March 8, 1955 R. O. PETERSON 2,703,472

BRUSH AND BRUSH MATERIAL

Original Filed Sept. 6, 1952 2 Sheets-Sheet 1

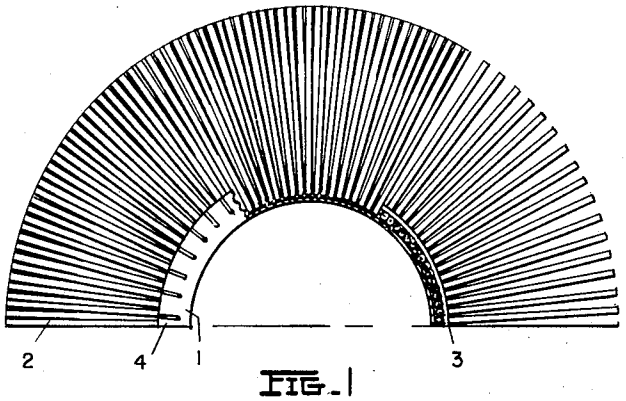


FIG. 1

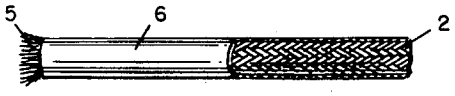


FIG. 2



FIG. 3

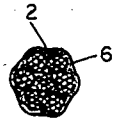


FIG. 4

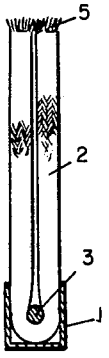


FIG. 5

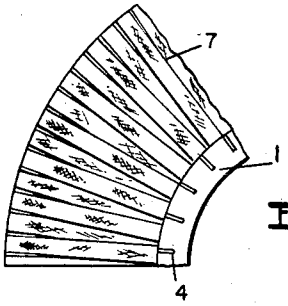


FIG. 6

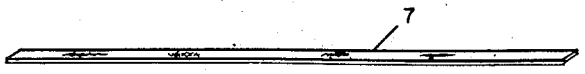


FIG. 7

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BRUSH AND BRUSH MATERIAL

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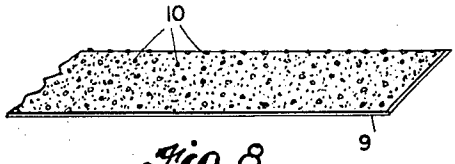


Fig. 8

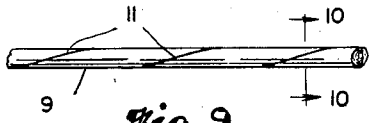


Fig. 9

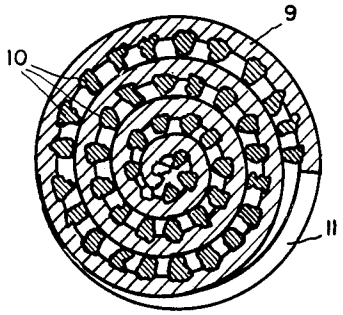


Fig. 10

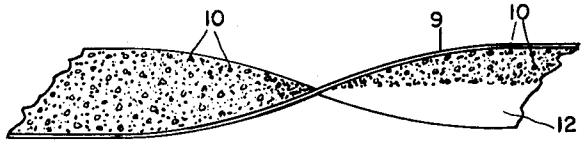


Fig. 11

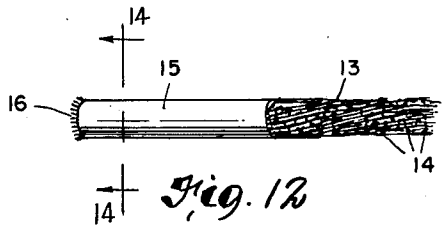


Fig. 12

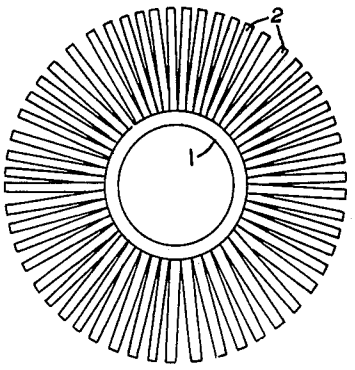


Fig. 13



Fig. 14

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2,703,472

BRUSH AND BRUSH MATERIAL

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Original application September 6, 1952, Serial No. 308,243. Divided and this application March 16, 1954, Serial No. 416,475

11 Claims. (Cl. 51—193)

This invention relates as indicated to brushes and brush material, and more particularly to brush material designed for very hard usage.

Brushes, and especially rotary brushes, have long been employed to apply abrasive, polishing, and buffing materials to clean, smooth, polish and refine the finish of metallic surfaces and the like. Cotton fabric buffing wheels and Tampico fibre brushes, for example, are commonly employed for this purpose but are not satisfactory for all the various types of jobs which might very satisfactorily be done by methods employing such tools. For some purposes they not only wear more rapidly in use than is desirable but also waste an unnecessarily large proportion of the abrasive material supplied to them. There is a tendency for these tools to generate a great amount of heat when doing work with resultant "burning" of the fibrous material. With an excessively small area at the working end or edge of the fabric or fiber, the abrasive particles may not be properly applied to the work-piece. The resultant uneven application of the abrasive causes work to be done at an uneven rate. An excessive amount of lint may be cast off by the ordinary fabric buff or string brush to become a fire hazard. Other causes tending to shorten the lives and reduce the effectiveness of such brushes include the indefinite, irregular and sometimes limp character of natural individual brush fibers.

It is, therefore, a primary object of this invention to provide brushes and brushing material which will be improved in effectiveness in cleaning, scouring, polishing and refining the finish of metallic surfaces and the like and which will also have a greatly increased useful life.

A further object is to provide such material and brushes comprising the same which will be resistant to the action of acids and/or alkalis.

Still another object is to provide brushing material which will carry and apply abrasive or polishing materials in a manner to achieve improved working relationship with the work-piece and with a minimum of waste.

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 a side elevational view, partly cut away, of a rotary brush section employing brush material in accordance with my invention;

Fig. 2 is an enlarged view of one type of material treated in accordance with my invention;

Fig. 3 is a view of similar material illustrating one manner in which the same may be rendered acid- and alkali-proof;

Fig. 4 is a sectional view of the material of Fig. 2;

Fig. 5 is a sectional view taken through a rotary brush section as illustrated in Fig. 1;

Fig. 6 is a fragmentary view of a brush section illustrating an embodiment employing an alternative form of brushing material;

Fig. 7 is a view of the braided strip or tape employed as brushing material in the brush of Fig. 6;

Fig. 8 shows a sheet of plastic in which abrasive is embedded from which stranded brush material may be produced in accordance with my invention;

Fig. 9 shows a brush strand produced from the sheet of Fig. 8;

Fig. 10 is an enlarged sectional view taken on the line 10—10 on Fig. 9;

Fig. 11 shows a strip of sheet material such as paper or fabric to which abrasive particles have been adhered except for a portion of one side, and from which stranded brush material may be produced;

Fig. 12 is a fragmentary view of a composite strand of brush material comprising a porous inner core of fine filaments and an outer sheath;

Fig. 13 is a side view, on a reduced scale, of the entire brush of which a portion is shown in Fig. 1; and

Fig. 14 is a transverse cross-section taken on the line 14—14 on Fig. 12.

In one embodiment of my invention I employ a braid of tightly twisted strands such as braided tire cord or "cable-cord" since the tightly twisted strands do not unravel in use with nearly the rapidity of loosely twisted strands, and the braiding introduces a porous internal structure, and also, when braided and treated as explained below, are relatively stiff enabling the brush to retain its form much better than when limper sorts of cordage and the like are employed. Referring now more particularly to the drawing, a brush formed in accordance with this invention may comprise a circularized channel-form brush back 1 in which brushing material 2 is held by a retaining member such as wire 3. It will, of course, be understood that the material of this invention may be employed in other than annular or helical brush backs although it is primarily in the field of rotary brushes that there is the greatest need for the novel qualities of such material. The brush back may desirably be indented as at 4 to prevent displacement and packing of the brushing material. The brush material may likewise be retained in a brush back of the type described in my Patent No. 2,303,386 dated December 1, 1942. Brushes similar to those described in my prior Patents Nos. 2,409,309; 2,345,422; 2,320,384; 2,316,185, and Whittle Patent No. 2,288,337 are especially adaptable for use with the brush material herein specified.

A further advantage of the braided material resides in its tendency to form excellent abrasive carrying open tufts 5 of considerable end area making an ideal working surface to the finished brush. This is particularly striking when compared to Tampico fiber brushes now generally employed which permit powdered abrasive to filter down between the fibers in addition to dropping a good deal of of it, rather than holding it in working position. It has been found possible to remove marks from steel surfaces by employing brushes made in accordance with my invention and to do this with improved economy and satisfaction.

The material of this invention may also be stiffened by impregnating with a hardening and stiffening agent such as glue 6 (see Figs. 2 and 4) which will desirably be set and toughened by subsequent treatment with an agent such as formaldehyde and, optionally, a solution of sodium silicate (water glass). Such agent penetrates between and thoroughly wets the fibers in addition to coating the surface of the cord or like material. The resultant product is hard and tough, relatively waterproof, and is capable of considerable abrasive action of its own. Such abrasive action may be further enhanced by applying an abrasive substance such as powderous alumina, emery dust or the like prior to the hardening step and preferably prior to or at the same time that the glue is applied. A superficial coating of the brush material with a soft material, as with rubber, is ineffective for this purpose, it being necessary to employ a stiffening agent and one which will penetrate between and wet the fibers as do glue base materials. For this reason it is often desirable that a wetting agent be present if an aqueous solution of glue be employed as a stiffening agent. The above treatment not only produces a hard tough brush material but also aids in preventing unraveling of the strands. Instead of braided cord of the generally circular form illustrated in Figs. 1 to 5 inclusive, flat braided strips 7 of fabric, as shown in Fig. 5, may be treated in a similar manner and employed as

shown in Fig. 6. The term "cord" as employed herein and in the claims is to be understood as including both such forms of brush material. Other embodiments of the invention are obvious to those skilled in the art. When the fabric is to be impregnated with the stiffening agent, it is generally not necessary to employ tightly braided material and a relatively soft braid is entirely satisfactory and sometimes preferable.

The material of this invention may be further treated, if desired, to render the same water-, acid- and alkali-proof. This may be done by coating the cord or other material with a thin film of certain synthetic plastics, such as "Pliofilm". One method of thus coating braided tire cord, for example, is illustrated in Fig. 3 where a narrow strip 8 of "Pliofilm" is wrapped in slightly overlapping spirals about the cord. Heat and pressure are then applied to weld the strip into a continuous impervious coating. Obviously, this treatment may be applied to the tightly braided cord or the soft-braided but impregnated cord, etc., as desired.

Another way would be to extrude over the surface a thin coating of plastic material such as nylon. If the nylon is applied in molten condition, as is preferred, it will be of relatively low viscosity and may be flowed on with relatively low pressures although delivered to the cord by extrusion methods.

In each of the above-described forms of my improved stranded brush material it will be noted that the individual strands comprise smaller strands or fibers assembled in general criss-cross relation, specifically to form a braided cord in contradistinction to twisted and other types of cord in which the fibers are arranged in general parallel relation. As is well known, the latter types of cord are structurally the stronger since the slippage between the individual fibers permits an adjustment to allow the aggregate strength of the fibers to resist a given stress. However, what has not been heretofore recognized in attempting to use such cord as brush material where the component strands are subjected to severe flexing as well as terminal and side wearing action when in use, is that when the cord is treated with a material of low limit resilience such as a plasticized glue compound, this adjustability is reduced or eliminated. In other words, the impregnated and stiffened cord is only as strong as the impregnating material plus the strength of the few fibers that happen to be in a position to function when a stress is applied. The foregoing explanation, it is believed, accounts for the fact that cords treated in the manner described are weaker than the untreated cord, unless the latter be held under tension while being treated. It is for this reason that for some uses it has been found desirable to hold the cord under tension while being treated with a binding material so as to add the strength of the latter to that of the aggregate strength of the fibers (cf. Patent No. 2,220,958 to Jennings).

In contradistinction to the foregoing, the present invention is based on the discovery that increased tensile strength is not a chief requisite in brush material made from cord, but that it is very important that such material be capable of withstanding the wear, and particularly the beating and flexing, that it will encounter when made into a brush. Actually such cord will stand up better if the outer fibers composing the same are not under tension but somewhat loosely looped so that flexing will not over-strain them. For this reason, a braided cord, for example, while not a good construction for attaining maximum tensile strength, has been found highly satisfactory for the purpose in hand, in that it has an open porous structure, is very well suited to withstand flexing after the described treatment and has greater non-raveling characteristics than a twisted cord. Furthermore, since the component strands or fibers of such braided cord lie at angles to each other, i. e. in general criss-cross relation, rather than in general parallel relation, the cord is provided with uniformly distributed pocket-like interstices which receive and retain an adequate amount of the treating material. Moreover, where the latter contains a finely ground abrasive, the latter will be retained in such interstices despite absorption by the fibers of the cord of a portion of the treating agent which serves as the vehicle for introducing such abrasive.

The ideal abrasive-carrying brush material requires to have several rather conflicting characteristics which have in the past prevented any really satisfactory solution. The abrasive should be incorporated into the brush material instead of being fed thereto since such latter method is messy and wasteful, and does not provide a uniform concentration of abrasive at the work-piece. Loose abrasive particles between the strands of the brush material and abrasive which is superficially exposed on the lateral surfaces contribute to the generation of excessive heat and useless wearing of such strands. On the other hand, if the abrasive particles are to have an efficient cutting action they should not ordinarily be entirely embedded or submerged in a solid supporting medium or matrix. A continuous non-porous abrasive-containing strand such as might be made in accordance with the teachings of Radford Patent No. 2,328,998, for example, does not leave the edges and points of the abrasive particles free to act. The more loosely bound porous structure here contemplated can release contained abrasive particles in a way to give their points and edges freedom to cut, scratch or otherwise perform their function. Moreover, the open short fiber tuft which forms in use at the end of the material of this invention can receive and make effective the abrasive grains of externally applied abrasive compound.

I have successfully solved this problem, as shown by actual tests, by providing stranded brush material having a relatively smooth exterior surface but with abrasive contained internally thereof. As the ends of the strands wear down additional abrasive is exposed in position to contact the work but there is little friction between the strands themselves as they are flexed, greatly reducing heat generation and resulting tendency to self-destruction. It will be seen, therefore, that I have produced stranded brush material which has increased abrasive action at its ends but minimized abrasive action along its length.

Referring now more particularly to Figs. 8–11 inclusive, such figures illustrate one embodiment of my invention whereby such result may be achieved. A thin film or strip 9 of a plastic such as Pliofilm (rubber hydrochloride-rubber derivatives and rubber-like resins) or nylon (a polyamide resin) serves as the base in which particles of abrasive 10 may be embedded as by rolling. Or such particles may be cemented in place either by means of an adhesive or by use of a little solvent effective to render the surface of the sheet gummy and which then evaporates. In whatever manner the abrasive particles are embedded or adhered they will in effect be mounted on the surface where they are enabled to exert full cutting action. The strip 9 will then be rolled or twisted as shown in Fig. 9 to form a strand useful as brush material. Obviously this may be carried out as a continuous process employing a long strip of plastic, and the resultant strand cut into desired lengths.

As shown in Fig. 10, the particles of abrasive 10 project into the interstices between the convolutions of the twisted strip where they will be exposed at the ends of the strands for effective cutting acion. The overlapping seams 11 may be heat-treated to weld the same or cemented by treatment with solvent or adhesive, thereby providing a smooth exterior surface affording a minimum of frictional resistance to relative movement of the strands in the rapidly rotating brush.

As shown in Fig. 11, the plastic strip 9, instead of having abrasive particles secured to one side only, may have such particles on both sides except, preferably, for an area 12 which will form the exterior surface of the strand when the strip is rolled as above. In this way it is possible to greatly increase the abrasive content of the finished strand.

Instead of using a strip of plastic, paper, preferably of "super-kraft" strength, may be employed, the abrasive particles being cemented thereto and the strand formed by twisting or rolling. Such strand may be treated to secure the same in twisted condition as by means of adhesive or a wax coating. Various fabrics such as cotton cloth may be similarly employed. Care should be taken that adhesives and the like are of a type which will have little or no tendency to smudge the surface of the work-piece to be brushed, and such smudge as may be produced should be easily removable by ordinary cleaning methods.

It has been found that for many purposes relatively fine filaments or fibers provide a more satisfactory result than fibers of larger diameter. In particular, brush material made up of small filaments of a diameter less than ten one-thousandths of an inch (cotton fibers are about four ten-thousandths) will give a fine surface on metal parts for plating, for example. However, the smaller the composite strands of the brush material the greater is the

total surface area which, by action within a brush may increase the tendency of the brush to generate frictional heat. Also, most very small diameter fibers of practical lengths for brush purposes are not sufficiently stiff to stand up and act individually. I therefore prefer to assemble a body of such small filaments to form a porous composite strand and to encase the same in a sheath which has the advantages above described and additionally substantially reduces relative movement of the individual filaments. A sliver of such fine filaments **13** may be passed through a bath or slurry containing adhesive and abrasive material **14** and then twisted, dried and encased in a sheath **15** of plastic, paper of fabric (see Fig. 12). The tuft **16** of fine filaments formed at the end of the strand provides an excellent polishing and finishing face to the brush. I have found that the heat generated by the interaction of the brushing material may thus be greatly reduced, and in one case found a reduction to about one-eighteenth that developed when the composite filaments were not thus encased and were about two-hundredths the diameter of my new material.

Fibrous material such as American hemp, for example, may be passed through a slurry of abrasive while in sliver-form and then twisted into abrasive-containing strands. Such strands will then be given an outer coating, as of liquid nylon or wax, and are ready to be incorporated into a rotary brush. This surface coating in effect encases the composite strand and minimizes abrasive cutting action between the strands themselves. Chlornaphthalene is an example of a wax-like coating material which is suitable for thus coating the strands of brushes designed for certain uses.

A great advantage of this type of strand is that short (and therefore cheap) fibers may be employed which are not otherwise useful since twisting of the filaments together provides a strand of indefinite length and the sheath of plastic or other coating confines the fibers and prevents loosening thereof with resultant disintegration of the strand. The bonding agent such as glue also assists in securing the fibers together.

In the past, buffing operations have been performed almost entirely by means of buffs composed of woven fabric. Such buffs, however, suffer from several serious disadvantages. Since more than one-half of the threads or fibers of the fabric are non-radially disposed such threads are easily shed and the buff disintegrates and becomes irregular much more rapidly than it actually wears away. The layers of fabric afford a solid face which will not conform to a slightly uneven surface on the work-piece as do the strands of a true brush. It will be seen that my new brushing material will surpass the usual cloth buff in abrasive-holding ability, in the action of the ends of the brushing strands in conforming to the surface of the work-piece, and in providing firmly held fine filaments and abrasive at the brush face where it is needed.

Attempts have been made to use as brush material flat strips of emery cloth held with the flat surfaces in the plane of the shaft when extended as during rotation of a brush, but without much success for obvious reasons. The exposed abrasive tends to cause development of excessive heat and promotes self-destruction of the material. I overcome these problems by forming the strips into strands with at least the major portion of the abrasive internally thereof. Such strands afford greater density of brush material at the brush face and avoid the difficulty of shedding threads which otherwise is so prevalent.

It will be seen that I have provided a new type of brush material and a new brush capable of greatly improved brushing action and a longer and more economical life. Such brushes may be rotated at much greater speeds than ever before without danger of "burning" and with a much increased production of finished work-pieces. At the same time, such material and brushes may themselves be produced in large quantities and at little expense.

Certain fibrous materials such as fiber glass, for example, may themselves be quite abrasive when employed as the core material, with or without the inclusion of granular abrasive particles therewith. The glass fibers will desirably be bonded together at spaced points to leave interstices or pores therebetween to facilitate flexing and enhance the abrasive action. The outer plastic coating of the strand or bristle may be of nylon or other similar material. Particularly when very fine glass fibers are utilized as the core material a dual effect is obtained: the coated strands serve as individual flexible and resilient bristles with good "snap action" when mounted in a brush, and small tufts of glass fibers are formed at the working end of each such bristle which catch minute particles of abrasive (if used) or sweep clean if the brush is employed as a floor cleaning tool, for example.

As explained above and as illustrated in Figs. 12 to 14, for example, I have provided a polishing brush comprising a hub body **1**, flexible fiber strands **2** of absorbent material such as cord secured at their ends in the peripheral surface of the body to extend radially therefrom, and particles of abrasive material **14** absorptively retained in the fiber strands. For many purposes such strands will desirably be encased in flexible outer sheaths in the manner described. Thus, such polishing brush may have bonding material assisting in securing the particles of abrasive material, with a multitude of small open interstices within the strands not completely filled with such particles or bonding material, and smooth flexible outer sheaths encasing said strands to expose the latter and the abrasive particles only at the extreme outer ends of such strands. The abrasive particles are thus retained in interstices of the fibrous structure of the strands while at the same time leaving small voids which serve to enhance the cutting action of the particles on the work.

This application is a division of my co-pending application Serial No. 308,243 filed September 6, 1952, in turn a continuation-in-part of co-pending application Serial No. 760,847 (now Patent No. 2,609,642) filed July 14, 1947, in turn a continuation-in-part of co-pending application Serial No. 427,466 filed January 20, 1942, and abandoned in favor of said Serial No. 760,847.

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 polishing brush of the character stated, comprising a hub body, flexible fiber strands of absorbent material secured at their ends in the peripheral surface of the body to extend radially therefrom, and particles of abrasive material absorptively retained in the fiber strands.

2. A brush in accordance with claim 1, said flexible fiber strands being encased in flexible outer sheaths.

3. A brush in accordance with claim 1, said flexible fiber strands being encased in smooth flexible outer sheaths.

4. A brush in accordance with claim 1, said flexible fiber strands being encased in smooth flexible outer sheaths of synthetic plastic material.

5. A brush in accordance with claim 1, said flexible fiber strands also having a multiple of small open interstices therewithin.

6. A brush in accordance with claim 1, said flexible fiber strands also having a multitude of small open interstices therewithin and being encased in flexible outer sheaths.

7. A brush in accordance with claim 1, said flexible fiber strands also having a multitude of small open interstices therewithin and being encased in smooth flexible outer sheaths.

8. A brush in accordance with claim 1, said flexible fiber strands also having a multitude of small open interstices therewithin and being encased in smooth flexible outer sheaths of synthetic plastic material.

9. A brush in accordance with claim 1, having bonding material assisting in securing said particles of abrasive material, with a multitude of small open interstices within said strands not filled with said particles or bonding material, and smooth flexible outer sheaths encasing said strands to expose the latter and said abrasive particles only at the extreme outer ends of said strands.

10. A rotary brush comprising a hub body and flexible fiber strands extending therefrom, said strands having abrasive particles retained in interstices of the fibrous structure of said strands.

11. A brush in accordance with claim 10, said flexible fiber strands being encased in smooth flexible outer sheaths.

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2,328,998 Radford ---------- Sept. 7, 1943