United States Patent

[11] 3,610,234

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[21] Appl. No. **704,339**
[22] Filed **Feb. 9, 1968**
[45] Patented **Oct. 5, 1971**

[54] **WATER-JET TOOTHBRUSH**
19 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** ..... **128/66,** 128/62 A
[51] **Int. Cl.** **A61h 9/00**
[50] **Field of Search** 128/62, 66, 229; 401/22, 289

[56] **References Cited**

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Primary Examiner—L. W. Trapp
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ABSTRACT: A water-jet toothbrush equipped with a water passage extending longitudinally within its bristle-holding elongated head portion. This water passage has critical dimensions at its discharge orifice in the anterior portion of the head. It is also curved within the head of the toothbrush. The curvature, plus the critical orifice dimensions, act together at the anterior end of the head to form a water-jet exit orifice which directs water in a stream essentially free of contact with bristle-tufts of the head of the toothbrush and at a forward angle between about 95° and 160° from the elongated head of the toothbrush. Preferably, the handle part of the toothbrush is integrally united with the head, with the water passage of the head continuing through the handle. Walls of the water passage may be preformed to consist of a material different from remaining material employed in forming the head or handle, or both. Connectors and clamps are taught for channelling or controlling waterflow.

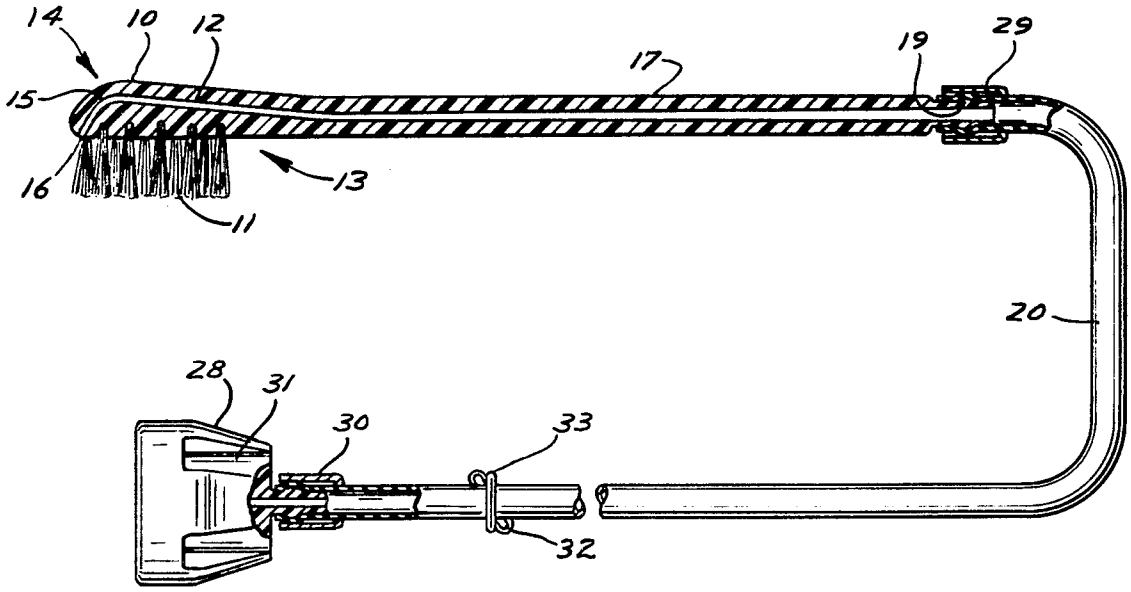
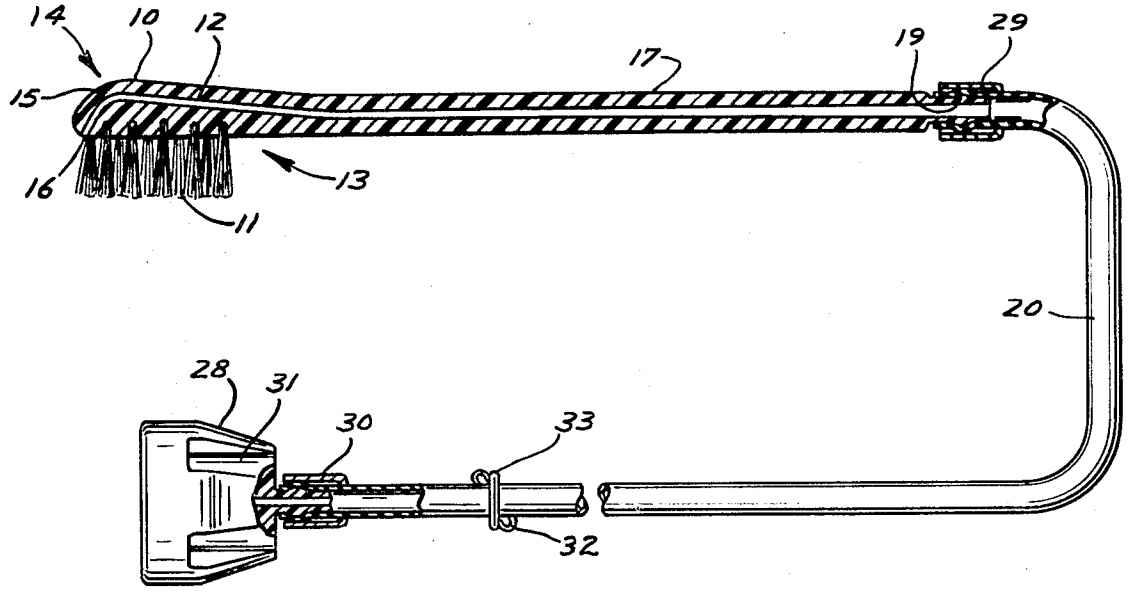


FIG. 1



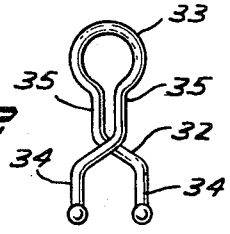


FIG. 2

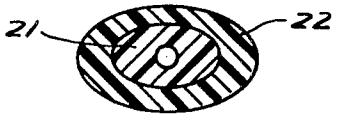


FIG. 4

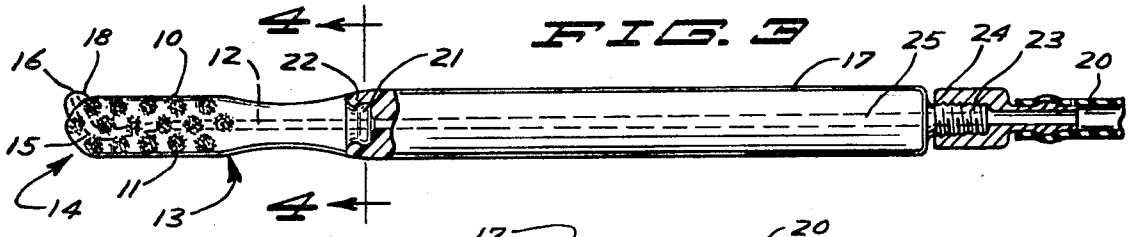


FIG. 3

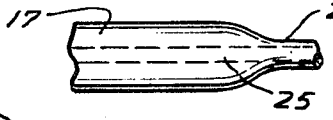


FIG. 6

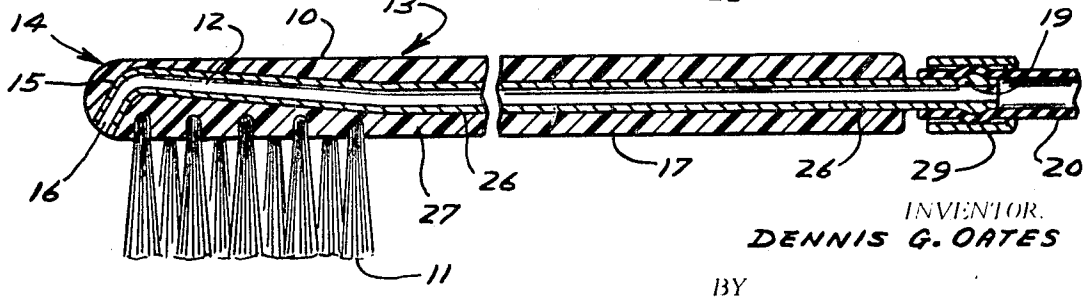


FIG. 5

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WATER-JET TOOTHBRUSH

This invention relates to a new oral-cavity-cleaning device characterized as a water-jet toothbrush. This toothbrush is equipped with a specialized water-jet exit orifice which, in combination with the bristles of the toothbrush, provides for improved cleaning of teeth and and stimulation of gums.

Mere water-flushing toothbrushes having a multitude of orifices or passages for flushing exit of water in or through bristles are old; see illustrative U.S. Letters Pat.: Campbell, No. 1,163,319; Sundstrand, No. 1,205,681; Braunstein, No. 2,028,042; Taborski, No. 2,303,667; Versteeg, No. 2,865,038; and Gatti, No. 3,135,989.

Toothbrushes having water-flushing apertures at spaced intervals between rows of toothbrush bristle-tufts are also old, and are in the nature of the aforenoted multiorifice toothbrush devices; see U.S. Pats. to Engstrom, No. 1,097,122 and Finton, No. 2,516,195.

Toothbrushes also have been equipped with single ports or orifices for the exit of water. For example, single ports for the exit of flushing water posterior to or at the base of the bristle portion of the toothbrush are illustrated in U.S. Pats. to Shepard, No. 105,135 and to Hegge, No. 1,913,079. Single ports or orifices have also been buried within the body of the bristle portion of the toothbrush so that the water exiting therefrom exits through, or centrally in, the mass of bristles, as, for example, in U.S. Pats. to Schamberg, No. 1,278,225 and to Andvig, No. 2,006,289. An interesting structure combined with a multiport water-flushing toothbrush is illustrated by the aforenoted Versteeg patent, No. 2,865,038. Versteeg equips his handle end with a nozzle or nipple through which water from the multiport bristle attachment is drained.

Of course, water-jet apparatus for use in cleaning teeth is extremely old, having been used by dentists for many decades. Despite the long-standing availability of water-jet apparatus, and the long-standing availability of toothbrushes, no practical combination of the beneficial and essential features of these structures in a single article capable of performing required interrelated and cooperative cleaning functions has heretofore been available, insofar as I am aware. None of the water-ported toothbrush structures of the patents aforenoted is remotely similar to the present toothbrush.

My new toothbrush avoids shortcomings of standard toothbrushes, which only cleanse superficial or easy-to-reach bacteria or food residue. It avoids the shortcomings of mere water-flushing or bristle-port toothbrushes, which do not provide the possibility of placing a water-jet orifice in essentially direct cleaning contact with difficultly cleaned crevices. It avoids the inherent weaknesses of the automatic toothbrush, which, while capable of stimulating gums and cleaning exposed surfaces of teeth at high speed, also threatens to erode tooth enamel by constant use.

The toothbrush of the present invention comprises an elongated head equipped with toothbrush bristle-tufts extending laterally off one side thereof. A water passage extends longitudinally within the elongated head. The cross-sectional area of this water passage in the part of the head opposite the anterior end of the head is no greater than about 20 sq. mm., and usually less. The anterior portion of the water passage at the anterior end of the head of the toothbrush is laterally curved within the head toward a lateral termination in an orifice at the anterior end of the head. The lateral termination of the water passage consists essentially of a directed-water-jet exit orifice no greater than about 3 sq. mm. in cross-sectional area. Further, at least the last stretch of the water passage immediately adjacent to the orifice, and for a length at least as great as the widest width of the orifice, has a cross-sectional area approximately equal to the orifice. The lateral curvature and cross-sectional area of the water passage within the anterior end of the head are such that water exiting from the orifice jets therefrom in a directed stream essentially free of the bristle-tufts of the head of the toothbrush, and at a forward angle between about 95° and 160° from the elongated head. The end of the water passage opposite the orifice end is equipped with connector means to removably connect it to a source of water, that is, to a member providing or serving as a conduit or guide for water. Optional means for channeling or controlling water supply to the orifice is also provided.

An effective oral-cavity-cleaning device is therefore provided in which a directed essentially uninterrupted water jet acts in functional combination with bristles of the toothbrush to accomplish specialized cleaning of teeth, including cleansing under bridges in the mouth as well as cleansing and stimulation of gums, with great efficiency and effectiveness. In operation, after the teeth are brushed with toothpaste, only the brushable exposed sides and chewing surfaces of the teeth are substantially cleaned for removal of bacteria and foreign particles. The directed water jet of the new toothbrush contributes to the flushing of toothpaste from the mouth; but it simultaneously, and this is most important, serves as the effective instrument for cleaning between teeth, between bridges and gums, and for cleaning other crevices in the oral cavity, as well as for cleansing and stimulating the gums. Thus, all necessary cleaning and treatment is accomplished to limit or even prevent decay of the teeth and recession of the gums. This is made possible by my new toothbrush because its component parts or elements cooperate in accomplishing the necessary cleaning functions, without any part improperly interfering with others in performing those functions rapidly, effectively, and conveniently.

It should be recognized that oral cleaning is accomplished by people mostly by feeling the effect of the cleaning instrument on the areas of the gum contacted during the oral cleaning. The new water-jet toothbrush permits one to place the water-jet exit orifice of the toothbrush in essentially direct contact with gum lines and areas adjacent teeth and bridges requiring cleansing. This permits one to "sense" or "feel" the proper position of the jet to effect full jet action under bridges and the like. Heretofore, bristles of known water-port toothbrushes have been around the water ports in such profusion that, even if a jet orifice were substituted, the effect of it for practical cleaning would be negligible because proper "feel" or "sensing" of the orifice to orient it for fully effective cleaning under bridges and the like becomes lost in the profusion of bristles.

The invention will further be described by reference to a drawing, made a part hereof, wherein:

FIG. 1 is a side plan view of a complete oral-cavity-cleaning device according to the invention, with parts broken away for partial cross-sectional view;

FIG. 2 is a side view of a clamp, which is illustrated about the water supply tube in FIG. 1;

FIG. 3 is a dorsal (back) plan view of a toothbrush illustrating alternate embodiments for structural features of the invention;

FIG. 4 is a cross-sectional view taken on line 4—4 of FIG. 3;

FIG. 5 is an enlarged cross-sectional view illustrating a further embodiment of the invention, taken through a longitudinal plane from the dorsal to the ventral bristle-tuft side of the toothbrush; and

FIG. 6 is a fragmentary dorsal view of a unitary toothbrush handle and conduit.

Referring to the drawing, the new oral-cavity-cleaning device comprises a toothbrush having an elongated head **10** equipped with toothbrush bristle-tufts **11** extending laterally off one side thereof. The lateral side off which the bristles extend is conveniently referred to as the ventral side or surface of the head, whereas the opposite lateral surface of the head is conveniently called the dorsal or back surface. Left and right lateral sides are those between the ventral and dorsal sides, and are determined by viewing the dorsal side with the head up. Illustratively, an elongated head is usually at least 25 percent or 50 percent longer than its widest side. Such heads generally are at least 1 cm. long, usually about 2 to 3 or possibly 4 cm. long (or even 5 cm. long, especially where a constriction toward a neck portion at the base end is considered part of the head). The ventral widths are at least 5 mm., usually about 1 centimeter (e.g. 7 or 8 to 12 mm.). Dor-

sal widths may be narrower than the ventral, but are in most cases comparable to the ventral. Left and right lateral side widths or thicknesses are about 3 or possibly 4 mm. up to about 5 or 6 or possibly 8 mm. (with about 12 mm. being normally the maximum useful left and right lateral side width or thickness). Deviation from these illustrative dimensions is possible so long as the essential features described are retained.

A water passage **12** extends longitudinally within the elongated head. The cross-sectional area of this water passage in the posterior or base part **13** of the head, i.e., the end of the head opposite the anterior end **14** of the head, is no greater than 20 square millimeters. It is usually no greater than about 15 or even 10 sq. mm., and may be even smaller, e.g. no more than 5 sq. mm.; but it is never below at least 1 or 2 sq. mm. in cross section at the minimum in this portion of the toothbrush.

The portion of the water passage in the anterior end **14** of the head **10** is laterally curved, as at **15**, within the head toward a lateral termination **16** at the anterior end portion **14** of the head **10**. The curvature **15** suitably and preferably is at first away from the lateral side of the head at which the water passage terminates, and is then gradually toward the side of the head where it terminates. A smooth water path without sharp corners is preferred to reduce internal turbulance such as might interfere with a uniform jet action.

Termination **16** consists essentially of a directed-water-jet exit orifice **16** no greater than about 3 sq. mm. in cross-sectional area. This orifice may be as small as 0.2 sq. mm. in cross section, but usually is at least about 0.5 sq. mm. up to 2 or even possibly 3 sq. mm. in cross section. Above about 2 or 3 sq. mm., the size becomes so large that the jet feature is lost; and below about 0.2 sq. mm., even to some extent below 0.5 sq. mm., the opening is so small as to introduce the danger of excessive and even harmful jet pressures. Generally, the orifice is approximately round or oval in character. If it is oblong, its widest width is not over about twice its narrowest width dimension.

At least the last stretch (e.g., the last two millimeters) of the water passage **12** immediately adjacent to the orifice **16** is of a cross-sectional area approximately equal to the cross-sectional area of the single orifice. Of course, this last 2 mm., preferably even the last 4 or 5 mm., of the water passage adjacent the orifice, while essentially of similar cross-sectional area to the orifice and preferably essentially straight, may vary 5 to 10 or even 15 percent in total cross-sectional area from the cross-sectional area of the orifice. Such variations are not considered significant, and may arise in manufacture even when attempts are made to maintain precise dimensions. The important criteria is the maintaining of a directed jet exit for the water as it leaves the orifice, which means that drastic changes of cross-sectional area between the orifice and the adjacent water passage should be avoided. Generally, this means that an adjacent stretch of water passage at least equal in length to the widest width of the jet exit orifice should not be of total cross-sectional area significantly different from the cross-sectional area of the orifice.

As illustrated, the lateral curvature and cross-sectional area of the water passage within the anterior end of the head are such that water exiting from the orifice jets therefrom in a single directed stream essentially free of contact with bristle-tufts of the head and at a forward angle between about 95° and 160° (preferably between 110° and 135°) from the elongated head. Thus, the direction of slant for the terminal portion of the lateral curvature of the water passage (i.e., its portion which is essentially straight and lies immediately adjacent the orifice) is oriented in the direction of the jet; that is, the extended direction of the terminal portion of the passage is at an angle between about 95° and 160° (preferably between 110° and 135°) from a longitudinal line generally along the lateral side of the head where the water passage terminates. Preferably, the termination is toward the lateral side characterized as the ventral side (the side holding the bristle-tufts); and the orifice termination is sufficiently toward the anterior end of the head of the toothbrush so that the jet of exiting water either passes outwardly from the head entirely free of contact with bristles or with only minor bristle contact (e.g. a few anteriormost bristles, possibly those squashed or spread by use so that some extend into the jetstream) insufficient to destroy the jet character of the existing stream. The most preferred angle for water jet exit is about 120° from any longitudinal lateral surface of the elongated head, inasmuch as this angle appears to provide an oral-cleaning jet direction most conveniently manipulated through movements of the toothbrush handle **17**.

Referring to FIG. **3**, the exit orifice may optionally comprise a laterally pointing nozzlelike projection **18** from the main body **10** of the head of the toothbrush. The orifice, regardless of its lateral termination, whether pointing toward the ventral, dorsal, or other side surface of the head may comprise such a nozzle projection. When a nozzle is used, it does not project more than about 2 or possibly 3 mm. beyond surrounding surfaces of the head (i.e., the otherwise surface level of material of the head); and preferred practice is to avoid a nozzle projection beyond surrounding surface levels, except possibly a nozzle projection not over or approximating about 1 mm. beyond surrounding surfaces of the head. A nozzle projection as discussed is provided with relatively smooth exterior surfaces free of sharp corners or edges which might introduce a cutting hazard. A nozzle aids the "feel" for positioning of the exit orifice properly for effective cleaning, and is not so great as to interfere with the usual toothbrushing manipulations.

Connector means **19** is provided to removably connect the end of the water passage **12** opposite the orifice **16** to a source of water, that is, a means providing or guiding water. The connection may be to a member comprising a water supply passage **20**.

As illustrated in FIG. **1**, the elongated handle **17** is unitary or integral with the elongated head and unified with the end of the head opposite the anterior end thereof to extend longitudinally therefrom, with the water passage **12** through the head also extending through the handle **17**. Connector means **19** is illustrated in FIG. **1** as comprising a mere annularly ribbed and constricted portion at the end of elongated handle **17**.

In the embodiment illustrated in FIG. **3**, the elongated handle **17** is formed so as to be removable from the head of the toothbrush, or vice versa; and in this case, connector means **21** at the end of water passage **12** opposite the anterior end of the head **10** preferably is oval or noncircular or noncylindrical in shape, so that the meshing or mating parts **21** and **22** to form the connection between the handle **17** and the head **10** are less apt to accidentally rotate during brushing movements. Additionally, to prevent the head from slipping out of the handle during longitudinal brushing movements, it is preferred to provide interlocking annular-type ribs on the mating parts of the connector between the head and handle, as illustrated in FIG. **3**. If desired, however, connector means **21** may comprise a threaded member cooperative with a threaded mating part on handle **17**, analogous to threaded connector parts **23** and **24**. Threaded connection **23**, illustrated in FIG. **3**, is connected to water supply tube **20** through an internally threaded nutlike member **24**. But a connector of the type illustrated in FIG. **1**, or any other suitable connector, may solely be employed to join the handle **17** and water supply tube **20**. The water supply passage **20** shown in FIG. **3** connects to water passage **25** in handle **17** and to water passage **12** in head **10**.

In the embodiment illustrated in FIG. **5**, the walls **26** of the water passage **12** are preformed and consist essentially of a material having a higher melting temperature or softening temperature than the remaining material **27** forming the head (as well as handle) of the toothbrush. A 10° C. differential in temperature is sufficient. These walls **26**, as well as the remaining material **27**, may be formed of any suitable material such as organic plastic (e.g., polystyrene, irradiated polyethylene, polytetrafluoroethylene, polyamides such as "nylon" or any other suitable organic plastic) — or a glassy or ceramic material — or a metal material (e.g., stainless steel, copper, or any other suitable metal). Of course, these materi-

als may be employed in forming the head or handle, or both, of any embodiment of the invention; but where the walls **26** of the water passage are preformed as illustrated in FIG. **5**, a convenience in manufacture is introduced by employing material (e.g., a highly polymerized polystyrene) for those walls which does not soften or flow when the remaining material **27** (e.g. a polystyrene of slightly lower polymerization and therefore lower softening range) is shaped about the walls while in a heat-softened plastic condition. If desired, metal walls may be used, and adherent organic plastic or glass employed as the remaining material. As illustrated in FIG. **5**, the connector **19** for the end of the water passage **12** opposite the anterior end of the head may comprise a projection of the wall material **26** out of the end of the handle **17**. To be noted is the point that connector **19** in FIG. **5** may be omitted, and wall material **26** may extend as a flexible conduit to a connector (such as **28** shown in FIG. **1**), i.e., one adapted to be affixed to a member such as a water faucet. Also to be noted is that separate head **10**, as illustrated in FIG. **3**, may be formed using the principles here discussed for FIG. **5**; or, as illustrated in FIG. **5**, the entire head and handle, whether unitary or removable, may be so formed.

Passage or conduit **20** is such that at least a portion thereof is flexible and is in the nature of a tube. As illustrated in FIGS. **1** and **5**, this water supply passage **20** is easily slipped over connector means **19**; and a flexible annular band **29** may be slid into place over the connection, if desired.

In all embodiments, the passages feeding the portion of water passage **12** at the base **13** of head **10** are of sufficient cross-sectional area to provide adequate waterflow. These passages need not exceed about 20 sq. mm. in cross-sectional area.

Referring to FIG. **1**, connector or attachment means **28** serves as a means for connecting flexible water supply tube **20** to a water faucet or source. The connector **30** between attachment means **28** and tube **20** may be of any suitable type, e.g., suitably one similar to the connector between the end of handle **17** and tube **20**. Preferably, attachment means **28** is equipped with bypass ports **31** through which water from the faucet may pass when the water supply tube **20** is constricted or closed, as by clamp member **32**. Clamp member **32** is adjustable so that the flexible water supply tube **20** may be opened for water passage by merely placing the ring area **33** of the clamp member about the water supply tube. To close the water supply tube **20**, and therefore cause water from the water faucet to be discharged through the bypass **31** without entering the water supply tube **20** and without entering the water passage **12** in the head **10** of the toothbrush, all that need be done is to pinch the prongs **34** of the adjustable clamp member **32** and slide it over the water supply tube so that, upon release of the prongs **34**, the flexible water supply tube is collapsed between the relatively flat portions **35** of the clamp.

In FIG. **6**, an embodiment is illustrated for a unitary handle and flexible conduit structure so united together that the parts are integral or nonremovable one from the other. This structure is suitably formed by shaping heat-softened polyethylene in the form of handle **17** and conduit **20**, with a water passage **25** extending through both, and then, after setting the structure by cooling, subjecting the handle **17** to high intensity electron irradiation to stiffen it, should further stiffening or rigidification be desired. Another way to form this structure is to heat seal or mold together, under heat and pressure, a handle **17** with water passage **25**, formed of relatively stiff plastic such as polystyrene, and a tube **20** of any suitable plastic bondable to the material of the handle **17**. Still another technique, which also provides a structure free of connector **19** (see FIGS. **1** and **5**) and free of connector **23** (see FIG. **3**) is best discussed by reference to FIG. **5**. This technique contemplates a flexible tube of wall material **26** and any suitable material shaped and bonded about an end portion of the tube to form handle **17**.

In forming any of the toothbrushes or cleaning devices of this invention, bristle materials, whether natural (e.g. hog or horse hair) or synthetic (e.g. nylon) may be employed.

The connection between the head and handle of the toothbrush may be at a slight angle, as is conventional, without departing from the essentially longitudinal relationship between the head and handle, or a pressure reduction unit may be introduced in the water supply passage, or other nonessential features added to those essential features and relationships discussed; but added elements are unnecessary and not necessarily desirable for effective oral hygiene using the instrument of this invention. Minor variations to the foregoing teaching, without departing from the spirit and scope of the appended claims, as construed under the law on equivalents, are comprehended, including those variations involving the use of new materials which are constantly being discovered and which sometimes provide benefits essentially attributable to the materials themselves.

That which is claimed is:

1. As a new article of manufacture: a toothbrush comprising an elongated head having a rounded anterior end and equipped with toothbrush bristle-tufts extending laterally off one side thereof from adjacent said anterior end, a water passage extending longitudinally within said elongated head, the cross-sectional area of said water passage in the part of said head opposite the anterior end of said head being no greater than 20 sq. mm., the portion of said water passage in the anterior end of said head being laterally curved within said head toward a lateral termination at the surface of said rounded anterior end of said head, said lateral termination of said water passage consisting essentially of a directed-water-jet exit orifice no greater than about 3 sq. mm. in cross-sectional area, at least the last stretch of said water passage immediately adjacent to said orifice and for a length at least as great as the widest width of said orifice being of a cross-sectional area approximately equal to said orifice, the lateral curvature and cross-sectional area of said water passage within the anterior end of said head being such that water exiting from said orifice jets therefrom in a directed stream essentially free of said bristle-tufts of said head and at a forward angle between about 95° and 160° from said elongated head, and connector means to removably connect the end of said water passage opposite said orifice to a source of water.

2. The article of claim **1** comprising, in addition, an elongated handle at the end of said head opposite the anterior end thereof and extending longitudinally therefrom, said handle and head being characterized by being unitary and by the fact that the water passage through said head also extends through said handle.

3. An oral-cavity-cleaning device comprising the article of claim **1**, a water supply passage affixed to said connector means, at least a portion of said water supply passage being flexible, attachment means at the opposite end of said water supply passage to affix the same to a water faucet, and adjustable means to cause water exiting from said faucet to pass through said water supply passage to said jet exit orifice or to be discharged in a bypass without entering the water passage in the head of said toothbrush.

4. The article of claim **1** wherein the material of the head consists essentially of organic plastic material and the water passage consists essentially of a hole through said plastic material.

5. The article of claim **1** wherein the walls of the water passage are preformed and consist essentially of a conduit member formed of material having a higher melting temperature than the remaining material forming said head, said article being made by a process comprising shaping said remaining material of said head in a heat-softened plastic condition about said preformed walls of said water passage.

6. The article of claim **5** wherein both the preformed walls of the water passage and the remaining material forming said head consist essentially of organic plastic.

7. The article of claim **1** wherein the jet exit orifice at the anterior end of said head points toward the lateral side of said head equipped with said bristle-tufts.

8. The article of claim **7** wherein the termination of the jet exit orifice lies in essentially the same surface plane as sur-

rounding material of said head, without projecting outwardly therefrom to form a nozzle.

9. The article of claim 1 wherein the jet exit orifice at the anterior end of said head points in a lateral direction from said head other than toward the lateral side of said head equipped with said bristle-tufts, and wherein the termination of said jet exit orifice lies in essentially the same surface plane as surrounding material of said head, without projecting outwardly therefrom to form a nozzle.

10. The article of claim 1 wherein the jet exit orifice comprises a nozzle formation which projects outwardly up to about 1 mm. from the surface plane of surrounding material of the head.

11. The article of claim 1 wherein at least the last 2 millimeters of the water passage adjacent to the orifice has a cross-sectional area approximately equal to the cross-sectional area of said orifice.

12. The article of claim 1 wherein the lateral curvature and cross-sectional area of at least the last 4 millimeters of the water passage conduit adjacent the orifice are such that water exiting therefrom jets in a stream at a forward angle between 110° and 135° from the elongated head.

13. The article of claim 1 comprising, in addition, a removable elongated handle connected to the end of said head opposite the anterior end thereof, with a water passage through said handle connecting with the water passage in said head.

14. The article of claim 13 having a flexible conduit nonremovably united to the end of said handle opposite the end connected to said head.

15. A water-jet toothbrush comprising a toothbrush having

an elongated head having a rounded anterior end and secured to one end of a handle extension and equipped with toothbrush bristle-tufts extending laterally off one side thereof from adjacent said anterior end, a water passage extending longitudinally within said elongated head, said water passage exiting adjacent said anterior end of said head into a single directed-water-jet exit orifice ending at the surface of said rounded anterior end and positioned such that water exiting therefrom under pressure jets in a directed stream which is effectively free of said bristle-tufts and at a forward angle of no less than 95° from said elongated head, and connector means to removably connect the posterior end of said water passage to a source of water under pressure.

16. The water-jet toothbrush of claim 15 characterized in that said water passage extends longitudinally through said handle.

17. The water-jet toothbrush of claim 15 characterized in that the jetstream of water is directed forwardly with the direction of extension of said passage and at a forward angle of between 95° and 160° with the axis thereof.

18. The water-jet toothbrush of claim 17 characterized in that said orifice is a directed-water-jet exit having an orifice no greater than about 3 square millimeters in cross-sectional area.

19. The water-jet toothbrush of claim 18 characterized in that the last portion of said water passage immediately preceding said orifice and for a length at least as great as the widest width of said orifice is of a cross-sectional area approximately equal to that of said orifice.