Dec. 19, 1961 R. C. SASENA 3,013,289

CIRCUMFERENTIALLY WAVED ROTARY BRUSH

Filed March 13, 1958

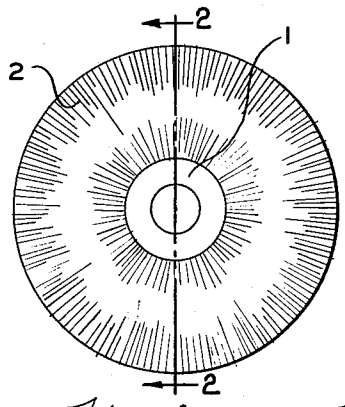


Fig. 1

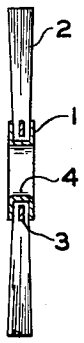


Fig. 2

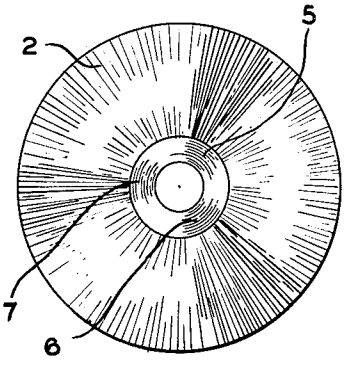


Fig. 3

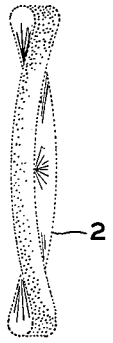


Fig. 4

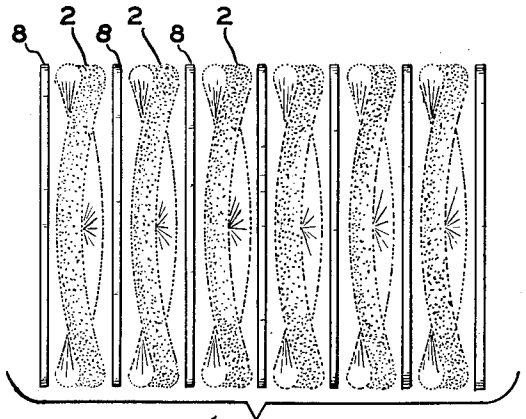


Fig. 5

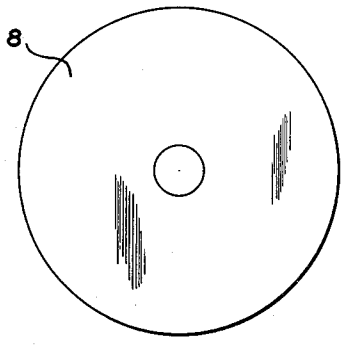


Fig. 6

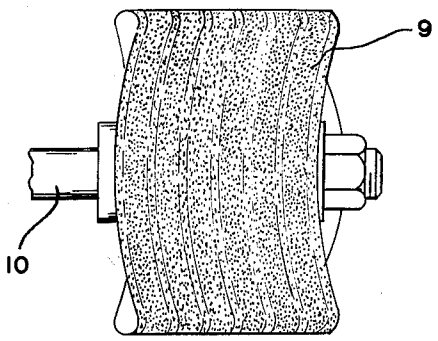


Fig. 7

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CIRCUMFERENTIALLY WAVED ROTARY BRUSH

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8 Claims. (Cl. 15—181)

This invention relates as indicated to a circumferentially waved rotary brush, and more particularly to a unitary cylindrical rotary brush comprising a number of sections secured together preliminary to mounting upon a spindle or the like.

Small cylindrical power driven rotary brushes are widely used in pairs for removal of insulation from the ends of electric wires which are to be employed in the manufacture of a multitude of electronic devices and appliances including radios, television sets, electric motors and the like. Such brushes are ordinarily made up of a number of annular brush sections mounted in close side-by-side alignment upon an appropriate spindle or brush arbor, the usual brushing material being either metal wire or glass fiber. In order to operate efficiently, the cylindrical brush face is ground or otherwise dressed to present a uniform surface, but it is found that the brush face tends soon to become circumferentially grooved, largely due to uneven distribution of the brush bristle material longitudinally of the brush. Such brush material is ordinarily secured within the hub elements of the individual brush sections by means of a retaining ring so that two layers of brush material extend radially outwardly therefrom with a region of less density therebetween. Of course, the hub elements themselves tend to space the brush material of each brush section slightly from that of the adjacent sections, forming additional circumferential regions of reduced bristle density. When a work-piece such as a length of wire from which the insulation is to be stripped is inserted between two such cylindrical rotary brush assemblies, there is obviously a considerable likelihood of both grooving the brush face and of performing a relatively inefficient brushing operation on the work.

The axial assembly of annular brush sections is ordinarily clamped on the spindle by means of end plates or equivalent members, but when one or two adjacent sections are strongly engaged with a narrow work-piece, there may sometimes be a tendency for such sections to turn relatively to the remainder of the brush. It is also rather inconvenient to handle a number of small individual annular brush sections when replacing a worn brush on the drive spindle.

It is accordingly an important object of my invention to provide a cylindrical rotary brushing tool in the form of a single unit adapted to be mounted upon an appropriate spindle and having a brush face which is highly resistant to circumferential grooving in use.

Another object is to provide such brushing tool comprising a plurality of individual annular rotary brush sections which are both mechanically interlocked and bonded together to form a single unit.

A further object is to provide such brushing tool in which the individual bristles are maintained in properly spaced relationship and resiliently supported for most efficient action on the work.

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 typical annular rotary brush section adapted to be modified in accordance with my invention to produce my new rotary brushing tool;

FIG. 2 is a transverse section taken on the line 2—2 on FIG. 1;

FIG. 3 is an end view similar to FIG. 1 after the annular rotary brush section has been deformed between dies to put three axial waves therein circumferentially of the brush face;

FIG. 4 is an edgewise view of the modified FIG. 3 brush section;

FIG. 5 illustrates semi-diagrammatically the manner in which a number of the FIG. 3 and FIG. 4 brush sections may be axially assembled and nested with discs of plastic interposed therebetween;

FIG. 6 is an end view of one such plastic disc; and

FIG. 7 is a side view of the completed unitary rotary brushing tool formed from the FIG. 5 assembly.

Referring now more particularly to such drawing, the typical annular rotary brush element of FIG. 1 may comprise a central annular back or hub **1** shaped like a grommet and having a channelform cross-section with such channel opening radially outwardly. Brush bristle material **2** such as wire is doubled about a flat retaining ring **3** within such channelform hub and extends radially outwardly from the latter in a generally flat layer. The central opening **4** of such hub is, of course, adapted to be seated upon an appropriate spindle or brush arbor. The annular hub **1** may be of brass, for example.

The brush section of FIGS. 1 and 2 may now be deformed between appropriate dies to produce a plurality of waves or undulations (ordinarily preferably three) in the hub as indicated at **5**, **6** and **7** on FIG. 3 with the layer of brush material **2** consequently conforming thereto in undulations as shown in FIG. 4. A plurality of such deformed annular brush sections are then axially assembled and nested as indicated in FIG. 5, annular discs **8** of elastomeric material being inserted therebetween and applied to the respective ends of the assembly. Such assembly is now axially compressed, enclosed and heated to soften such elastomeric material to flow and intrude the same between the brush bristles and to bond the adjacent annular sections together both in the regions of the hubs and the brush material layers. Upon further heating to cure such elastomeric material, a cylindrical unitary rotary brushing tool **9** is produced which is adapted to be mounted and secured on an arbor or drive spindle **10** as illustrated in FIG. 7.

It will be appreciated that a wide variety of different brush materials may be employed depending upon the particular ultimate use of the tool. Such brush material maybe hard, low damping capacity steel wire, and the elastomeric composition may, for example, be Neoprene (polychloroprene) having a certain amount of a filler such as bentonite incorporated therein together with the usual vulcanizing agents and the like. If desired, other abrasive powders may likewise be incorporated in such material, and it is often preferred to include a blowing agent of well-known type so that the final cured elastomer will be sponge-like as well as tending to erode away at its working face at a greater rate than the brush bristles themselves in use.

By properly selecting the brush bristle material and the elastomeric body, a tool of this type may be provided in which the elastomeric body wears or crumbles away at a slightly more rapid rate than the hard wire or other brush material wears back in use. As the tool wears down in use, the elastomeric body continues to erode continuously progressively to expose short outer end portions

(e.g. about ¼ inch in length) of the bristles so that there is no substantial alteration in the brushing face presented. This is, of course, very different from the case of the usual brushes where, as the bristles wear back in use, their brushing action becomes much modified and altered. When the preferred hard brush material is employed in a resilient plastic composition as taught herein, any fracture thereof due to impact or vibration will occur close to the working ends of the bristles which protrude slightly from the elastomeric body. This serves to keep such ends sharp without reducing the over-all diameter of the tool with undue rapidity. Such hard materials may desirably have a Knoop hardness of at least 600 and in some cases even of 800 or 900. When the latter extremely hard materials are employed, it becomes very important that the bristles protrude only very slightly from the elastomeric body.

A rotary brush revolves at such speeds that each strand is kept vibrating at all times from repeated contact with the work, whether such strands be of the high or low damping capacity type. Low damping capacity material is much less susceptible to self-destruction from this particular cause, however, since it does not do as much work fighting against vibration. Hard brushing materials are therefore desirable not only for their increased cutting capacity but also for the relatively low damping capacity which is generally associated therewith.

In accordance with this invention, brush bristle material may be employed having a Knoop hardness in excess of 600, and preferably in excess of 700 or even 800. Strands of materials such as the following are available having the requisite degree of hardness:

Hard steel wire (severe quench and a minimum draw back)
Glass fiber
Beryllium copper wire
Stainless steel wire
"Z" nickel wire (hard drawn, heat treated, relatively pure nickel)

The last two materials listed have somewhat greater damping capacity than the others. It is interesting to note that an ordinary brush employing stainless steel wire was observed to have about one-third the life expectancy of a brush tool employing the same wire but manufactured in accordance with this invention. The resilient plastic takes over much of the damping function and literally saves the life of the brush material.

It should be appreciated that most wire, including steel wire, as well as most glass fiber commercially available has a degree of hardness substantially below Knoop 600. The techniques are, however, well known for the production of such wire and glass fiber having a hardness of the order specified.

The Knoop hardness of fine metal wire filaments, glass fibers and the like may be determined by means of apparatus known as the "Knoop indenter" which has been developed at the National Bureau of Standards and is now commercially available. The specification for Knoop indenters is set forth in detail in circular letter LC 819 for the National Bureau of Standards, United States Department of Commerce, dated April 1, 1946. The Knoop indenter is also described in U.S. Patent No. 2,091,995, and such indenter meeting the specifications of the National Bureau of Standards is manufactured and sold by Wilson Mechanical Instrument Company, Inc., an associate company of American Chain & Cable Company, Inc., 230 Park Avenue, New York 17, New York.

The relative hardness of different materials may be compared on a Knoop hardness scale in which the Knoop hardness number is expressed by the formula

$$I=\frac{L}{Ap}=\frac{L}{l^2Cp}$$

where:

I=Knoop hardness number
L=Load (in kilograms) applied to indenter
Ap=Unrecovered projected area of indentation (in square mm.)
l=Measured length of long diagonal of the indentation (in mm.)
Cp=Constant relating l to the projected area

In making the Knoop hardness test, it is standard practice to make a number of measurements and to take the average of the results obtained inasmuch as the hardness of some materials tested (e.g. steel) is not entirely uniform throughout. When materials such as steel wire used for brush bristle material are selected of increasing Knoop hardness, they become more and more brittle and susceptible to fracture whereas, as materials of lower Knoop hardness are selected, they become increasingly tough.

The degree of hardness obtainable will, of course, vary with the material employed. Thus, glass fiber is available which is considerably harder than most harder grades of steel wire, and the latter may be had harder than stainless, for example. It is a general characteristic, however, that as hardness incerases so does brittleness and notch sensitivity and the more important becomes the provision of resilient, high damping capacity mateiral in association therewith. With the modified construction shown and described herein, stranded brush materials hava Knoop hardness in the 800 to 900 range have been employed with very great success.

In the case of steel wire, wire having a tensile strength of at least 300,000 p.s.i. attained by tempering (rather than by drawing) will ordinarily be in the upper range of Knoop hardness (and scratch hardness) which places it in the category of especially hard materials which may now be employed with superior results.

The plastic

The plastics employed should ordinarily be able to withstand reasonably high operating temperatures without softening or smearing the work. Examples include:

Rubber (if operating temperatures not too high)
Neoprene (polychloroprene)
Hycar (modified copolymers of butadiene and acrylonitrile)
Nylon (polyamide resins)
Vinyl plastics (vinyl polymers and copolymers)
Melamine resins (melamine-formaldehyde reaction products)

It will be understood that in employing such plastics the same will ordinarily have included therewith suitable fillers as well as the usual vulcanizing agents or the like to produce the resilient plastic composition for the purpose of this invention.

The brush bristles will, of course, reinforce the plastic matrix to some extent and in all cases the plastic material must be strong enough to resist the outward pull of centrifugal force at operating speeds and should not break out in large pieces. It will be sufficiently resilient to prevent permanent deformation in use and should have a relatively high damping capacity. It is furthermore generally desirable that the plastic material be able to withstand a certain amount of contact wih oil and grease.

The metal hub **1** and the metal brush bristle material **2** may desirably be treated with a thin coating of an epoxy resin composition to facilitate bonding of the elastomeric composition **8** thereto.

A preferred elastomeric composition suitable for em-

ployment as the resilient unifying and bristle spacing medium is as follows:

	Percent by wt.
Neoprene GN	51.94
Zinc oxide	2.60
ELC magnesia	2.08
Sodium acetate (retarder)	.26
Unicel N.D. (blowing agent)	1.56
Mapico red (coloring material)	.52
Zeolex (filler)	16.62
Paraffin (lubricant)	.52
Circo Lite Foil (plasticizer)	23.38
Thermoflex A (anti-oxidant)	.52
	100.00

The molding, blowing and curing operation may desirably be performed in the manner described in application Serial No. 686,499 of Ruben O. Peterson, filed September 26, 1957, for "Composite Brushing Tool."

It will be seen from the foregoing that I have provided a novel rotary brushing tool adapted to be mounted on an arbor or the like comprising a plurality of axially aligned annular rotary brush elements, these elements being deformed to provide undulating circumferential brush faces nested together and bonded together by resilient elastomeric material interposed therebetween and intruded between the brush bristles.

While the hub **1** will ordinarily be of metal, particularly copper or brass in the smaller sizes of brush, it may also be of appropriate plastic material such as nylon. The brush material **2** may be of any type suitable for the purpose intended, including crimped steel and brass wire, horsehair, tampico fiber, nylon monofilaments and composite filaments having wire or glass fiber cores with outer coatings of protective plastic material such as nylon. The hub **1** should, of course, be of a material adapted to be deformed, molded or set to produce the desired undulations or waves in the layers of brush bristle material.

Since the individual deformed annular brush sections are thus joined together into a unit of any desired predetermined length, the handling of the same is much facilitated when replacing worn brushes on the spindles. The mechanical interlock afforded by nesting the sections together produces a very strong tool without any tendency of one section to turn relative to the other. This advantage is, of course, obtained even when such brush sections are nested and clamped together without the employment of the interposed eleastomeric composition. The employment of such latter composition, however, is ordinarily very much to be preferred. The tendency of the brush to groove in use is very greatly reduced, and it is necessary to dress the brush face only at relatively long intervals. The tool produces a very desirable uniform action on the work.

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 brushing tool adapted to be mounted on an arbor, comprising a plurality of individual axially aligned annular rotary brush elements having brush bristle material extending about a flat ring and secured thereby within a unitary annular channelform hub member, such channel opening radially outwardly to direct said brush material in a generally flat radially extending layer; said brush elements being shaped to provide undulating circumferential brush faces nested together; and resilient elastomeric material betwen adjacent brush elements and between said brush bristles effectively bonding said elements together as a unitary cylindrical brushing tool, thereby constituting a sandwich of alternate interlocked layers of resilient elastomeric material and annular brush elements.

2. The tool of claim 1, wherein said brush material is wire.

3. The tool of claim 1, wherein said elastomeric material is a polychloroprene composition.

4. The tool of claim 1, wherein each brush element is formed with but three such circumferential undulations.

5. The tool of claim 1, wherein said elastomeric material extends substantially to the brush face and is compounded to erode back in use more readily than the working ends of said bristles.

6. A rotary brushing tool comprising a plurality of axially aligned individual annular rotary brush sections each having a layer of brush material exending generally radially outwardly from a central annular hub; said brush sections being shaped to provide axially waved brush faces circumferentially thereof and nested together; and material bonding such individual sections together as a cylindrical unit.

7. The rotary brushing tool of claim 6, wherein said bonding material is a thin intervening layer of an elastomeric material extending substantially to the cylindrical outer brush face and between brush bristles thereof.

8. The rotary brushing tool of claim 6, wherein said hubs and brush material have a coating of a thin layer of an epoxy resin composition and said bonding material is an elastomeric composition bonded thereto.

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