent of the elastomeric annulus, although a desirable feathering out of the material toward the brush O.D. will be achieved.

FIG. 8 illustrates a preferred form of the method of this invention. A rotary brush indicated generally at 80 with radially extending bristles 81 is positioned upon a turntable 82 which is driven by motor 83. As the brush is rotated, a stream of elastomeric material, polyurethane in the preferred embodiment, is sprayed onto the bristle material from nozzle 84 which is preferably placed near the base of the brush in order to facilitate the distribution of the plastic about the surface of the brush by means of the forces created by rotation of the brush.

The elastomeric material is driven into the bristles by blasts of air from air nozzle 85, a plurality of which may be empolyed although only one is illustrated. A circumferential baffle 86 is positioned closely adjacent the periphery of the brush and causes the air blasts to be forced through the brush thereby intruding the plastic material into the body of the brush. The air is exhausted through 87. It is also to be understood, of course, that the elastomeric material can be forced into the bristles by means of a vacuum, if desired, rather than by the positive pressure arrangment illustrated.

After the brush has been treated in the manner illustrated, it may be transferred to a mold in which the treated brush will be heated to blow and set the elastomeric material. Alternatively, the brush can be finished without using a mold, for example, by placing the treated brush directly on the rack in an oven depending upon the mount of material in the mold or brush. If a large amount of elastomer is used, the brush should be finished in a mold as described.

When the elastomeric material is blown into the brush, it will be feathered out as it approaches the outside diameter of the brush or the region which is free of such plastic material. Polyurethane rubber blown into a brush in this manner causes the formation of heavy membrane-like "muscles" between brush wires which can be made to feather out toward the periphery. Filler materials can be added to the polyurethane rubber so that it will have a tear strength less than its bonding strength to the wire. In this case, the matrix will become full of cracks and tears during use thereby permitting the wires to move relative to each other, but yet adhering strongly to the wire providing the proper wire cushion and protective coating. If desired, such air intrusion can be employed with the aforementioned molding rings to obtain the desired placement of the plastic material.

The speed of rotation of the turntable and brush depends upon the desired distribution of plastic within the bristles which, of course, is itself dependent upon the type of brush to be produced to meet the requirements of a particular type of work. For example, if it is desired to have the plastic distributed completely across the surface of the brush thereby substantially entirely embedding the bristles, the speed of rotation would be greater than if the plastic is to be distributed only across a portion of the surface. Similarly, the manner of applying air pressure

and plastic to the brush depends upon the extent of instrusion of the plastic desired and on the intended use of the resultant brush. If the brush is of the type illustrated in FIGS. 1 and 2 or in Stingley patent, 2,950,495, the air pressure and plastic can be applied continuously, whereas the air pressure may be applied intermittently if the brush is the type shown in FIGS. 3–5 or in Charvat patent, 3,114,925. In producing articles in accordance with this Charvat patent, the plastic is, of course, also applied intermittently. The speed of rotation and the mode of applying air pressure can, of course, readily be determined for each particular case.

It can now be seen that there is provided an improved method for manufacturing brushes of various types and which is especially suitable for producing a modified form of brush which enables substantially longer brush life to be obtained. Moreover, it is possible to employ straight or shallow crimped bristle wire in such brush to obtain an improved brushing action while yet preventing such straight wires from suffering long fracture heretofore found so prevalent. It will be readily appreciated that the present method, due to its utility in the production of various types of brushes and its relative simplicity, has considerable advantages over the methods of the prior art of which the aforesaid Stingley patent is illustrative.

It is to be understood that, although the method of this invention has been primarily described in the production of power driven brushes, it has application in other fields such as in the production of abrasive articles of the type described in my aforesaid co-pending application, Serial No. 834,501. Similarly, this method may be used to produce brushes other than those specifically described such as those disclosed in Peterson Patent No. 2,995,401, and Charvat patent, 3,044,833.

Other modes of applying the principles of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. A method of manufacturing a brush comprising placing a brush having a body of radially extending bristle material on a rotary surface, rotating said rotary surface and brush, applying an elastomeric resinous plastic material to the surface of said brush, and applying air pressure to said plastic and brush to force said plastic outwardly of and into the body of brush material and between the bristles thereof.

2. The method of claim 1 in which said plastic is sprayed onto said brush near the base thereof.

3. The method of claim 2 in which said plastic is forced into said body by blowing air thereon.

4. A method of manufacturing a power driven filamentous tool comprising placing such a tool on a rotary surface, rotating said surface and tool, applying an elastomeric resinous plastic material to the surface of said tool, and applying air pressure to said plastic and tool to force said plastic outwardly of said tool and into said filamentous material thereinto.

5. The method of claim 4 in which plastic is forced into said tool by blowing air thereon.

6. A process of manufacturing a brushing tool having a body of radially extending brush material comprising applying an elastomeric resinous plastic material to the surface of such brushing tool, rotating such tool as said plastic is applied, and applying air pressure to said plastic during rotation of such tool to force said plastic outwardly of and into the body of brush material and between the bristles thereof.

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