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BRUSH AND BRUSH MATERIAL

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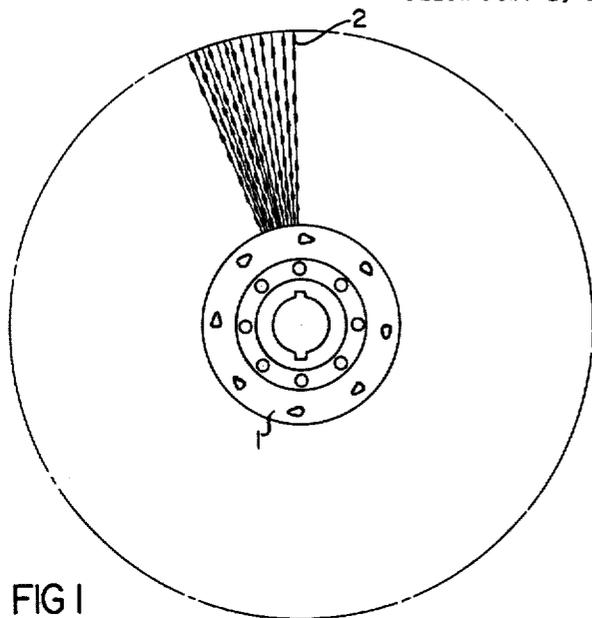


FIG 1

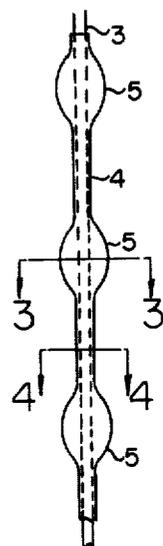


FIG 2



FIG 3



FIG 4

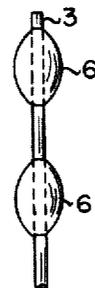


FIG 5



FIG 8

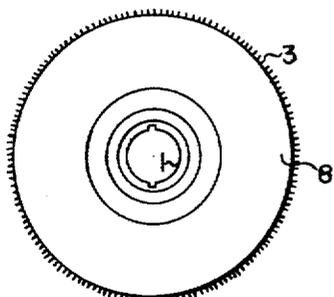


FIG 7

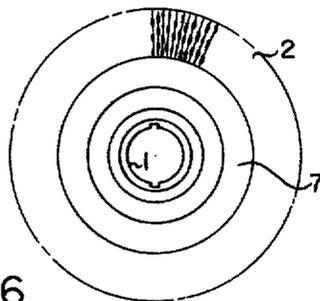


FIG 6

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BRUSH AND BRUSH MATERIAL

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This invention relates as indicated to a novel brush and brush material, and more particularly to power driven rotary brushes having much improved brushing characteristics.

Power driven rotary brushes may utilize a wide variety of brush fill material including wire bristles, Tampico fiber, plastic bristles such as nylon, horsehair, and plastic coated wire or glass fiber filaments as disclosed in Peterson Patent 2,682,734, for example. As the power brushing art has developed, there has arisen an increasing demand for rotary brushes which are true precision tools adapted to be driven at high speeds and having carefully trimmed and often ground brush faces adapted to produce specified predetermined effects upon the work. When using wire or plastic filaments as the brush bristle material, it has been conventional to crimp the filaments for a variety of reasons including the damping effect thereby achieved due to the interengagement of the filaments with one another at intervals along their length. This assists in the prevention of localized concentrations of stress which tend to produce long fracture of the bristles. Also, in wheel brushes and the like where the bristles extend generally radially from a central support, the density of brush fill material is necessarily less at the working face than where such material is secured to the support, and it is accordingly difficult to ensure uniform spacing of the brush bristle ends to produce a uniform brush face. Crimping of the brush material has likewise been of assistance in this regard.

Crimping of the brush material, on the other hand, also has certain disadvantages. When power driven rotary brushes having crimped brush bristle material, particularly wheel brushes, are rotated at high speed and brought into engagement with the work, some of the bristles tend to lengthen under the action of centrifugal force and as a result of their frictional engagement with the work, soon producing a relatively uneven brush face so that other of the bristles are prevented from engaging the work surface to the same degree or even at all. The carefully trimmed and often ground brush face loses its precision contour and the action of the brush on the work becomes correspondingly irregular. It may accordingly become necessary, for precision work, to regrind the brush face. Also, due to the crimp, certain of the brush bristle ends will extend in the direction of rotation of the brush whereas other bristle ends will extend in more or less the opposite direction, the first named bristle ends tending to dig into or gouge the work whereas the last named merely drag across the work surface. Very hard brush bristle material is also usually rather brittle and does not take a satisfactory crimp. It is accordingly an important object of the present invention to provide novel brush material and brushes utilizing the same which will have the advantages previously obtained by crimping but without the disadvantages of the same. A further object is to provide straight brush bristle material and brushes utilizing the same which will not have the disadvantages encountered in the past, such as long fracture in use, but will instead have the characteristics previously obtained by crimping as well as a new constancy and precision of brushing face.

Another object is to provide a power driven rotary brush utilizing straight hard brush bristle material treated in a manner effective properly to space and control such

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bristles to prevent undue compacting or "knifing" of the brush face and to assure equal frequency of tip contacts per unit length of face despite surface projections which ordinarily tend to part the fill of conventional brushes so that it does not contact the portions of the work most needing such contact.

Still another object of this invention is to provide such brush in which the interaction of the brush bristle material is self-regulated to control the degree and manner of flexing in use.

Yet another object is to provide such a brush in which the brush bristle material is resiliently but relatively firmly supported adjacent the base in a manner to assist in maintaining the desired spacing of the bristles and effectively to avoid stress concentration and so improve fatigue life, with such spacing being similarly controlled in the outer portions thereof by individual plastic coatings thereon.

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

To the accomplishment of the foregoing and related ends, said invention then 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 illustrative 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 drawing:

FIG. 1 is an end view of a rotary brush of the "wheel" type utilizing the new brush material of this invention;

FIG. 2 is a side view of an individual novel brush bristle in accordance with this invention, on an enlarged scale;

FIG. 3 is a transverse cross-section taken on the line 3—3 on FIG. 2;

FIG. 4 is a transverse cross-section taken on the line 4—4 on FIG. 2;

FIG. 5 is a side view of another brush bristle in accordance with this invention, on an enlarged scale;

FIG. 6 is an end view of a rotary brush utilizing the novel brush material of this invention, the inner end portions of the same being embedded in an elastomeric matrix in the region adjoining the central hub;

FIG. 7 is an end view of a modified brushing tool in which such novel brush bristle material is embedded in or encapsulated in a body of elastomeric material extending substantially to the outer working ends of the bristles; and

FIG. 8 is a side view, partly in section, showing a unitary brush bristle having enlarged portions spaced longitudinally thereof.

Referring now more particularly to FIGS. 1-4 inclusive of the drawing, the brush there illustrated comprises a central annular channelform back or hub 1 having secured therein generally radially outwardly extending brush bristle material 2. The particular form of hub or back and the mode of securing the brush material therein are not per se a part of the present invention, and reference may be had, for example, to Peterson Patent 2,303,386, Whittle Patent 2,228,337, and Peterson Patent 2,757,400 for typical suitable brush assemblies. The invention is equally adapted for employment in the manufacture of end brushes as shown, for example, in Benyak Patent 2,449,158, wire stem brushes as shown in Peterson Patent 2,895,155, roller brushes and duster brushes as shown in Peterson Patent 2,682,734, cup brushes, and many others. The brush bristle material may comprise any suitable brush bristles modified in accordance with the present invention but will ordinarily preferably comprise hard wire, especially steel wire having a Knoop hardness of at least 600. The Knoop hardness test is a

U.S. Bureau of Standards test and is particularly suited to measure the hardness of fine filaments. In some cases, the filaments may desirably have a Knoop hardness in excess of 700 and even in excess of 800. Stainless steel brush bristles are greatly improved and their life much extended in use by following the teachings of the present invention.

In accordance with the present invention and as illustrated in FIGS. 2-4 inclusive of the drawing, the individual wire bristle 3, for example, may have applied thereto a thin outer plastic coating or sheath 4 of the general type disclosed in Peterson Patent 2,682,734, but with longitudinally spaced enlarged regions which may be conveniently referred to as "beads" 5 therealong. While the wire core filaments 3 may be crimped if desired, it is ordinarily much preferred that such filaments be straight, and, in the case of the wheel brush illustrated in FIG. 1, extend directly radially outwardly from the central support or hub. By thus coating such filaments, all of the advantages explained in Patent 2,682,734 are obtained and, in addition, the beads 5 serve several very important functions. In the first place, they enable such straight bristle filaments to be employed with very much more satisfactory results than in the past. By adding bulk to the bristles in spaced localized regions only, they serve one of the purposes of the crimping ordinarily previously employed and prevent undue compacting of the brush material in the region of the brush face to gain cutting clearance. The bristles are maintained in relatively uniformly spaced relationship and the bristles also support one another in use in a manner to avoid undue concentrations of stress which would lead to early fatigue and long fracture of the bristles. As indicated above, very hard filaments may be employed with much increased brushing effectiveness inasmuch as such bristles do not require to be crimped when treated in the manner just described above. Being straight, there is no tendency toward lengthening in use as has been the case in the past when crimped bristle material has been employed and a very accurately contoured brush face may be produced by appropriate trimming and grinding which will be maintained for a much longer period in use than has been the case previously.

It is desirable that the outer plastic coating and beads be bonded to the core filament, and for this purpose various well-known bonding agents may be utilized such as "Ty-Ply-S" for bonding rubber and rubber-like materials, and epoxy resins for bonding nylon. Certain other coating materials such as polyurethane may often themselves bond adequately to the core filament without the employment of an adhesive or bonding agent. Polyvinyl chloride has been found satisfactory in producing the beads 5 and 6 and the coating 4, and foamed polyurethane and polyurethane rubber are especially effective.

Abrasive granules may, if desired, be incorporated in the plastic coating, and more particularly in the beads 5 to be released at the brush face as the composite bristles wear back in use and there applied to the work by the rotating brush. Such granular abrasive may, for example, include aluminum oxide ("Alundum" or "Aloxite"), silicon carbide ("Carborundum," "corundum"), chrome oxide, natural abrasives (e.g. pumice, emery), and mixtures of these.

Now referring more particularly to FIG. 5 of the drawing, a further embodiment of the invention is there illustrated wherein the brush bristle filament 3, ordinarily wire, is provided with spaced globules or beads 6 of the plastic material along its length, the wire being uncoated in the intervening regions. Obviously, the brush fill material may be somewhat more densely packed into the channel-form brush back or like supporting element so that a somewhat more dense brush face may accordingly be achieved. Where the brush is to be operated in a more or less corrosive atmosphere, however, or where

the brush filament 3 is of a particularly hard brittle material, it may ordinarily be preferred also to coat such intervening portions of the filaments with a relatively thin film of the protective plastic 4 as shown in FIG. 2. The extreme ends of the filaments 3 will in any case ordinarily be exposed at the working face of the brush as shown in FIG. 2 as the coating is quickly abraded away. Such exposed protruding end portion of the filament may ordinarily be as short as $\frac{1}{32}$ " for example, or as much as $\frac{1}{2}$ " or more in some cases. Likewise, the spacing of the beads longitudinally of the filament is a matter of choice but may generally preferably be on the order of $\frac{1}{8}$ " for most purposes although such spacing may likewise vary considerably. Uniform spacing of the beads along the filament is not necessary, and some irregularity of spacing is, in fact, preferred.

In order further to regulate the brushing action of the brush, and to seat the inner ends of the brush bristle material in a manner still further reducing any localized concentrations of stress in the region of such support, elastomeric material and preferably foamed elastomeric material 7 may be intruded into the body of brush material in the region adjacent the annular hub or support 1 as shown in FIG. 6. Foamed neoprene may be employed in this manner or preferably foamed polyurethane which has proven to be especially satisfactory for the purpose. Also, when a relatively harsh brushing action is desired, such elastomeric material may be thus intruded into the body of brush material between the beaded bristles as at 8 in FIG. 7 extending substantially to the brushing face of the tool with only the extreme end portions 3 of the bristles protruding therefrom, although such end portions may retain a portion of their individual coatings 4, if any. Granular abrasive may likewise be included in the body of elastomeric material 8 to be released at the working face of the tool as the latter wears back in use, such body of elastomeric material preferably being of a type adapted to erode at a somewhat greater rate under working conditions than the ends of the bristles themselves. Intrusion of the elastomeric material between the individual bristles of the brush element is greatly facilitated by provision of the aforesaid beads 5 and 6 on such bristles inasmuch as such beads serve to prevent undue compacting of the layer of brush bristle material and hold the bristles uniformly spaced as the elastomeric matrix material is intruded therebetween, interconnecting passages for intrusion of the matrix material being thus maintained by such beads.

As indicated above, the basic brush bristle ordinarily employed for most purposes will be steel wire with the beads of spacing material adhered thereto at intervals, but the principles of the invention are also adapted to the employment of bristles having similarly spaced bulges therealong as in the case of nylon monofilaments having integral bulges 9 of the same material at spaced points along their length (FIG. 8).

When producing composite brushing tools of the type illustrated in FIG. 7, one may desirably employ the method disclosed and claimed in my prior co-pending application Serial No. 854,468, filed November 20, 1959, the brush with the beaded brush material being placed in an appropriate mold and the elastomeric material being introduced into the mold while the latter rotates at high speed so as to distribute such material uniformly within the outer peripheral portion of the mold; as such elastomeric material continues to foam, it expands radially inwardly of the brush to intrude uniformly between the beaded bristles thereof.

As pointed out above, there are a number of reasons to avoid crimping the brush bristle material if the desired effects can be otherwise obtained. Such crimping of wire bristles metallurgically damages the latter as by nicking and stretching beyond the yield point, and actually tends to cause localized concentrations of stress at intervals therealong so that while the bristles may mutually

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support one another to a considerable extent to reduce long fracture of the bristles where the latter are secured to the hub or support, nevertheless the bristles do tend to break off in segments corresponding in length to the length of wire between crimps or changes in direction rather than merely to wear back at their extreme outer ends in use. The straight beaded brush bristle material of this invention is considerably easier to handle in brush making operations than is the springy crimped brush bristle material and lends itself more readily to automatic brush making processes. Due to tangling of the crimped wire, many of the filaments may not extend as radially as possible when assembled into a wheel brush and subsequent high speed rotation will cause movement of such filaments to a more truly radial position with consequent alteration of the brushing face. Employment of straight bristle material instead of crimped material likewise requires considerably less material for the manufacture of a wheel brush of the same diameter, the saving in material ordinarily being on the order of about 12%. More brush material can be packed into the same brush back, e.g. sheet metal channel or metal cup, when employing the beaded straight bristle material than when employing crimped material, resulting in greater bristle density at the working face of the tool and consequent increased brushing efficiency, the bristle ends being held slightly spaced apart at the brush face. When producing modified brushing tools of the type shown in FIGS. 6 and 7, for example, the beads on the bristles mechanically interlock with the elastomeric matrix embedding the bristle material, considerably strengthening the assembly and preventing individual bristles from being readily released from the restraining action of the matrix when the latter tears or pulls apart to some extent adjacent the brushing face in use. While the advantages of the present invention are most notable in the case of power driven rotary brushes, certain benefits such as ease of handling and uniformity of fill are obtained even when the novel brush bristle material is employed in the various well-known types of hand brushes such as scrub brushes and the like. The beaded brush material of this invention may also be intermixed with other types of bristle material such as Tampico fiber, for example, and such brushes may be treated with tacky fluids in the manner taught in Peterson Patent 2,388,867. A mixture of wire bristles and Tampico fiber, approximately equal quantities of each, with plastic beads adhered to the wire bristles at spaced intervals therealong, has been found especially satisfactory. Glass filament bristles may also be coated and beaded in accordance with this invention.

The so-called "beads," while desirably symmetrically disposed relative to the axes of the bristle filaments as shown, need not necessarily be so disposed but may instead be laterally offset therefrom. When using neoprene (polychloroprene) as any of the coating 4, beads 5, or embedding matrix 7, 8, such material may be foamed in well-known manner, if desired, by incorporation of an appropriate blowing agent therein and heating to foam prior to curing. The polyurethane may be caused to foam by the presence of moisture during reaction of the constituent ingredients. While the coating 4 and beads 5 may be applied in a continuous process, it is, of course, also optional to apply a continuous thin plastic sheath or coating to the bristle filament core and thereafter apply the "beads" or enlarged portions of the same or a different plastic. The inner end portions of the coated filaments may be left without such beads to facilitate packing a larger quantity of brush bristle fill into the channel form or other back or support. The beads may be applied to the bristle filaments, ordinarily prior to assembly into the completed brush, by dropping or printing drops of the plastic on the travelling wire or the like and thereafter severing such wire to proper bristle length. Spraying has also been employed successfully for this purpose.

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By way of illustration, certain preferred specifications for steel wire bristle material are set forth below:

Brush fill diameter	Calibre (amplitude), inch	Bead length, inch	Frequency per inch	Coating thickness between beads, inch	Permissible bead eccentricity, inch
10 Fine—.006" and under	.020-.030	3/4+/- .003	10-15	.00075	.005
Medium—.008"	.020-.050	1/4+/- .015	6-10	.001	.010
Coarse—.014"-.035"	.050-.070	3/32+/- .003	3 1/2-6	.002	.015

The bead forming material should ordinarily be capable of withstanding continuously a service temperature of at least 190° F. and preferably between about 200-250° F. for most purposes. Some polyurethanes, for example, may be compounded to withstand temperatures of 300°-400° F. These plastics should preferably be self-extinguishing. Non-foamed plastics may have a tensile strength on the order of 5000 p.s.i., whereas satisfactory foamed plastics may have a tensile strength as low as 10 and as high as 1200 p.s.i. While non-brittle elastomeric materials are much preferred to form such beads, other materials such as drops of solder applied to bristle wires are effective to afford certain of the advantages of the invention.

In a typical preferred embodiment of the invention, a wheel brush was constructed having an annular channel form hub 4 1/2" in diameter within which the brush bristle material was retained by means of a wire retaining ring within the channel, the bristles being doubled thereabout with their ends extending radially outwardly of the hub. The over-all diameter of the brush was 12 1/2" and the bristles were .0118" carbon steel wire coated with polyvinyl chloride and provided with beads of the same material as set forth in the specifications above for medium diameter brush fill material. The wires were first given a very thin epoxy resin adhesive coating more firmly to bond the polyvinyl chloride thereto. In operation, the brush was driven at 1750 r.p.m. and employed to brush steel articles such as automobile panels to prepare the surfaces for subsequent coating with vinyl plastic. The brush was also utilized to brush rubber articles before adhering the latter to other metal or non-metallic articles. Additionally, such brush has been found highly satisfactory in preparing steel articles for plating and painting, and also for removing burrs from such articles. It was found that this brush produced in accordance with the invention was effective to remove material from the work-pieces at a rate at least 50% greater than that obtainable with an identical brush in which the steel bristles were untreated and despite such rapid cutting rate the brush nevertheless had a useful life at least twice as long as that of the untreated brush. Such untreated brush is a standard commercially available tool at the present time. When a brush of the same diameter and length of fill is produced using the same wire bristle material but with a plastic coating of uniform thickness thereon, the resultant brush was not found suitable for performing many of the same brushing operations at all due to the fact that the thickness of the uniform plastic coating necessarily applied to protect the hard carbon steel wire prevented obtaining the same density of fill in the brush back so that a much less dense brush face was produced. Efforts to force such brush to do the same amount of work as the above-described brush in accordance with the invention required imposition of excessive pressures on the brush with consequent rapid disintegration. Also, when employing un-beaded brush filaments, there is a greater tendency for such filaments to skew during assembly into the brush back with a result that not all of the filaments will extend in a truly radial direction and optimum brushing efficiency is not obtained.

In view of the foregoing, it will be seen that the objects of the invention have been achieved in a relatively simple manner which actually facilitates the assembly stages of the brush manufacture.

Other modes of applying the principle 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 rotary brush comprising a support and stiff brush bristles secured thereto and extending therefrom, said individual bristles having small enlarged portions at spaced intervals along their length effective to space the bodies of said bristles and to engage adjacent bristles to modify the brushing action of such brush in use.

2. The brush of claim 1, wherein said enlarged portions are formed by substantially smooth beads adhered to the bodies of said bristles.

3. The brush of claim 1, wherein said enlarged portions are formed of distinct spaced plastic beads adhered to the bodies of said bristles.

4. The brush of claim 1, wherein said enlarged portions are formed of distinct spaced elastomeric beads adhered to the bodies of said bristles.

5. The brush of claim 1, wherein said enlarged portions are formed of distinct spaced foamed elastomeric beads adhered to the bodies of said bristles.

6. The brush of claim 1, wherein said enlarged portions are formed of distinct spaced plastic beads adhered to the bodies of said bristles with a relatively thin layer of plastic coating such bodies between said beads.

7. A rotary brush comprising a brush back with brush bristles secured thereto and extending generally radially therefrom, said individual bristles having small enlarged portions at spaced intervals along their length, and a body of elastomeric material embedding said bristles and interengaged with said enlarged portions.

8. The brush of claim 7, wherein said elastomeric material is cellular.

9. The brush of claim 7, wherein said elastomeric material is cellular polyurethane.

10. The brush of claim 7, wherein said elastomeric material is cellular polychloroprene.

11. The brush of claim 7, wherein said elastomeric material embeds the inner end portions of said bristles only.

12. The brush of claim 7, wherein said elastomeric material is cellular and extends closely adjacent the outer working ends of said bristles with the latter protruding only slightly therefrom, said elastomeric material being more readily erodable in use than said bristle ends to maintain such relationship as the bristles were back.

13. A composite brushing tool with bristles having small enlarged portions at intervals along their length, and a body of yielding material embedding said bristles and interengaged with said enlarged portions.

14. A brushing tool comprising a support and brush bristles secured thereto and extending therefrom, said individual bristles having substantially smooth small plastic enlarged portions at intervals along their length.

15. A brushing tool comprising a support and wire brush bristles secured thereto and extending therefrom, said individual bristles having small enlarged plastic portions thereon at intervals along their length.

16. The brushing tool of claim 15 wherein a relatively thin plastic coating individually covers said bristles in the regions between said enlarged portions.

17. A brushing tool comprising a support and stiff straight brush bristles secured thereto and extending therefrom, said individual bristles having small enlarged portions at intervals along their length.

18. A brushing tool comprising a support and straight wire brush bristles secured thereto and extending there-

from, said individual bristles having small enlarged portions in the form of adherent plastic beads at spaced intervals along said wires.

19. A brushing tool comprising a support and straight hard wire brush bristles having a Knoop hardness of at least 600 secured thereto and extending therefrom, said individual bristles having small enlarged portions in the form of adherent plastic beads at spaced intervals along said wires.

20. A brushing tool comprising a support and Tampico fiber brush bristles secured thereto and extending therefrom, said individual bristles having small enlarged portions at intervals along their length in the form of adherent plastic beads.

21. A brushing tool comprising a support and glass fiber brush bristles secured thereto and extending therefrom, said individual bristles having small enlarged portions in the form of adherent plastic beads at intervals along their length.

22. A brushing tool comprising a support and plastic brush bristles secured thereto and extending therefrom, said individual bristles having small integral enlarged portions at intervals along their length.

23. Brush bristle material for use in the manufacture of power driven brushes and the like comprising straight steel wire having a Knoop hardness of at least 600 with plastic beads adhered thereto at spaced intervals therealong.

24. Brush bristle material for use in the manufacture of power driven brushes and the like comprising Tampico fiber having plastic beads adhered thereto at spaced intervals therealong.

25. Brush bristle material for use in the manufacture of power driven brushes and the like comprising glass filaments having plastic beads adhered thereto at spaced intervals therealong.

26. Brush bristle material for use in the manufacture of power driven brushes and the like comprising hard straight stiff monofilaments having distinct individual plastic beads adhered thereto at appreciably spaced intervals therealong.

27. The bristle material of claim 26, with the individual bristles having a thin plastic coating in the regions between said beads.

28. A brushing tool comprising a support and brush bristle material extending therefrom, said brush bristle material comprising a mixture of wire bristles and Tampico fiber bristles, with plastic beads adhered to said wire bristles at spaced intervals therealong.

29. The brushing tool of claim 28, wherein said brush bristle material is embedded in a matrix of elastomeric material.

30. A rotary brush comprising a support and straight wire brush bristles extending therefrom, said individual wire bristles being coated with polyurethane having enlarged bead-like portions at spaced intervals therealong.

31. A rotary brush comprising a support and straight wire brush bristles extending therefrom, said individual wire bristles being coated with polyurethane rubber having enlarged bead-like portions at spaced intervals therealong.

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