Dec. 1, 1942. E. R. SWANN 2,303,800

METHOD OF MAKING AGITATOR BRUSHES

Filed Aug. 29, 1940 2 Sheets-Sheet 1

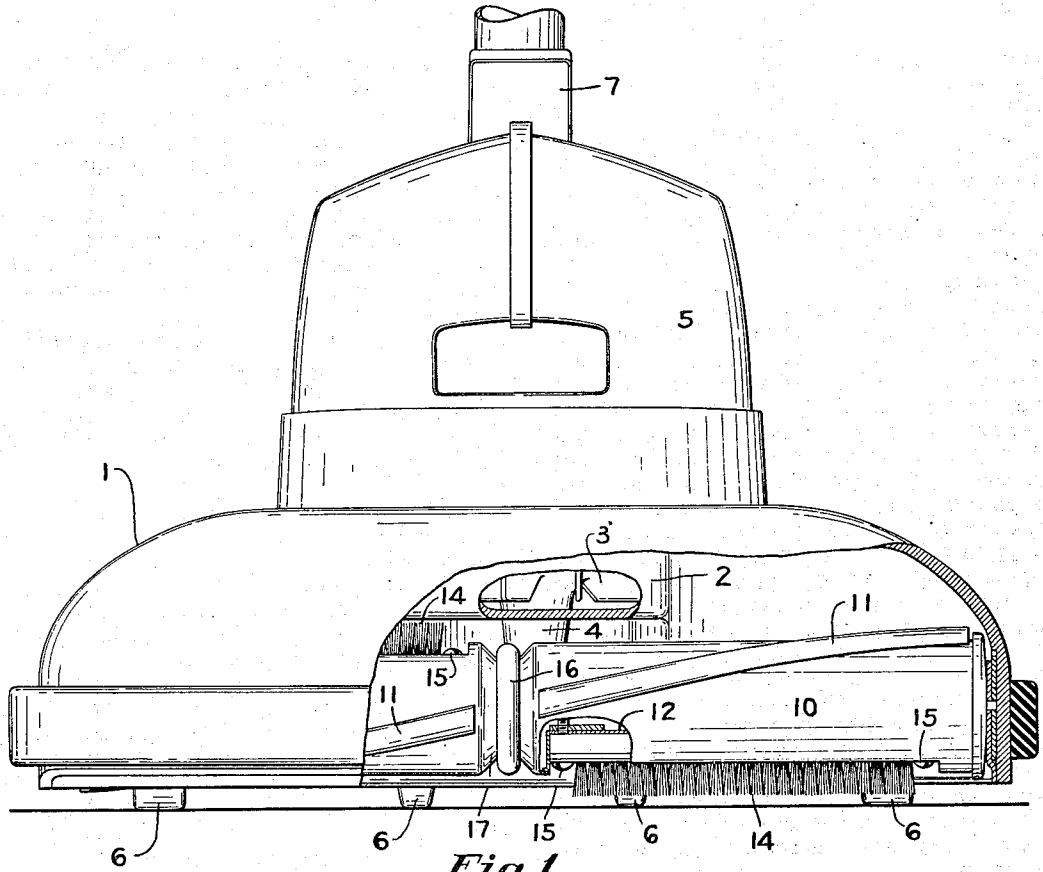

Fig. 1

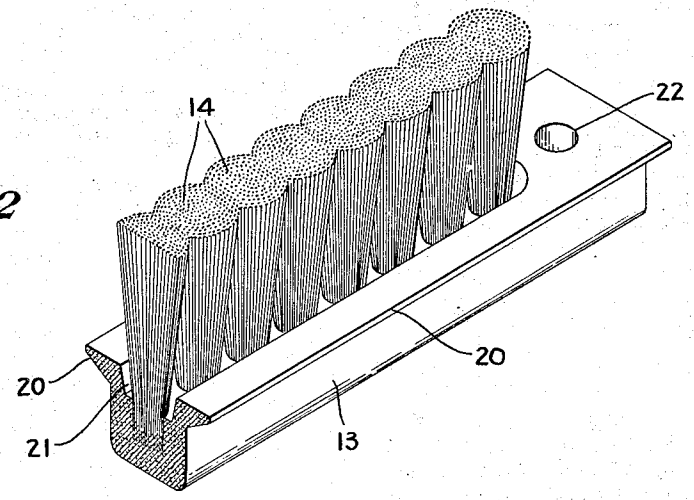

Fig. 2

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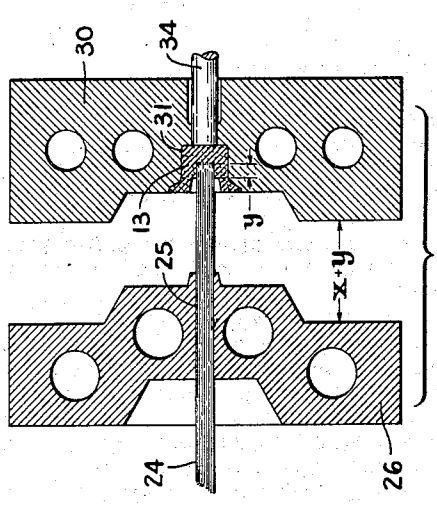
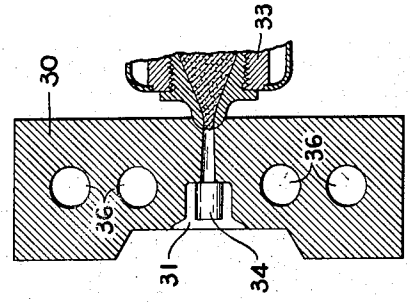


Fig. 8



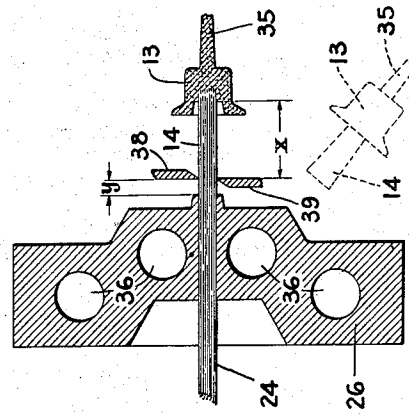


Fig. 9

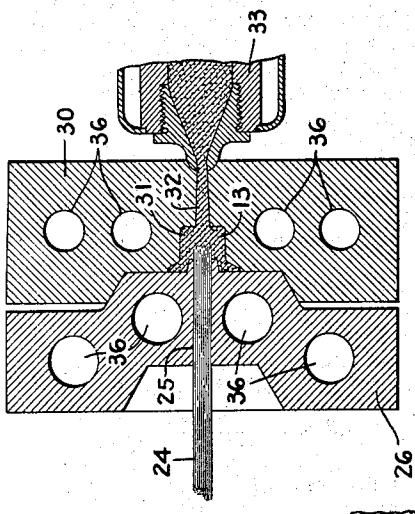


Fig. 7

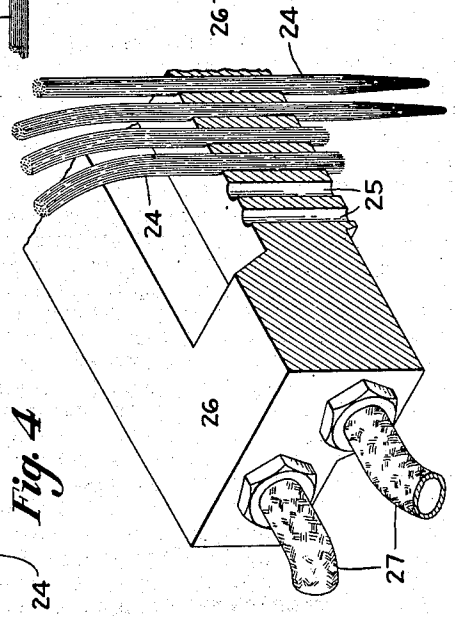


Fig. 5

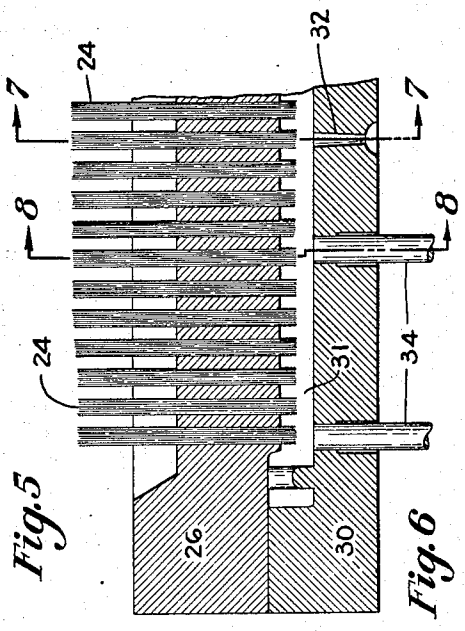


Fig. 6

Fig. 3

Fig. 4

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Patented Dec. 1, 1942 2,303,800

UNITED STATES PATENT OFFICE

2,303,800

METHOD OF MAKING AGITATOR BRUSHES

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Application August 29, 1940, Serial No. 354,644

10 Claims. (Cl. 18—59)

The present invention relates to a method of making an agitator brush for suction cleaners. More specifically, the invention comprises an improved method of making an agitator brush for a suction cleaner by the use of a continuous source of bristles which are fed into a mold and imbedded in a thermoplastic material.

It is an object of the present invention to provide a new and improved method of making a surface-covering-agitating brush for a suction cleaner rotary agitator. Another object of the invention is to provide a method for making agitator brushes by molding a back of thermoplastic material to synthetic organic brush bristles. Still another object of the invention is to provide a method of making agitating brushes for rotary agitators for suction cleaners by the use of bristles from a continuous source which are advanced step by step into an injection mold to be imbedded in a thermoplastic brush back and thereafter cut to length. These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawings to which they relate.

Referring now to the drawings in which a preferred embodiment of the present invention is disclosed:

Figure 1 is a front view of a suction cleaner with a portion of the front nozzle wall broken away to show a rotary agitator positioned therein which incorporates a brush unit constructed in accordance with the present invention;

Figure 2 is a view in perspective of a section of the removable brush unit constructed in accordance with the present invention;

Figure 3 is a side view of the end of a strand of brush bristles from a continuous source;

Figure 4 is a view similar to Figure 3 and illustrates the same strand of filaments with the outer end bonded together by heat in order that the strand can be threaded into the mold;

Figure 5 is a partial view in perspective of the movable section of the mold with brush tufts threaded into some of the tuft seats, certain of the tufts being cut to proper length after insertion;

Figure 6 is a partial longitudinal section through the mold in closed position and illustrates the plurality of tufts extended into the brush back cavity awaiting the injection of the back material;

Figure 7 is a transverse section through the mold upon the line 7—7 of Figure 6 and shows the injection nozzle in place and the mold cavity being filled with the back material in a molten or plastic condition;

Figure 8 is a section upon the line 8—8 of Figure 6, but with the mold in an open position, and discloses the opening operation of the mold with the movable mold section sliding along the brush tuft strands before the ejection pins have forced the brush back from its cavity;

Figure 9 is a view of the last step of the operation in which the movable section of the mold, as illustrated in Figure 8, has moved to open position, the brush back has been ejected by the ejection pins from the brush back cavity, and the brush tufts are being cut to length.

The modern suction cleaner embodies surface brushing and beating means which cooperate with a flow of cleaning air in the removal of foreign material from the surface covering undergoing cleaning. Surface brushing and beating means preferably comprise a rotary agitator which incorporates rigid surface beating elements and flexible surface brushing or sweeping elements. The beating elements function to vibrate the surface covering to effect the dislodgment therefrom of foreign material imbedded therein while the brushing elements perform a pile straightening and smoothing function and, to a limited extent dependent upon the flexibility of the elements, a vibrating and dirt dislodging effect. It has been found that filaments of certain synthetic organic compounds can be used as brush bristles which function satisfactorily in place of the usual animal hair bristles in the agitator brush unit. In the present invention bristles made of synthetic organic compounds are molded into a base of thermoplastic material by an improved method in which the brush tufts are fed from a continuous source into the brush back cavity of the mold to be engaged by the thermoplastic brush material and thereafter cut to length, the brush tuft material and the brush back material being so selected that fusion takes place in the molding operation to produce a bond which is stronger than a mere mechanical bond.

Referring again to the drawings, and to Figure 1 in particular, a suction cleaner is illustrated and is seen to comprise a main casing 1, the forward portion of which comprises a nozzle. The nozzle is interiorly connected to a fan chamber 2 within which is positioned a suction-creating fan 3 carried by the downwardly extending lower end of the motor shaft 4. A motor casing 5 is positioned immediately above the main casing 1 and houses an unshown driving motor of

any ordinary type and which includes the shaft 4. The entire cleaner body is movably supported upon wheels 6 and, as in the usual suction cleaner, a pivoted handle 7 is provided through which a propelling force may be exerted.

Within the nozzle portion of the main casing 1 is positioned a rotatably mounted cylindrical agitator 10 upon the surface of which are positioned helically extending rigid beater bars 11. Within recesses 12 in agitator 10 are positioned elongated brush units or elements comprising rigid backs 13 and tufts of bristles 14, the brushes being removably secured by means of screws 15. The brushes are illustrated as being axially extending but can as well extend in curves, if desired, around the agitator. The agitator is rotated by means of power-transmitting belt 16 which seats in a grooved pulley 17 formed centrally in the agitator body. Power to the belt is provided by the motor shaft 4.

Referring now to Figure 2 in particular, an enlarged view of the brush elements per se is shown. The brush base or back 13 is seen to be formed along its side with laterally extending shoulders 20, 20, between which is a longitudinally extending recess or groove 21. In each end of the brush back is a vertically extending screw-receiving seat 22 adapted to seat the screws 15 illustrated in Figure 1. Extended vertically from the back along the longitudinally extended groove 21 is a line or series of brush tufts 14. Each of these tufts comprises a plurality of bristles, each of which extends downwardly into the back 13 in which it is fixed. The bristles are not looped and there are no brush tuft seats which can be independently identified as such. Instead the brush bristles are positioned in the brush back and are individually enclosed by and in fact fused with the material of the brush back.

In a preferred embodiment, the brush bristles are formed of nylon, a synthetic organic compound which is also identified as a synthetic linear condensation polyamide and also as a synthetic fiber-forming polymeric amide. The brush back is known as vinylite, which is identifiable as a polymer vinyl acetate and vinyl chloride. It has been found that by the use of these two preferred materials for the brush bristles and the brush backs that a construction is provided in which fusion takes place at the conjunction of the bristles and the back, which fusion provides a permanent bond stronger than a mere mechanical bond.

Referring now to Figures 3 to 9, inclusive, the proposed method of making the brush element in accordance with the present invention is illustrated. A plurality of filaments of a synthetic organic compound, such as nylon, are brought together to form a continuous strand which may be gathered in the form of a skein or wound upon a drum. An end of such a strand is illustrated in Figure 3. The number of such strands used is dependent upon the number of brush tufts which are to be formed in the individual brush unit. Reference to Figure 2 illustrates that the brush tufts are positioned side by side and are contiguous. Their number will depend upon the length of the brush back. The end of each brush tuft strand is subjected to a heat treatment, which may be either exposure to high temperature or direct exposure for a very brief interval to a flame for the purpose of forming a bond between the separate filaments of the strand, as illustrated in Figure 4, so that the strand may be threaded into the tuft seat in the mold, as illustrated in Figure 5.

In Figure 5 the brush tuft strands, indicated by the reference character 24, are shown threaded into tuft seats 25 formed in the movable mold section 26. Two of the tuft strands are there illustrated immediately after insertion with the fused outer ends thereof in place. All of the tufts are, after being fed into the mold section 26, cut off, as illustrated by the two shorter tuft sections in Figure 5, so that they protrude a distance beyond the mold section 26 which is equal to the distance which the brush tufts are to be imbedded in the brush backs. The flexible conduits 27 convey cooling fluid to the mold section 26.

After the placing of all the tuft strands in the mold section 26, the latter advances to the stationary mold section 30, illustrated in Figures 6 to 9, inclusive, which section is formed with the brush back cavity. A feeding inlet 32 extends from the back of the mold section 30 into the cavity and is adapted to convey the plastic material for the brush back to the cavity from the injection nozzle 33, illustrated in Figures 7 and 9. Ejector pins 34 are slidingly mounted in section 30 and are adapted to be propelled inwardly at the conclusion of the molding operation to eject the brush back from the cavity 31.

With the movable mold section 26 advanced into place relative to the stationary section 30 the strands 24 are extended beyond the section 26 and into the cavity 31 as is clearly illustrated in Figure 6. Upon sealing contact being made between the two mold sections the material of the brush back 13 is injected from the nozzle 33 through the inlet 32 completely filling the cavity 31 and coming into contact with each separate filament of each brush tuft strand 24. The back material 13 which, as stated above, is preferably of vinylite, is heated into a plastic condition and upon contact with the ends of the brush tufts fusion takes place therebetween. Each of the mold sections is provided with a plurality of conduits 36 which are fed by a cooling fluid which circulates through the mold the fluid for movable section 26 coming from the flexible conduits 27. Two of these orifices, conduits or passageways 36 in the movable section 26 of the mold are positioned along and immediately adjacent the brush tuft seats 25 and perform a cooling function which reduces the temperature of the tuft strands and, of course, the temperature of the mold at that point. This results in a lowering of the temperature of the plastic back material which solidifies and is not extruded along the strand into the seat 25. This is desirable as any such extrusion results in a reduction of the effective bending length of the tufts.

The injection of the plastic back material into the mold cavity 31 continues until that cavity is entirely filled. The next operation is the separation of the two mold sections and this is illustrated in Figure 8 in which movable section 26 is illustrated as withdrawn from the molding position a certain predetermined distance. The brush tuft strands 24 being held in the newly formed back which is temporarily stuck in the mold cavity, have passed along the tuft seats 25 in each instance as the mold section moved. The distance of this movement is indicated by the characters x plus y and is a distance which is equal to the brush tuft length or height x in the completed brush unit plus a distance y which is

equal to the distance which the brush tuft is imbedded in the brush back. Upon the movable mold section having moved outwardly this distance x plus y the ejector pins **34** come into action and force the brush back **13** from its cavity **31**, the back **13** carrying with it a sprue **35** which filled the injection inlet **32**. This sprue must thereafter be removed by any suitable means, such as filing or cutting. Additional outward movement of the movable mold section **26** beyond the distance x plus y illustrated in Figure 8, to its outermost position, illustrated in Figure 9, is accompanied by a corresponding movement of the newly formed brush unit which is still connected thereto by the tuft strands **24**. Upon the mold section **26** reaching its outermost position, two cooperating knife blades **38** and **39** contact the opposite sides of the aligned filament strands to sever them, as is clearly illustrated in Figure 9, and the newly formed brush unit falls, as is also illustrated in Figure 9, into a suitable receptacle or catch receiver. The sprue is removed in any suitable manner and the newly formed brush is ready for use. The operation of forming the next brush unit is immediately begun with the advance of the movable mold section **26** toward the stationary section. The operation is, of course, a repetition of that described.

It is to be understood that the protection herein applied for is not confined to the particular combinations of features or elements set out in the following claims. Protection is herein applied for, for any one or more of the features or elements referred to in the following claims, or described in the foregoing specifications or shown in the accompanying drawings, either independently or in combination.

I claim:

1. The method of making a brush comprising loading a movable mold section with brush bristles so that the bristles extend therethrough and therefrom, advancing the said mold section and said bristles into cooperating position with a second mold section formed with a brush back cavity which encloses the projecting ends of said brush bristles, injecting a heated thermoplastic into said cavity to form a brush back in which said bristles become embedded, retracting said movable mold section from said cooperating position while said bristles remain stationary, ejecting said back from said cavity, and cutting said bristles to length.

2. In a method of making a brush, the steps comprising feeding a plurality of continuous brush bristles into a brush back cavity in a stationary mold section by means of a movable mold section through which they extend, injecting a molten brush-back-forming material into said cavity to form a back in which said bristles become embedded and fixed, and retracting said movable mold section from said stationary mold section and without moving said bristles a distance equal to the desired bristle length plus the distance said bristles extend into said back, and severing said bristles at said latter distance from said movable mold.

3. In a method of making a brush, the steps of feeding a plurality of brush strands composed of a multiplicity of filaments into a brush back cavity in a second mold section by means of a movable mold section through which the strands extend individually, injecting a molten brush-back-forming material through said second mold into said cavity to form a back in which said strands become embedded, separating said movable and said second mold section a distance at least as great as the desired length of bristle for said brush, said movable mold section sliding over said strands in said separation, cutting said strands to form brush tufts carried by said back, and ejecting said back from said second mold section.

4. In a method of making a brush, the step of advancing a feeder to feed a strand of organic bristles into a stationary mold shaped to form a brush back, injecting a heated thermoplastic from a stationary source into said mold to form a back and to anchor said bristles, retracting said feeder a distance equal at least to the desired length of brush tuft with said bristle and back remaining fixed, and severing said strand between said back and said feeder.

5. In a method of making a brush, the step of advancing a feeder to feed a strand of organic bristles into a stationary mold shaped to form a brush back, injecting a heated thermoplastic into said mold to form a back and to anchor said bristles, retracting said feeder a distance at least equal to the desired length of bristle for said brush plus a distance equal to the length of bristle embedded in said back and with said bristle and back remaining stationary, and severing said strand at a distance from said back equal to the desired length of bristle.

6. In a method of making a brush, the step of advancing a feeder to feed a strand of organic bristles into a mold shaped to form a brush back, injecting a heated thermoplastic into said mold to form a back and to anchor said bristles, cooling said bristles and said thermoplastic adjacent said bristles to prevent extension of the latter along the former, retracting said feeder a distance equal at least to the desired length of brush tuft, and severing said strand between said back and said feeder.

7. In a brush making machine, a stationary mold section formed with a brush back cavity, a reciprocatory mold section formed with friction bristle seats adapted to retain releasably by frictional engagement a bristle extended therethrough, cooling orifices in said movable mold section to cool bristles positioned therein and to prevent extrusion of material into said seats, and means to inject a molten material into said cavity in said stationary mold section.

8. In a brush making machine, a stationary mold section formed with a brush back cavity, a reciprocatory mold section formed with friction bristle seats adapted to retain releasably by frictional engagement a bristle positioned therein, cooling orifices in said movable mold section to cool bristles positioned in said movable section and also in said stationary section adjacent thereto to prevent extrusion of material into said seats, means to inject a molten material into said cavity in said stationary mold section, means to eject a back from said cavity in said stationary mold, and means to cut said bristles to length.

9. In a brush making machine, a stationary mold section formed with a brush back cavity, a reciprocatory mold section adapted to be reciprocated toward and from said stationary mold section and formed with a plurality of brush bristle seats extended entirely therethrough and opening into said cavity with said sections juxtapositioned, said seats being of a size to engage frictionally the brush bristles positioned therein, means to inject moldable material through said

stationary mold into said cavity to form a brush back about the ends of the bristles extended therein, means acting through said stationary mold section to eject a molded brush back therefrom to permit the newly formed brush unit to be carried by the bristles in said reciprocatory mold section, and means to cut the bristles at a distance from the face of said reciprocatory mold equal to the distance said bristles are embedded in said back.

10. The method of making a brush comprising feeding a plurality of tufts of bristles forwardly until their ends extend into a brush back cavity formed in a stationary mold, molding a brush back around the ends of said bristles, retracting the bristle feeding means along said bristles a distance equal to the distance said bristles are embedded in said back plus a distance equal to the desired bristle extension above said back, ejecting said back from its mold thereby leaving it supported by said bristles, and severing said bristles at a distance from said back equal to the desired bristle extension from said back.

EDWARD R. SWANN.

CERTIFICATE OF CORRECTION.

Patent No. 2,303,800. December 1, 1942.

EDWARD R. SWANN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 38, claim 6, after the word "feeder" insert --along said bristles--; line 39, same claim, after "tuft" and before the comma insert --with said back and bristles remaining stationary--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of March, A. D. 1943.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)