United States Patent

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[54] **TOOTHBRUSH**
3 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** ..... **15/167 R**
[51] **Int. Cl.** **A46b 15/00**
[50] **Field of Search** ..... 15/167, 159 A, 110

[56] **References Cited**

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ABSTRACT: An improved toothbrush head, especially adapted for use in association with an automatic toothbrush power handle including as an energy source a source of vibratory energy in the sonic range, comprises a plurality of first bristle tufts and a plurality of second bristle tufts, the individual bristles in the first and second tufts of bristles being of different diameter. About four times as many bristles are provided in the tufts of smaller diameter bristles. The large diameter bristles are designed to clean the oral hard tissues, whereas the softer smaller diameter bristles are designed to polish the oral hard tissues and stimulate the gingival tissues. The bristle tufts are arranged on a brush head in three rows, with all peripheral bristle tufts being formed of relatively smaller diameter bristles and with the centrally disposed tufts being formed of relatively larger diameter bristles.

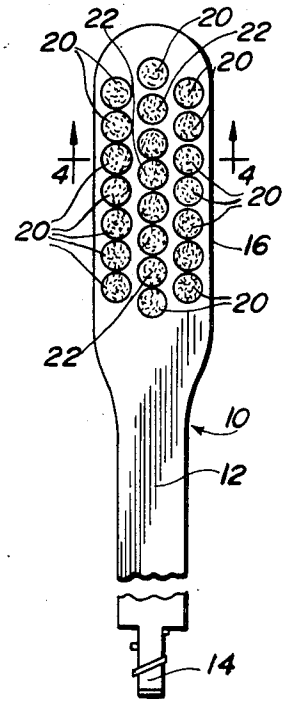


FIG-1

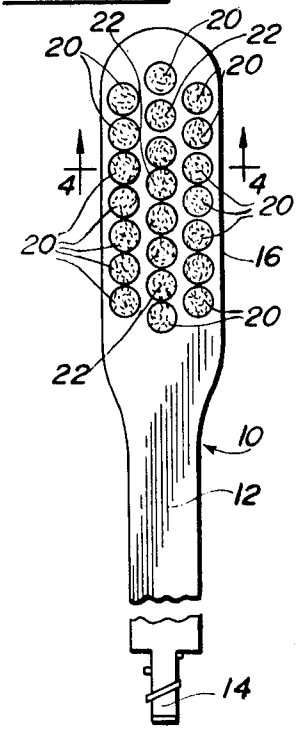


FIG-2

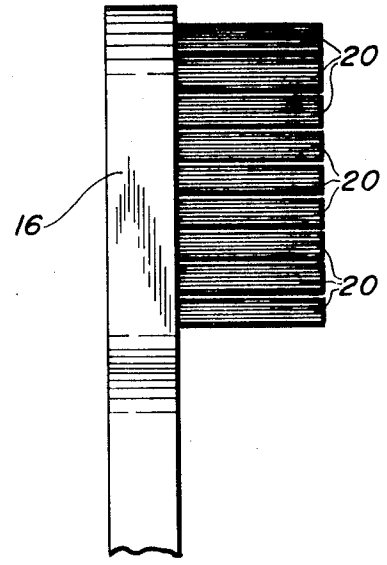


FIG-3

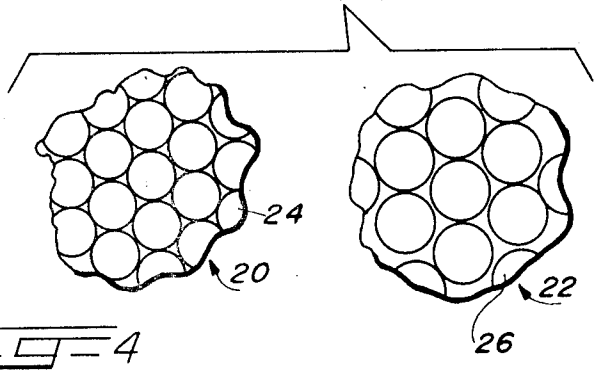
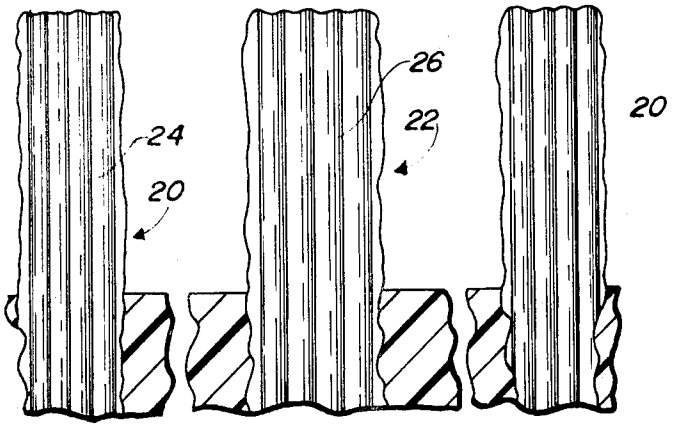


FIG-4



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BY

TOOTHBRUSH

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to the dental arts and more particularly to a brush head designed for and compatible with an automatic toothbrushing head embodying a source of vibratory energy in the sonic range as the source of motive power.

Description of the Prior Art

Automatic toothbrushes are provided with conventional toothbrush heads in which all of the bristles are of uniform character (i.e., length and diameter). While such brushes have demonstrated utility in combination with mechanical toothbrushes which are designed to produce a mechanical reciprocating motion of the brush head in order to simulate manual brushing techniques, such brush heads have sever limitations when employed on power handles utilizing a source of vibratory energy in the sonic range (hereinafter referred to as sonic energy) as the source of motive power. Examples of two power handles of the character described are given in Hubner U.S. Pat. No. 3,183,538 and Aurelio et al. application Ser. No. 698,675, now U.S. Pat. No. 3,466,689.

In particular, where such sonic energy power sources are used in association with a toothbrushing implement, substantial oral health advantages have been achieved by virtue of the stimulation of the gingiva. However, one of the difficulties heretofore encountered with such sonic energy power units is that such improved gingival health could only be obtained at the sacrifice of satisfactory cleaning and polishing of the oral hard tissues.

Accordingly, the prime object of this invention is to provide a brush especially designed for use with a power handle of the character described in order that improved cleaning and polishing may be achieved at the same time the gingival health benefits are obtained.

Another object of this invention is to provide a toothbrush head especially designed for compatible use with such a power handle.

A further object is the provision of a toothbrush head of the character described embodying two different types of bristles, one type having relatively stiff and capable of cleaning the teeth in a highly satisfactory fashion and the other set being relatively soft and therefore capable of polishing the oral hard tissues and stimulating the gingiva in a satisfactory fashion.

Yet another object is the provision of a brush head of the character described in which all of the bristles are fabricated from the same material, but with the relatively stiffer bristles differing in diameter from the relatively softer bristles, preferably by a substantial amount whereby the softer bristles are less abrasive.

SUMMARY OF THE INVENTION

The foregoing and other objects, advantages, and features may be achieved with a brush head adapted for removable connection with an automatic toothbrush power handle comprising brush handle means, means for attaching the brush handle means to the power handle, and a brush head, the brush head; brush handle means, and attachment means preferably being integrally formed in one piece of plastic. A plurality of first tufts of bristles and a plurality of second tufts of bristles are secured to the brush head. The bristles of the first and second tufts differ substantially in stiffness so that the first tufts perform primarily a polishing function and the second tufts perform primarily a cleaning function when applied to the oral hard tissues.

More particularly, the desired substantial difference in stiffness is preferably obtained by forming all of the bristles of the same material, but varying the diameters thereof such that the bristles of the second tufts are substantially larger in diameter (e.g., by a factor of about 25–50 percent) than the bristles of the first tufts are more numerous than those of the second tufts (e.g., the ratio of the number of bristles in the first tufts lies in the range of about 1.3:1–4:1). The bristle tufts are preferably arranged in three parallel rows, with the outer rows comprising first tufts, with the endmost tufts of the center row being first tufts, and with the balance of the center row being second tufts.

DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary elevational view of the brush head produced in accordance with the present invention;

FIG. 2 is a fragmentary side elevational view thereof;

FIG. 3 is an enlarged fragmentary plan view of two bristles thereof; and

FIG. 4 is an enlarged fragmentary sectional view taken substantially along line 4–4 in FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawing, there is shown a toothbrush **10** especially adapted for use in association with an automatic toothbrush power handle comprising as its power source a source of vibratory energy in the sonic range. Toothbrush **10** comprises a handle **12** which terminates at one end in attaching means, which take the form of a threaded shaft **14** adapted for use in removably attaching the toothbrush **10** to a power handle (not shown). Of course, other conventional attachment means that permit a removable mounting of the toothbrush on a power handle could be employed. At the opposite end of handle **12**, a brush head **16** is formed, and handle **12**, attachment means **14**, and brush head **16** are preferably formed in a unitary body, as by injection molding.

A plurality of first bristles tufts **20** are provided on brush head **16**, as are a plurality of second bristles tufts **22**. The bristle tufts are stuffed into drilled or otherwise preformed hole by conventional techniques which do not form a part of this invention.

As best shown in FIG. 1, the first and second bristle tufts **20**, **22** are arranged on brush head **16** in three parallel rows with the tufts of the two outer rows being in alignment, and with the tufts in the center row being staggered in the spaces between the bristles of the first two rows. All of the bristle tufts in the two outer rows are of the first plurality **20**, while the end most tufts of the center row are likewise of the first plurality. However, the centrally disposed tufts of the second row are in the form of the second plurality of bristle tufts **22**. Tufts of the first plurality are thus provided about the periphery of the brush head **16**, whereas the tufts of the second plurality are centrally located.

In accordance with the present invention, the bristles of tufts **22** are relatively stiffer and hence designed to accomplish a cleaning function especially vis-a-vis the oral hard tissues, whereas bristles of tufts **20** are relatively softer and thus primarily accomplish a polishing and gingival stimulation function. It has been found that the desired difference in stiffness of the bristles of the respective sets of tufts may be obtained even though the same material (i.e., plastic resin or the like) is employed to fabricate the bristles. More particularly, it has been found that if the individual bristles **24** of the first plurality of tufts **20** are relatively smaller in diameter and the bristles **26** of the second plurality of tufts **22** are of relatively larger diameter and if the differences in diameters are substantial (i.e., by a factor of about 20–50 percent or more), then the desired difference may be achieved, even though an identical plastic material is employed. Among the suitable plastics of other materials from which bristles **24**, **26** may be fabricated are nylon polyethylene, polypropylene, urethanes, acetals, and other similar polymers.

By way of specific example, a preferred embodiment of this invention includes nylon bristles of the tufts **20** about 0.006 inches in diameter, with approximately 100 bristles being provided per tuft. Tufts **22** are formed of bristles about 0.009 inches in diameter, with about 26 of said bristles being provided in each tuft **22** (i.e., about 4:1 ratio in the number of bristles being provided in the respective sets of tufts). In

general the bristle per tuft ratio of the tufts **20** and **22** lies in the range of about 1.3:1 and 4:1 (i.e., the numbers of bristles in each tuft **20** will always exceed the numbers of bristles in each tuft **22**, with the excess being between 1.3 and 4 times as many). Of course, the exact bristle diameters and numbers if bristles per tuft, as well as the exact number of bristle tufts provided on the brush head, may be varied to suit the particular case so long as the following principal parameters are maintained; namely; a substantial difference in diameter between the bristles of the two sets of tufts and a difference in the number of bristles bound per tuft varying on an inverse basis. As best shown in FIGS. **2** and **4**, the length of the individual bristles in the respective sets of tufts should be about the same.

The outstanding effectiveness of the brush heads produced in accordance with this invention when employed on a (sonic energy) automatic toothbrush power handle has been verified by the following experimental evaluations.

A definitive laboratory cleaning test procedure has been used to evaluate a number of toothbrushes, among which were brushes produced in accordance with the present invention. This procedure (as set forth and described in Cooley et al. U.S. Pat. No. 3,151,027) involved the use of polyester plastic blocks specifically designed for use in an electric toothbrushing machine. The blocks are ground smooth, washed, dried, and a thin coating of black lacquer is carefully applied to the surface of the block. The blocks are then inserted in the toothbrushing machine and brushed with the brushes for 15 seconds with a pressure on the lacquer surface of 150 grams. Reflectance measurements of the blocks are then obtained through the use of a reflectometer. Cleaning values are given on a scale ranging from 0 to 6.5, a higher value indicating a greater cleaning ability (i.e., higher reflectance produced by greater removal of the lacquer is indicative of better cleaning ability).

Enamel polishing values have also been obtained in accordance with a so-called "toothbrush-polishing procedure". The lingual surfaces of freshly extracted maxillary anterior teeth are reduced with the aid of a diamond disc, and the teeth are mounted by means of a low melting alloy, such as Wood's metal, on hexagonal jigs constructed so as to fit the movable stage of a reflectometer. The exposed labial surface of each tooth is mounted in such a manner that the height of the contour is a suitable distance above the base of the jig. Throughout the procedure, care is taken to ensure that the teeth do not become dry in order to prevent damage of the tooth tissue. The exposed enamel surface is then dulled by exposing it to 0.10%N. hydrochloric acid (pH 2.2) for 30 seconds. Any acid remaining on the tooth surface is neutralized by immediately transferring the tooth to a saturated sodium carbonate solution for 30 seconds. THe tooth is then rinsed with water and blotted dry.

The maximum reflectance of the dulled tooth surface is determined by means of a reflectometer especially adapted to detect the changes in the degree if polish of the enamel surface. The reflectometer is constructed so that the enamel is exposed to a beam of polarized light, and the amount of light reflected from the enamel surface is determined by a photoelectric cell which in turn activates a galvanometer, The smoother the enamel surface, the smaller the amount of diffused and absorbed light and, hence, the higher the galvanometer reading.

After the maximum reflectance of the dulled tooth is determined, the tooth is polished with a toothbrush mounted on an automatic toothbrush machine for a specified period of time and at a representative pressure. After the tooth has been polished, the enamel surface is rinsed with water so as to remove any residual particles of the cleaning and polishing agent, and the reflectance of the enamel surface is again measured with the tooth located in exactly the same position as that used to obtain the "dull" reading. The absolute change in the amount of reflectance between the dulled and polished enamel surface in taken as a measure of the degree in polishing imparted by the treatment.

Utilizing the foregoing procedure, enamel polishing scores and cleaning values were obtained for a preferred toothbrush produced in accordance with the present invention and, for comparative purposes for several commercially available automatic toothbrushes with conventional brush heads. The results for these evaluations are given in table I, the data of which demonstrate the superiority of the brushes in accordance with the present invention, which, in each instance, produced not only superior polishing, but also superior cleaning, than could be obtained with any of the commercially available or other experimental arrangements.

TABLE I

Brush	Bristle Hardness	Enamel Polishing Score	Enamel Cleaning Score
Invention Brush		0.55	4.20
Commercial I	soft	0.44	4.00
Commercial II	medium	0.20	4.10
Commercial III	hard	0.34	4.08
Commercial IV	soft	0.15	4.10
Commercial V	soft	0.17	4.03
Commercial VI	hard	0.14	3.93
Commercial VII	medium	N.A.*	3.55
Commercial VIII	medium	0.40	3.30

*Not available.

Table II reports cleaning scores obtained in the foregoing manner for a series of specially fabricated brushes demonstrating the effectiveness of the brushes of this invention over a wide range of bristles/tuft ratios.

TABLE II

Bristle dimater		Bristles per tuft		Bristle/tuft ratio	
Outer row	Inner row	Outer row	Inner row	(outer/inner)	Cleaning score
0.006	0.006	35	+ 35	1:1	3.20
0.006	0.006	98	98	1:1	3.40
0.006	0.009	35	26	1.3:1	3.78
0.006	0.009	98	26	4:1	4.20

In sum, the brush head in accordance with the present invention, when provided in association with a power handle utilizing a source of fibratory energy in the sonic range, provides a system which offers the prospect of superior cleaning and polishing of the oral hard tissues, coupled with the advantages of gingival health that may be obtained with such power handles.

I claim:

1. A toothbrush adapted to be mounted on an automatic toothbrush power handle having as a power source a source of vibratory energy in the sonic range, the said toothbrush comprising:

an elongated brush handle adapted to one end to be removably mounted on the power handle;

a brush head formed integrally with the elongated brush handle at the opposite end thereof;

a plurality of first tufts of the individual bristles disposed on the brush head about the periphery thereof; and

a plurality of second tufts of individual bristles disposed centrally on the brush head so as to be surrounded by the first tufts,

the individual bristles of the first and second tufts being formed of nylon, of the bristles of the second tufts being about 50 percent greater than the diameters of the bristles of the first tufts and with the ratio of the number of bristles in the first tufts to the number of bristles in the second tufts being 4:1

whereby the first tufts primarily perform a polishing function and the second tufts primarily perform a cleaning function when they are applied to the oral hard tissues.

2. A toothbrush, as claimed in claim 1 wherein the bristles are all of the same length.

3. A toothbrush, as claimed in claim 1 wherein the first and second tufts are arranged in three parallel rows on the brush head, with the two outer rows solely comprising first tufts, with the endmost tufts in the middle row being first tufts, and with the balance of the second row being second tufts.

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