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H. W. BIBLE, JR
METHOD OF MAKING BRUSHES.

2,634,167

Filed July 14, 1949

2 SHEETS—SHEET 1

Fig. 1.

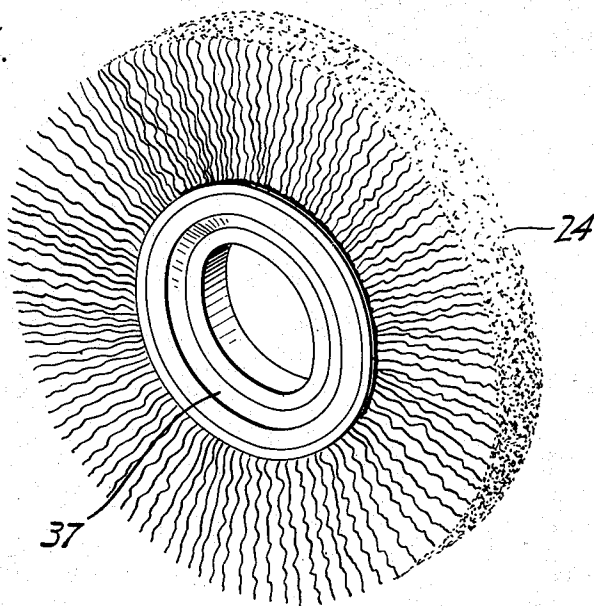
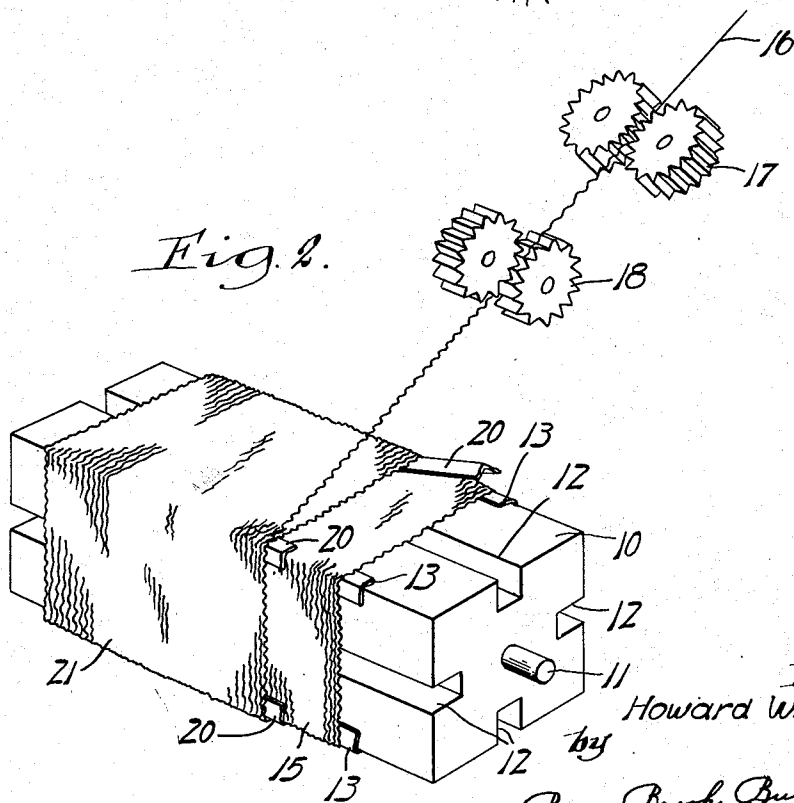


Fig. 2.



Inventor
Howard W. Bible, Jr.

by
Bear, Brooks, Buckley & Bean.
Attorneys

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2 SHEETS—SHEET 2

Fig. 3.

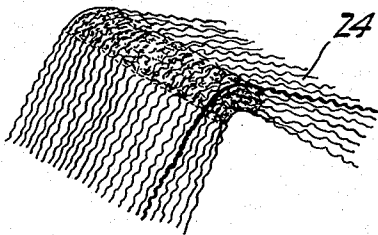


Fig. 4.

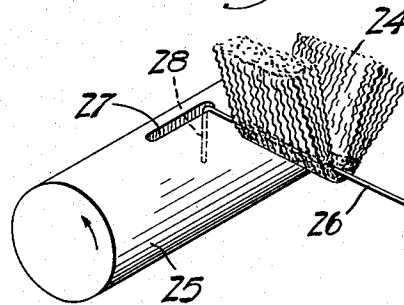


Fig. 5.

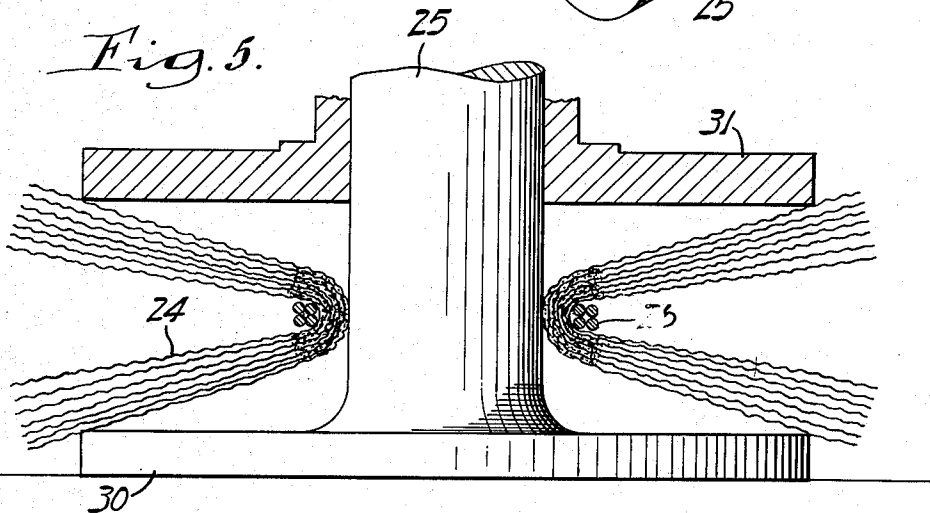
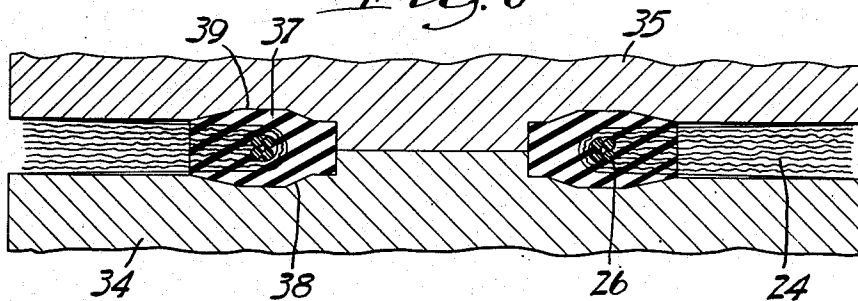


Fig. 6.



Inventor
Howard W. Bible, Jr.
by
Bean, Brooks, Buckleys & Bean.
Attorneys

UNITED STATES PATENT OFFICE

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METHOD OF MAKING BRUSHES

Howard W. Bible, Jr., Buffalo, N. Y., assignor
to Hewitt-Robins Incorporated, Buffalo, N. Y.

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4 Claims. (Cl. 300—21)

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This invention relates to a novel method of making a new brush having metal or similar bristles.

The present invention relates particularly to a brush wherein the bond or connection between the bristles and the carrier or support for the bristles is unique and, further, to a method wherein this bond or connection is brought about in a novel but highly practical and efficient manner. More specifically, the present invention relates to brushes wherein the inner ends of the bristles are embedded in rubber or other material having similar physical properties.

In brushes made according to the present invention the components of the brush are assembled in a novel manner and as a result the physical parts of the ultimate brush bear a novel relationship to each other, the parts being physically interlocked in a manner which gives the ultimate in physical strength and resistance to disintegration. The possibility of bristles becoming loose or disassociated from the brush proper under extreme centrifugal forces or other potentially damaging effects is, for all practical purposes, eliminated.

As a broad generality the idea of employing rubber or similar material for setting brush bristles in a holder is not new. While reference is had herein to metal bristles and binding wires, by way of example, the principles of the present invention, insofar as they are applicable, may be employed in brushes having non-metallic bristles, such for example as nylon and fibre glass, and the binding means may likewise be non-metallic. Certain of the advantages of brush bristles set in rubber have previously been recognized but fell short of full attainment because of other practical objections and disadvantages. Other objects and advantages are novel to brushes constructed according to the present invention.

In one practical embodiment of the present invention a circular rotary brush having wire bristles is adapted to perform a wide variety of operations in the industrial arts such as cleaning and polishing and other abrasive functions. In many such uses the brushes are rotated at high speeds where the centrifugal forces tending to throw off the bristles and generally disintegrate the brush structure are very high. In the brush construction of the present invention there is virtually no possibility of the bristles becoming loose or dislodged.

Prior brushes intended generally to have bristles and binding wires or similar anchoring

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means set in rubber or the like have invariably contained voids in greater or lesser degree, particularly at the root portions of the bristles where they are bunched together most intimately, with a resultant reduction in strength, efficiency, length of life and safety. In the brush of the present invention the root portions of the bristles and the binding wire or similar means are fully enveloped in rubber with no voids, even where groups of individual bristles lie in close bunches.

Further, in the prior art the manner in which the bristles are associated with binding wires or the like at the roots of the bristles has been such that the bristles, when they are flexed in normal use of a brush, are repeatedly stressed at a localized point where they are connected to the binding wire. As a result, fatigue, failure of the bristles due to this concentrated, localized flexure is frequent.

The accompanying drawings and the ensuing detailed description set forth, by way of example, one form of the brush of the present invention and the detailed steps of a method for manufacturing the same. However, it is to be understood that the specific brush and method are set forth for illustrative reasons and that the principles of the present invention are not limited thereto, or otherwise than as in the appended claims.

The drawings herein illustrate a brush having radial bristles, but it is to be understood that the principles of the present invention apply equally in the construction of a brush wherein the bristles lie in an axial direction to form a so-called cup-shaped brush. Also, the bristles may be arranged in a helical row or they may extend in a straight line, for attachment to the periphery of a supporting cylinder or otherwise. In other words, the present invention is concerned with the manner in which groups of bristles are anchored or assembled at their root portions and the arrangement of the brush in the vicinity of such root portions, regardless of the general shape or style of the brush.

In the drawings:

Fig. 1 is a general perspective view of one form of the brush of the present invention;

Fig. 2 is a fragmentary perspective view illustrating, somewhat schematically, a step in one method of producing the brush of the present invention;

Fig. 3 is a fragmentary perspective view of a group of bristles partly fabricated into a brush assembly;

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Fig. 4 is a fragmentary perspective view illustrating a further step in the brush forming method;

Fig. 5 is a cross-sectional view of means for effecting a further step in the method of forming the brush of Fig. 1; and

Fig. 6 is a cross-sectional view showing apparatus for finally molding the hub of the brush illustrated in Fig. 1.

Like characters of reference denote like parts throughout the several figures of the drawing. Various specific methods may be employed in assembling groups of bristles for fabrication into a complete brush. The essential characteristic of the preferred method is that alternate layers of wire bristles and gum strips are assembled in such a way that the intervening gum strips are located at points which will ultimately be the base of the bristles, and each gum strip may readily be subsequently pressed into intimate engagement with the individual bristles of the rows lying at each side of such gum strip. A gum strip is interposed between each individual layer of bristles to form a homogeneous solid portion at the base of the bristles with each individual bristle completely surrounded by rubber, save where such bristle may lie directly against another bristle, and with substantially no voids in such base region.

By way of example, Fig. 2 illustrates a mandrel 10 which is mounted for rotation about its longitudinal axis in any desired manner, a journal 11 for so mounting the mandrel being illustrated in Fig. 2. Mandrel 10 is substantially square in cross-section and has longitudinal grooves 12 extending along the mid-portions of each of its sides.

The gum strips referred to above are, in the specific embodiment here being described, strips of unvulcanized rubber which are somewhat tacky and adhesive. In beginning to fabricate a brush or group of brush bristles, a gum strip 13 is laid along each longitudinal edge of mandrel 10 as shown in Fig. 2. A continuous helical layer of wire is then wound upon the mandrel as at 15, the mandrel being rotated in any desired manner to effect such winding, and wire being fed therefrom any desired supply, the wire being designated 16 in Fig. 2.

Also, as shown in Fig. 2, two pairs of crimping rolls 17 and 18 are arranged to engage the wire in its passage to mandrel 10. Each pair of crimping rolls has parallel axes for intermeshing engagement and the axes of the two pairs of rolls are at right angles to each other so that the wire is given a generally helical crimp formation prior to its arrival at mandrel 10. While crimped bristles are generally desirable in the case of metallic bristles, it is to be understood that crimping is not necessary in the case of certain bristle materials and in the case of brushes having other special qualities and specifications.

After a complete layer of bristles has been wound, as at 15, four more gum strips are applied along the edges of mandrel 10 as at 20, the strips 20 overlying the layer of bristles 15. Following this, a second layer of bristles is wound helically upon mandrel 10 as at 21 in like manner and in each case the tension of wire 16 as it is being wound upon mandrel 10 may be maintained at such degree that the individual windings of wire upon the mandrel will embed themselves into the underlying gum strips at the corners of the mandrel to a sufficient degree. The number of successive layers of wire as at 15 and

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21 will vary according to the size and general design of the brush to be fabricated.

When the desired number of layers of wire bristles and intervening gum strips have been wound, a parting tool is passed through each of the grooves 12 to separate the wound assembly into four groups of assembly bristles, each of which generally resembles the preliminary assembly illustrated in perspective in Fig. 3. This parting tool may be in the form of a grinding wheel having a relatively narrow or acute-angled peripheral edge, known as an abrasive cut-off wheel, or any other mechanical shearing device may be employed as may be found suitable and expedient. The adhesion between the bristles and the gum strips as effected in the winding operation is sufficient to render each individual sub-assembly, as illustrated in Fig. 3 and designated 24, self-sustaining for further fabricating.

A further description of the method of fabricating one form of the brush of the present invention contemplates the formation of a brush having radial bristles. Fig. 4 indicates schematically an arbor or mandrel 25 for assembling the group of bristles designated 24 with one or more binding wires, one of which is illustrated in Fig. 4 at 26, and for winding the assembled bristles and binding wires into annular form with the bristles extending generally radially outwardly. The angle which the bristles make in Fig. 4 is fairly acute. However, the nature of the bristle material may be such that, when they are cut from the mandrel, they spread and form a more obtuse angle. In such instances, it will be desirable to make the bristle angle more acute before proceeding to wind the bristle assembly into circular form. This may be done by further bending the bristle assembly in an ordinary bending brake such as is well-known in the sheet metal art. One end of binding wire 26 may be bent laterally and inserted radially into a slot 27 in arbor 25 as at 28 and the bristle assembly 24 placed beneath the binding wire 26 so that, when both are subsequently wound upon arbor 25 by rotating the latter, binding wire 26 will be placed firmly into the apex of the angle formed by the bristle assembly 24. It is to be understood that only a part of the length of bristle assembly 24 is illustrated in Fig. 4.

The length of the bristle assembly 24 is such that one complete rotation of arbor 25 will wind the bristle assembly 24 into circular form and result in its ends substantially meeting at slot 27 with one circular turn of binding wire binding the circular bristle assembly about arbor 25. The rotation of arbor 25 may then be continued to lay or wind additional continuous turns of the binding wire 26 which will vary in number according to the design of the brush. In the specific form illustrated in Figs. 5 and 6 four continuous turns of the binding wire 26 are illustrated. It may, in certain instances, be desirable to place an additional gum strip in the apex of the angle of assembly 24 prior to laying the binding wire 26 therein.

After the desired number of turns of binding wire are wound on mandrel 25 the trailing end of the binding wire is severed and the end 28 of the binding wire is swung out of slot 27. The two ends of the binding wire are then twisted about each other and the thus twisted ends are bent downwardly into the apex of the bristle assembly to lie along the circularly extending turns of binding wire. If sufficient turns of binding wire are present, the ends need not be twisted together

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or otherwise directly secured. The friction of adjacent bunched turns will be sufficient to prevent any tendency of the binding wires to unwind by intersliding of adjacent turns of wire in a direction lengthwise of such wires.

The next step is to press the circular bristle and binding wire assembly from its opposite radial sides to close the angle which the bristles assume in Figs. 3 and 4 and to so compress the base of the bristles and the binding wires that the gum from the bristle assemblies is pressed intimately about and between the binding wires and is further intimately pressed about the individual bristles of the assembly. In actual practice this may be accomplished without removing the bristle and binding wire assembly from arbor 25, and in Fig. 5 the arbor 25 is shown as comprising the central guiding spindle of this pressing apparatus.

The arbor 25 is shown generally horizontal in Fig. 4 and vertical in Fig. 5, but the apparatus may be arranged in either way without affecting the principles of the present invention. Arbor 25 may have a fixed end or bottom plate 30, and a movable pressing plate 31 is slidably disposed upon arbor 25. As illustrated in Fig. 5, pressing movement of plate 31 toward plate 30 by hydraulic pressure, mechanical pressure, or in any desired manner, produces the required compacting of the gum at the base of the bristles and causes the individual bristles to extend radially outwardly in compact form.

The nature of the cut-off operation which separates the assembled bristles from mandrel 10 is such that subsequent trimming of the outer ends of the bristles is desirable. This may be accomplished after the plates 30 and 31 have pressed and compacted the bristles and the rubber at their roots and with the brush still held firmly between the plates. As shown in Fig. 5 the plates 30 and 31 are just slightly smaller than the desired finished outside diameter of the brush so that an abrasive cut-off wheel can be located just outside of plates 30 and 31, the latter being rotated to present the excess bristles shown in Fig. 5 to the wheel for trimming the periphery of the brush to size. Referring to Fig. 5, the cut-off wheel would be located with its horizontal center line coincident with the central horizontal plane of the brush.

After the bristles and binding wires are thus brought substantially to the final relative positions they assume in the finished brush, the entire assembly is placed in a mold element 34 and a complementary mold element 35 is placed thereover. Additional unvulcanized rubber is introduced to form a complete hub 37 of the ultimate brush. This additional rubber may be introduced in various ways. In one practical embodiment, a relatively flat rubber annulus is first laid in the annular cavity 38 of mold 34. The binding wire and bristle assembly is then placed upon this rubber annulus and a second smaller rubber annulus is placed concentrically within the bristle assembly. A third rubber annulus like the first one is then placed concentrically upon the bristle and binding wire assembly, the several rubber annuluses being subsequently pressed, together with the rubber already in association with the root portions of the bristles, into the desired form as defined by the annular cavity 39 of upper mold element 35 and the cavity 38 of mold 34 by bringing the two mold elements forcibly together. The complete assembly may then be vulcanized to form a unitary brush with the

hub comprising a hollow resilient annulus in intimate contact with all of the turns of the binding wire and with the individual bristles from their base at the binding wire to a point radially outwardly, which is approximately equivalent to the outer diameter of the flanges of hub 37. This vulcanization may be effected either in the mold 34, 35 or in any other desired manner.

It may be desired to use a different rubber batch composition for the smaller of the three rubber annuluses than for the two which form the flanges of the hub so that a harder rubber inner hub portion is provided, the flanges being relatively more resilient and flexible.

Numerous variations in the mode of winding the bristle wires or strands may be employed without departing from the principles of the present invention. For instance, while a single wire 16 is shown in Fig. 2, several wires or strands may be wound or laid simultaneously, either side by side through the same crimping rolls or independently at spaced points along a mandrel. In fact, both these methods of multiple winding may be employed simultaneously.

While the foregoing description specifies the application of gum strips between each layer of bristle wires or strands, there is no necessity for the above specified number of gum strips in all instances. Several layers of bristles may be wound upon a single set of underlying gum strips because the gum will ooze between the wires of successive layers and additional gum strips need be applied along the edges of mandrel 10 only when such oozing has reached its limit. This will vary depending on the diameter of the bristle wire, the degree of tension with which it is wound, the character and thickness of the gum strips, and other factors.

After the initial gum strips 13 are applied to mandrel 10, additional latex or unvulcanized rubber may be applied to the surfaces of the wires at the edges of mandrel 10 in liquid or semi-liquid form as by brushing, instead of using additional gum strips. Brushing means may be so located as to be automatically engaged by the wires at the edges of mandrel 10 as the latter rotates in winding the bristles.

It will be observed that the ultimate brush of the present invention is characterized by the fact that the bristle density is absolutely uniform throughout with each individual bristle extending in a true radial direction. In brushes of the prior art the bristles are generally arranged in a series of tufts or bunches so that the bristles of one tuft or bunch must extend over or meet with the bristles of the next tuft or bunch. As a result, the bristle density is generally lower, or at least different, midway between individual tufts or bunches than at the center of individual tufts or bunches. Also, it is generally necessary for certain of the bristles to depart from true radial or perpendicular extent in order to secure some semblance of uniform bristle distribution at the extremities of the bristles. No such deviation or compromise from the ideal theoretical arrangement is required in the brush of the present invention.

While reference is had herein specifically to the use of rubber as a component of the brush and in pursuance of the method of the present invention, it is to be understood that the spirit of the invention embraces any substitute or equivalent materials, either natural or synthetic and that other thermo-setting materials, or ma-

terial that may be cured or advanced by heat, may be employed.

What is claimed is:

1. The method of making a brush element which comprises disposing a strip of settable adhesive material along the surface of a holder, winding a continuous, helical bristle-forming strand about said holder substantially at right angles to said strip of material whereby the several turns of said strand become embedded locally in said strip, severing the wound strands parallel to the line of extent of said strip to provide multiple bristle portions extending perpendicularly from said strip, and flattening the assembly thus produced in return bent form to cause bristle portions extending from the opposite sides of said strip to lie in juxtaposition and provide a uniform and unitary bristle assembly.

2. The method of making a brush element which comprises disposing a strip of settable adhesive material along the surface of a holder, winding a continuous, helical bristle-forming strand about said holder substantially at right angles to said strip of material whereby the several turns of said strand become embedded locally in said strip, winding additional layers of strand over the strand thus wound and intermittently applying any necessity additional adhesive material between the layers of strands to insure complete embedding of all turns of strand along the area defined by said adhesive strip, severing the wound strands parallel to the line of extent of said strip to provide multiple bristle portions extending perpendicularly from said strip, and flattening the assembly thus produced to cause bristles extending from the opposite sides of said strip to lie in juxtaposition to form a uniform and unitary bristle assembly.

3. The method of making brush elements which comprises disposing strips of settable adhesive material along parallel lines equally spaced about the surface of a holder, winding a continuous, helical bristle-forming strand about said holder substantially at right angles to said strips of material whereby the several turns of

said strand become embedded locally in said strips, severing the wound strands along lines parallel to the line of extent of said strips and midway between each pair of strips to provide a number of brush elements equal to the number of strips initially provided about the holder, each brush element comprising multiple bristle portions extending perpendicularly from its associated strip, and flattening the assemblies thus produced in return bent form to cause bristle portions extending from the opposite sides of said strip to lie in juxtaposition to form uniform and unitary bristle assemblies.

4. The method of making a brush element which comprises disposing a strip of settable adhesive material along the surface of a holder, winding a continuous, helical bristle-forming strand about said holder substantially at right angles to said strip of material whereby the several turns of said strand become embedded in said strip, severing the wound strands parallel to the line of extent of said strip to provide multiple bristle portions extending perpendicularly from said strip in angularly disposed rows, placing binding wire means in the apex of such angle, flattening the assembly thus produced in return bent form to securely press adhesive material into contact with said binding wire means and to cause bristles extending from the opposite sides of said strip to lie in juxtaposition to form a uniform and unitary bristle assembly.

HOWARD W. BIBLE, JR.

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