Oct. 27, 1942. D. G. SMELLIE 2,300,267

SUCTION CLEANER BRUSH

Filed May 16, 1940 3 Sheets-Sheet 1

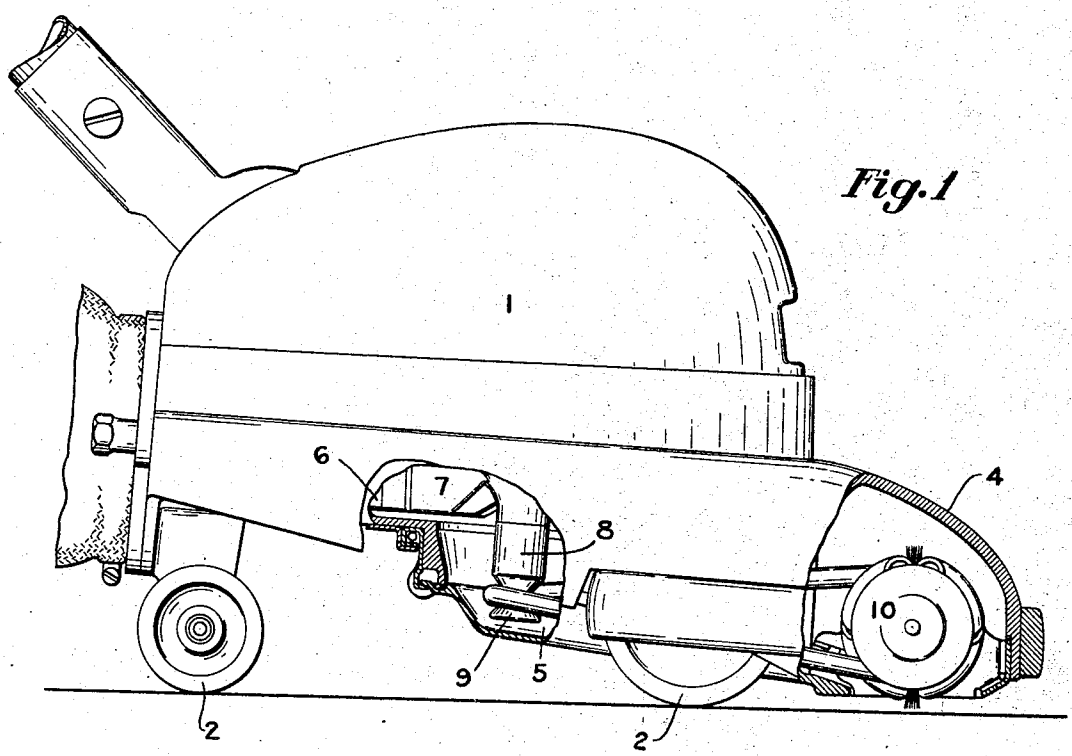


Fig. 1

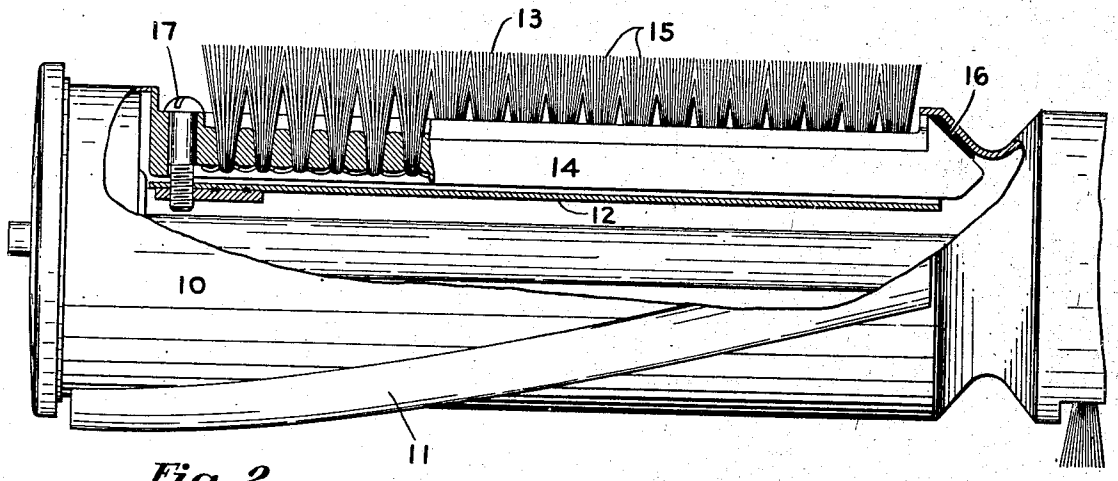


Fig. 2

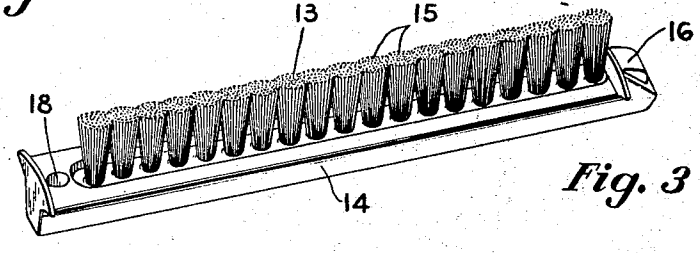


Fig. 3

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SUCTION CLEANER BRUSH

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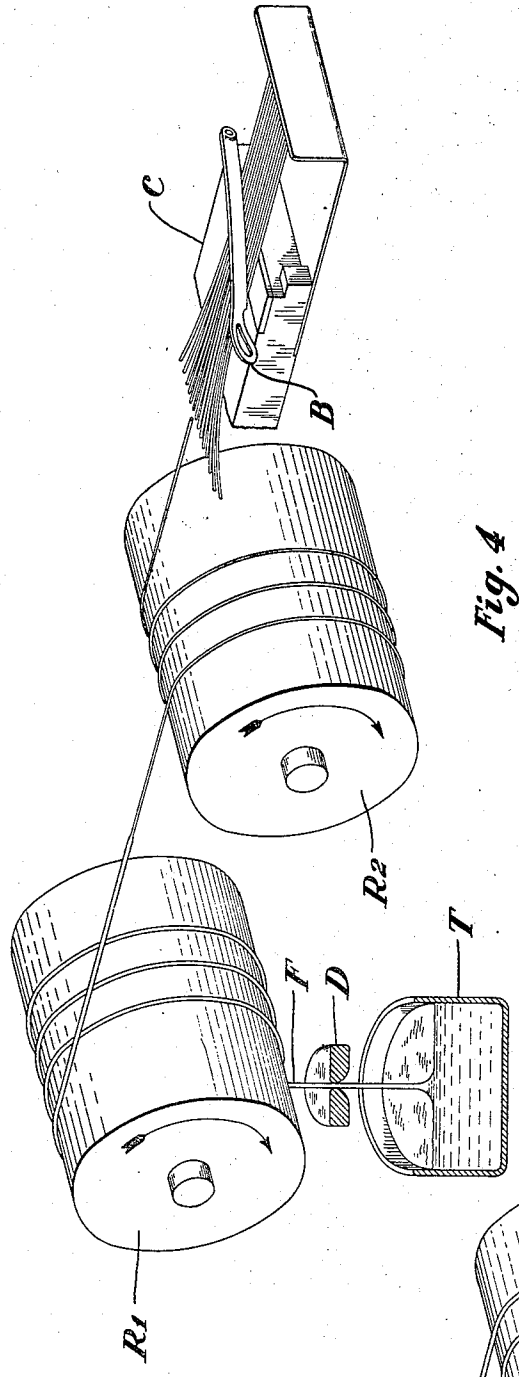


Fig. 4

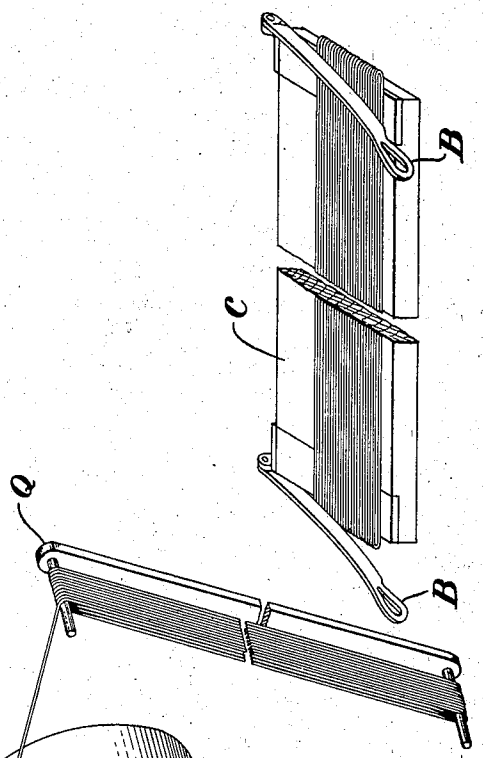


Fig. 5

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SUCTION CLEANER BRUSH

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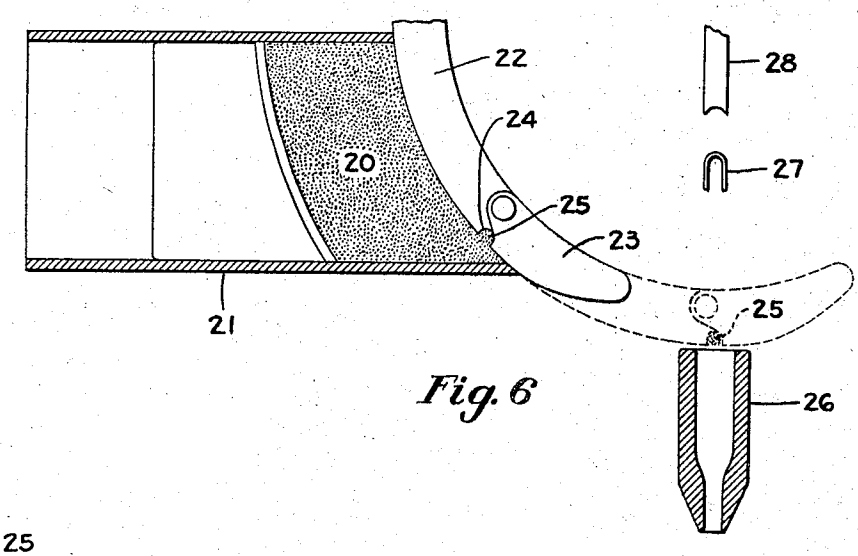


Fig. 6

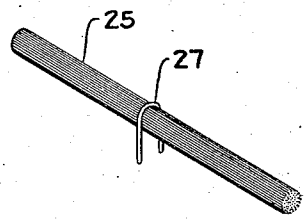


Fig. 7

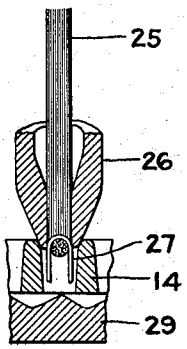


Fig. 8

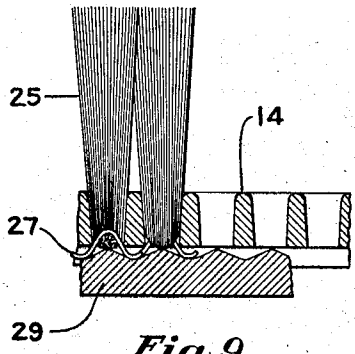


Fig. 9

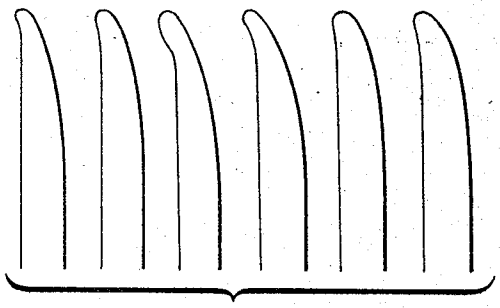


Fig. 10

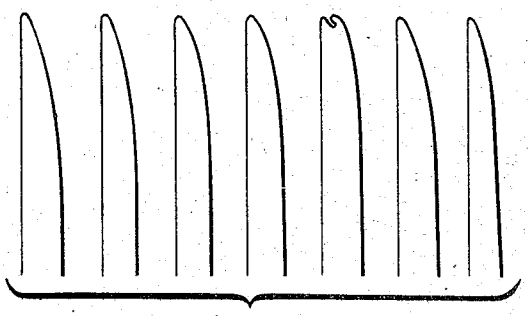


Fig. 11

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UNITED STATES PATENT OFFICE

2,300,267

SUCTION CLEANER BRUSH

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Application May 16, 1940, Serial No. 335,480

3 Claims. (Cl. 300—21)

The present invention relates to suction cleaner agitator brushes, the method of making same, and particularly to certain improvements and modifications in the bristle elements in such suction cleaner brushes.

The modern suction cleaner embodies surface-brushing means and also preferably surface-beating means. The former may be either positively actuated or fixedly mounted to the body of the machine. The present invention is applicable either to the positively actuated or stationary brushing means but is particularly advantageous in the former because of the greater work performed by that type of brush and the attendant severe operating requirements. The usual rotary brush in a suction cleaner is motor driven at high speed in contact with a surface covering undergoing cleaning. The brush, preferably removable, and comprising tufts of bristles secured in the brush back, is rotated at high speed and extends into contact with the surface covering where it performs the function of straightening the pile and also of dislodging the foreign litter therefrom. Heretofore it has been the practice to make use of animal hairs as bristles in brushes of this type and horse hairs have been found to be as satisfactory as most. Animal hairs when so used are found to have certain definite weaknesses and disadvantages. They become worn at a relatively rapid rate thereby requiring frequent replacement. Additionally, during use the bristle ends in contact with the surface covering wear away on the forward side to form sharp, pointed spear-like elements having undesirable covering wearing and tearing characteristics. Such bristles tend to split and break off thereby effecting various lengths. These factors result in variation in the flexibility of the brush tufts and in the performance characteristics. Animal hairs vary in size and diameter and correspondingly in flexibility thereby producing brush elements of uncertain stiffness. They are also objectionable in that they absorb moisture from the air resulting in varying characteristics under changing weather conditions. Finally they vary in curvature and shape in cross section and when sufficiently stiff to brush vigorously a surface covering undergoing cleaning are likely to be characterized by excessive wear upon that covering.

There has been discovered a new synthetic material which will be more fully identified hereinafter and which is free from most of the objections which characterize the animal brush bristles heretofore used. This material is a synthetic organic compound which is not found in nature. It may be manufactured in continuous lengths of a diameter most suitable for agitator brush bristles and which may be cut into lengths suitable for mounting in the brush. A preferred form of the artificial fiber comprises a synthetic linear condensation polyamide. The class is known broadly as polyamides and is now available to the public under the name of Nylon. Tests of agitators embodying brush bristles made of this new synthetic fiber discloses that an increased brush life is obtained, that surface covering wear and the power required to actuate the brush are reduced.

The invention is perhaps best understood by reference to the accompanying drawings in which:

Figure 1 is a side view of a suction cleaner with certain parts broken away and disclosing embodied therein a rotary agitator which includes a brush element constructed in accordance with the present invention;

Figure 2 is a partial view of the rotary agitator with part of the body thereof broken away to illustrate the agitator brush positioned therein;

Figure 3 is a view in perspective of the brush element per se;

Figure 4 is a diagrammatic view of the means employed in the process of making the equal length bristles employed in the present invention;

Figure 5 is a view of an alternative method;

Figure 6 is a diagrammatic view of the bristle-feeding step in the brush-making operation;

Figure 7 is a view in perspective of the unfolded tuft of artificial fibers and the encircling staple;

Figure 8 is a partial longitudinal section through the agitator brush element showing the insertion of the brush tuft and staple into the brush seat in the brush back;

Figure 9 illustrates a plurality of brush tufts secured in position with the staples locked in place in the brush back;

Figure 10 is a diagrammatic showing of a plurality of synthetic organic bristles after being subjected to considerable surface contact and wear;

Figure 11 is a diagrammatic showing of animal bristles such as horse hair after being subjected to a similar amount of wear.

The synthetic material which is used in carrying out the present invention is a member of a class of materials known generally as synthetic organic compounds. A preferred type comprises a synthetic linear condensation polyamide and is completely disclosed and claimed in the patent to Carothers 2,130,948, dated September 20, 1938. The product disclosed in the said patent is also known as Nylon and may, as indicated, be taken as a preferred example of synthetic organic materials which can be made into flexible filaments of smooth, uniform cross section. The filaments must be wear-resisting, non-brittle and in preferred forms show, by characteristic X-ray diffraction patterns, orientation along the filament

axis after being cold-drawn. The ability of the material to be cold-drawn not only permits the orientation of the molecular structure relative to the filament axis to increase fatigue resistance but also functions when the brush is in use to cause the bristle ends to flow into sloping rounded wear-and-friction-reducing contours.

The polyamide known as Nylon which is disclosed and claimed in the Carothers Patent 2,130,948 may also be referred to as a synthetic fiber-forming polymeric amide having a protein-like chemical structure. It is derivable from coal, air and water, or other substances, and is characterized by extreme toughness, flexibility and strength and the peculiar ability to be formed into fibers as well as various other shapes. Reference is made to the Carothers patent for a disclosure of the method of making the polyamide. For the purposes of the present disclosure it is sufficient to say that basically the process comprises the polymerization of amino acids by heat treatment into a molten mass and in the absence of air preferably in an atmosphere of nitrogen. The product can also be described as produced by the mutual reaction of a diamine with either a dicarboxylic acid or an amide-forming derivative of a dibasic carboxylic acid. The molten mass can be extruded into a continuous filament, it being necessary only to catch a thread thereof onto a rotating reel. Filament cross sections vary with the temperature of the mass and the rate of rotation of the reel, an increase in temperature and in the rate of reeling producing a finer filament. Continuous filaments can be extruded through a spinnerette containing orifices, the extruded filaments passing onto a rotating drum. These filaments may be extruded at a speed up to 3,000 feet per minute and may be cold-drawn by transferring from one drum onto a second drum which rotates at a higher rate of speed. This cold-drawing process may be carried out rapidly and without the use of plasticizers.

For use in an agitator brush the synthetic filament is preferably drawn to a diameter of approximately .007 to .010 inch and when so drawn has a uniform smooth cross section. When so made the filament has the desired characteristics for brush bristles and is adapted to be embodied in a suction cleaner brush, as will be hereinafter described.

In the drawings, and in Figures 1, 2 and 3 in particular a suction cleaner embodying a rotary agitator with a brush element is disclosed. In Figure 1 a complete suction cleaner is illustrated and is seen to comprise an ambulatory body 1 carried by wheels 2. Within the body are suitably formed a nozzle 4 which is interiorly connected by a passageway 5 through the fan chamber 6 within which is positioned a suction-creating fan 7. A depending motor shaft 8 formed with a pulley surface 9 at its lower end extends downwardly through the fan chamber 6 where it carries the fan 7. Within the nozzle 4 in a surface contacting position is rotatably mounted an agitator 10 which is seen to comprise a suitable cylindrical body upon the surface of which is positioned a helically extending rigid beater bar 11, and which is formed with a brush element-receiving seat 12 within which is positioned a removable brush element, indicated generally by the reference character 13. Brush 13 comprises an elongated rigid back 14 in which are secured radially extending brush tufts 15. The inner end of the brush back 14 is seen to underlie the brush seat 12 and to be provided with a resilient contact pad 16. At its opposite end a screw 17 extends through an opening 18 in the brush back and is secured at its inner end into the brush seat to clamp the brush element in place. Is it the removable brush element 13, illustrated by itself in Figure 3, with which we are particularly interested in the present invention and more particularly it is the brush bristles which form the tufts 15 of that brush element.

Referring now to Figure 4, in particular, there is disclosed the method of making equal length artificial fibers in accordance with the present invention. Within a tank T is positioned a molten mass of the artificial organic compound. A filament of the compound has been drawn from the body thereof and passes upwardly through the cover of the tank through a sizing die D which gives to the filament the desired initial diameter although this can also be controlled by varying the temperature of the molten mass and the filament speed. The filament of material, which is indicated by the reference character F, is drawn from the tank by a high speed rotating reel R1 and its speed also is a factor determining the initial diameter of the filament drawn from the molten mass. From the reel R1 the filament is drawn onto a second reel R2 which has a peripheral speed which is four times that of reel R1. Obviously the filament is drawn between reel R1 and R2 and its length increased four times. This may be varied with different types of material but in the preferred form in which the synthetic organic compound comprises a polyamide the relationship stated is a preferred one. From the reel R2 the filament passes onto a cutting machine C which is provided with a movable cutter blade B. As illustrated in Figure 4 a plurality of filaments are shown passing onto the cutting machine C. These individual filaments come from a plurality of reels R1 and R2 identical in nature to those described above. Of course the filaments can be cut individually if desired although the desirable factors of speed and time saving make the method indicated a preferable one. The filament F after passing through the cutter to the desired extent is severed by the blade B which may be either automatic or manually operated. The severed bristles of equal length are collected in the cutting machine receptacle and are removed by any suitable means.

In Figure 5 is illustrated a second preferred method of making the equal length fibers for the agitator brush in accordance with the present invention. Instead of drawing the filament from the molten mass of this synthetic organic compound, the compound is extruded under force from a spinnerette or nozzle N, the diameter of the opening in the nozzle determining the initial diameter of the filament. Thereafter the filament passes around the reels R1 and R2 which are identical in structure and function to the reels R1 and R2 of the first embodiment. From the reel R2 the filament passes over and is wound on a rotating flat frame Q. Subsequently the filament is removed from the frame and the resultant skein is cut to length upon a cutter C by means of manual or automatic cutter blades BB, the bent ends of the skein being discarded. In each of the methods the stretching and elongation of the filament between the reels R1 and R2 functions not only to extend it and reduce its diameter but also gives to the filament a fatigue resistance and physical characteristic which is very desirable and not otherwise obtained.

Reference to Figures 6 to 9, inclusive, illustrates the manner in which the bristles formed of the artificial fibers are embodied in the agitator brush element. The continuous filament of the desired diameter, made in accordance with the Carothers patent disclosure and as discussed above, has been cut into suitable lengths. These lengths of filaments or bristles are stacked as at 20 in a suitable hopper 21 past which oscillates a feeder 22. Feeder 22 carries a pivoted clamping element 23 which is so shaped as to clamp in a notch 24, formed in the outer face of the feeder element, a desired number of bristles as the feeder oscillates up and down relative to the hopper. The downward movement of the feeder element 22 carries the selected bristles indicated at 25, from the full line position illustrated in Figure 6 to the dotted line position in which they are centrally positioned immediately above a feeder head 26 and immediately below a staple 27 and a forcing needle 28. With the oscillating feeder so positioned the needle 28 moves downwardly until the brush tuft 25 is encircled and caught by the staple 27, as illustrated in Figure 7. The downward needle movement continues until the staple and the brush have been forced downwardly through the feeder head 26 and into the brush tuft seat formed in the rigid brush back 14. Immediately below the back 14 is positioned an anvil 29 formed with upstanding conical pyramids immediately below the brush seat which are adapted to contact and guide the downwardly extending ends of staple 27 so that upon the continued movement of the needle the staples are deflected laterally into the locking positions, as illustrated in Figure 9. The stapling operation is preferably done one tuft at a time, the brush back being moved relative to the stapling machine to accomplish the successive filling of the individual tuft seats. These seats, as is illustrated in Figures 6 and 7 are preferably smooth and rounded at their upper ends to provide enlarged rounded contacting surfaces for the bristle tufts which will be flexed in use. Upon the stapling of the last tuft in the last tuft seat the brush element can be trimmed to provide absolute alignment of the outer ends of the brush tufts and this may be done either with scissors or with any suitable trimming machine.

While the brush unit will in the majority of instances be sold with the bristle ends merely trimmed it is important to note that a further change in the character thereof takes place upon the movement of the bristles in frictional contact with a surface covering or other similar surface and that the brush unit does not reach its final form until this change has taken place. This final step can well be left to be carried out by the user for it is quickly accomplished upon the brush unit being mounted upon a suction cleaner agitator and that agitator rotated in a single direction in the cleaner use and with the bristles in contact with a surface covering undergoing cleaning. This change comprises the cold-flowing of the bristle end from its straight sharply sheared-off condition to a rounded slightly rearwardly inclined shape as illustrated in Figure 10. Suction cleaner agitators rotate at very high speeds and in such operation this final step is effected in a minimum time and after being effected the brush functions with improved characteristics. Injury to the surface covering by abrasion from the sharp, cut bristle ends is prevented. The frictional resistance of the brush to movement over the surface covering, and so the resistance to rotation of the entire agitator, is reduced with a resultant lightening of the load upon the driving motor. Naturally, this treatment of the brush unit resulting in the cold-flowing of the bristle ends can be accomplished by similar abrasive treatments and in other mountings.

With the agitator elements embodying brush tufts formed with the bristles described and made in accordance with this disclosure, the objections to the animal bristles heretofore used have been found to be eliminated. The brushes have the desirable characteristics of uniformity in bristle size, strength, flexibility and cross section. Their stiffness, which is dependent upon fiber diameter is uniform and may be varied by varying the diameter to any desired degree, a control not at all possible in the use of animal bristles. There is less waste in the trimming operation of the artificial fibers than when natural animal hair is used. Artificial fibers can be cut to exact lengths whereas the animal hairs vary materially in length by requiring the scrapping of much hair and the excessive trimming of the remainder to obtain uniformity. The artificial bristles, being all cut to length require a minimum of trimming. It has been found that the artificial fibers wear much longer than the natural animal fibers, both from the standpoint of total life and from the standpoint of life without deterioration. Reference to Figures 10 and 11 discloses diagrammatically the wear characteristics of the artificial fiber bristles and the natural animal hair bristles. After wear the former are found to cold flow slightly so that the tip thereof is turned rearwardly; an absence of sharpness of points being noted. In Figure 11 the horse hairs are seen to be sharpened at the ends after the same use and in some instances are found to be split. The sharpened and split ends produce greater surface covering wear while the smooth rounded ends of the artificial fibers have been found to reduce the power required for agitator actuation without sacrifice of cleaning effectiveness.

I claim:

1. An agitating brush for a suction cleaner or the like comprising a back and brush bristles of a composition comprising the product of the mutual reaction of a diamine with an amide-forming derivative of a dibasic carboxylic acid, characterized in that said bristles cold flow to form sloping rounded end portions upon abrasive contact in one direction with a surface covering.

2. An agitating brush for a suction cleaner or the like comprising a back and brush bristles of a composition comprising the product of the mutual reaction of a diamine with a dicarboxylic acid, characterized in that said bristles cold flow to form sloping rounded end portions upon abrasive contact in one direction with a surface covering.

3. The method of making an agitator brush comprising the step of securing Nylon bristles in a carrying back and moving the assembly relative to a surface in a single direction with the bristle ends in abrasive contact therewith to effect a cold flowing of the bristle ends to a rounded contour.

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