May 19, 1970 T. L. TAYLOR 3,512,202

POWER TOOTHBRUSH AND GUARD THEREFOR

Filed May 31, 1968

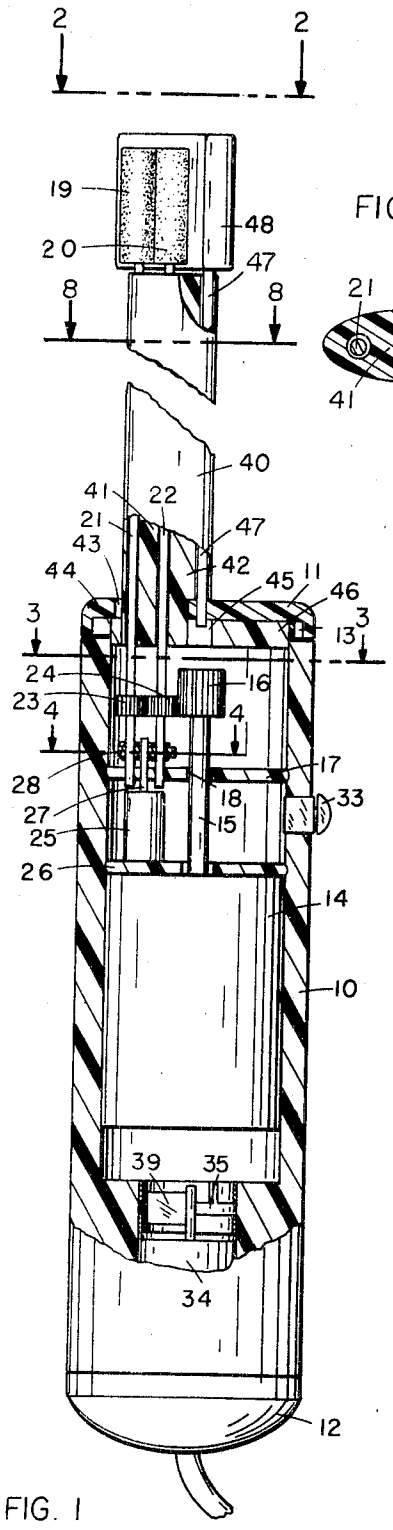

FIG. 1

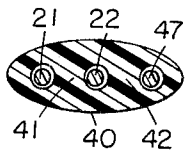

FIG. 8

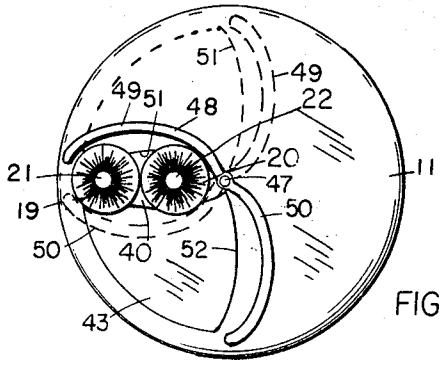

FIG. 2

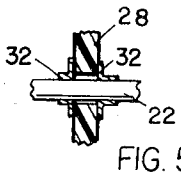

FIG. 5

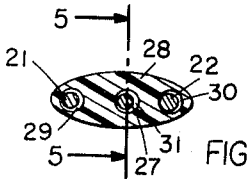

FIG. 4

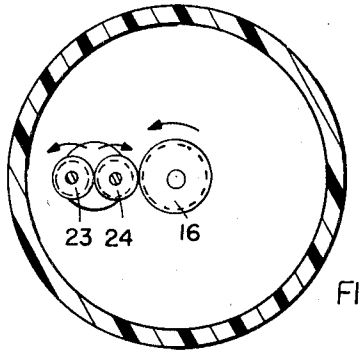

FIG. 3

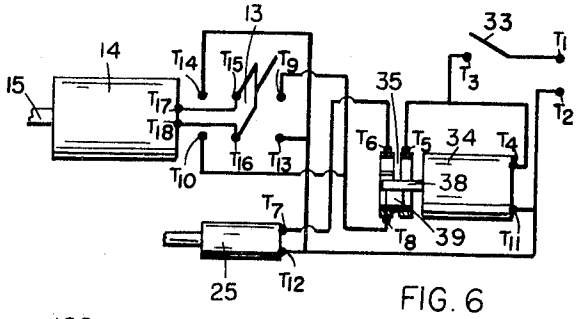

FIG. 6

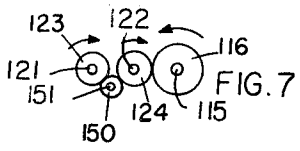

FIG. 7

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POWER TOOTHBRUSH AND GUARD THEREFOR

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Continuation-in-part of application Ser. No. 633,556, Apr. 25, 1967. This application May 31, 1968, Ser. No. 733,436

Int. Cl. A61c *17/00;* A46b *13/02*

U.S. Cl. 15—23 11 Claims

ABSTRACT OF THE DISCLOSURE

A reversible, rotary power toothbrush with reversible guard. When the motor reversing switch is actuated to energize the motor for rotation of brush in selected direction, a rod extending from the switch plate to a dual guard automatically turns the guard to correct position for shielding the brush from user's cheeks and lips, corresponding to the brushing position for selected brush rotation. When the switch is actuated for reversal of brush rotation and corresponding change in brushing position, the guard is automatically reversed correspondingly.

This application is a continuation-in-part of application Ser. No. 633,556, filed Apr. 25, 1967, entitled "Power Toothbrush."

This invention relates to power toothbrushes, more particularly the rotary brush head type. In its preferred form this invention employs dual brush heads.

Various motions have heretofore been proposed and used in power toothbrushes. The principal motions are: reciprocating, oscillating, rotating. However, no single motion alone is entirely satisfactory for the complete toothbrushing operation.

Reciprocation of bristle tips transversely of tooth faces and gingiva is generally undesirable, because continuous straight line motion of the tips across teeth and tissue may be severely injurious thereto. Such action may injure the tooth enamel, even cut grooves therein. Gingivitis may develop, and in any event, not only is brushing across the gingiva hazardous, such action does not effectively clean under the gingiva, in the crevices, or provide proper toning.

The most effective brush motion for general cleaning along the fronts and backs of the teeth is a rotary sweeping motion, beginning just above the gum line and continuing along the tooth face to the biting edge. A similar rotary or rocking motion is generally effective for cleaning the tops of molars and bicuspids. In the case of power toothbrushes, efforts have been made to simulate the desired action of the bristles by a rapid oscillatory motion of the brush head, with the intent that the user hold the brush with its head shaft parallel to the gum line, the brush tips then sweeping back and forth across the faces of the teeth. However, this scheme has the serious disadvantage that for half of each cycle the bristle tips move in the wrong direction, that is, toward the gingiva, in large part nullifying the effectiveness of the brushing action in the other half cycle, the result being largely moving debris back and forth along the teeth rather than removing it. Furthermore, when brushing near or upon the gingiva, as is necessary for removal of debris from beneath them and for toning, the reverse motion of the bristle tips may cause serious damage. Due to the relatively high speed at which a powered oscillating brush head operates, it is impossible to offset or ameliorate the undesirable bristle action by manipulation.

Because of the foregoing objections to reciprocating and oscillating bristle motion, a steady rotary brush head motion is preferable for cleaning tooth surfaces under power

operation, with the bristle tips steadily sweeping unidirectionally in an arcuate path. By providing a reversible drive, the direction of rotation can be established as required for brushing up or down, or from right or left hand, as required for cleaning in the various areas. However, I find that for cleaning between teeth, even the rotary motion may often be largely ineffective, due to the tendency merely to force debris into the crevices under pressure of the bristles, and without dislodging particles adhering tightly to tooth faces. These objections can be avoided or minimized by vibrating the bristles, with the bristle tips held stationary for a short period, the vibration loosening the particles sufficiently, so that, upon resumption of the arcuate sweep, the particles will be removed, rather than pressed onto the teeth and into the crevices.

It is desirable that a brush guard be provided, to obviate the rapidly rotating brush bristles scraping and damaging the delicate tissues of lips and cheeks inside the oral cavity. With a reversible brush, the guard must also be reversible, to provide effective shielding in alternative positions of the brush corresponding to the alternative brush rotation. Such guard reversal is preferably automatic, to eliminate the risk that user may otherwise apply the brush with the same rotating in the wrong direction for desired brushing position.

It is a principal object of this invention to provide in a power toothbrush a dual head motion, whereby most effectively to clean all surfaces of the teeth and gums, as well as crevices, throughout the mouth, with a minimum demand or reliance on manipulation by the user.

Another object of this invention is to provide in a power toothbrush having a reversible brush an automatically positioned reversible guard, whereby the guard is at all times in proper shielding position corresponding to correct brush rotation for selected brushing position.

Yet another object of this invention is to provide a power toothbrush which is convenient to use and yet effects satisfactory, dependable tooth cleaning and gum massage with a minimum demand for manipulation by the user.

The foregoing and other objects and advantages of the invention will be apparent upon reading the following description in conjunction with the accompanying drawings, wherein:

FIG. 1 is a foreshortened side view of the toothbrush of this invention, with a portion of the case cut away to expose the drive and control mechanisms therein;

FIG. 2 is a head end view of the brush assembly taken on line 2—2 of FIG. 1;

FIG. 3 is a transverse section through the case on line 3—3 of FIG. 1;

FIG. 4 is a transverse section taken through the reciprocating drive plate on line 4—4 of FIG. 1;

FIG. 5 is an enlarged section on line 5—5 of FIG. 4, showing details of connection between reciprocating shafts and the reciprocating plate;

FIG. 6 is a circuit diagram showing the electrical system and apparatus for driving and controlling the brush heads; and

FIG. 7 is a view showing a modified gear train for driving dual brush heads in the same direction of rotation; and

FIG. 8 is a section on line 8—8 of FIG. 1.

Referring now to FIG. 1, reference numeral **10** indicates the case for the drive and control elements, which case also serves as a handle. Case **10** is provided with removable caps **11** and **12**, which seal the case and permit access for insertion and removal of the drive and control components. The caps may be fastened to the case in any suitable manner, for example, by means of dowels or screws (not shown).

A gearmotor **14** is set into case **10** approximately midway thereof, with an extended coaxial output shaft **15** projecting toward cap **11**. At its outer end shaft **15** carries a wide-faced spur gear **16**. In order to minimize bending load and whip of shaft **15**, and for another purpose later to be described, a support plate **17** is provided about midway of the shaft extension, having a close-fitting central aperture **18**, through which the shaft **15** extends.

Gearmotors such as that here illustrated are well-known and commercially available. Therefore, detailed description thereof is not necessary here. Gearmotor **14** is selected for an output shaft speed which is best suited to producing the desired brush head speed through an associated drive train which meets the space limitations and efficiency requirements for the particular combination. In the embodiment here illustrated gearmotor shaft speed of 500 r.p.m. is desirable, involving a 7/1 reduction unit in gearmotor **14** from synchronous full load motor speed on 60-cycle-AC power supply. Gearmotor units having other output speed and/or reduction ratios are available or readily made in accordance with well known practices, as may be required for other power supply drive trains and ultimate brush-head speed.

The example here illustrated involves driving twin rotary brush heads **19** and **20** through twin drive shafts **21** and **22**, which at their inner ends are journalled in support plate **17** parallel to and alongside gearmotor shaft **15**. Shafts **21** and **22** carry spur gears **23** and **24** in mesh, gear **24** in turn meshing with gear **16** on output shaft **15**. A solenoid **25** is mounted on motor face plate **26** alongside output shaft **15**, with the reciprocating solenoid output shaft **27** midway between drive shafts **21** and **22**, shaft **27** extending through support plate **17**.

As best seen in FIG. 2, brush heads **19** and **20** are of the same outside diameter. For uniform cleaning action both brush heads preferably rotate at the same speed. Therefore, the gears **23** and **24** are preferably meshed in 1/1 ratio, as best seen in FIG. 3. As will be apparent from inspection of FIG. 1, the diameter of gears **23** and **24** is a function of the diameters of brush heads **19** and **20**, which in turn are primarily determined by considerations of dental structure and accessibility in the oral cavity, together with the requirement of providing a brush drive and case which are as simple, safe and convenient as possible. In the arrangement illustrated here it is found that gear **16** need be somewhat larger in diameter than gears **23** and **24**, whereby brushes **19** and **20** rotate at a speed somewhat greater than that of gearmotor drive shaft **15**. For example, with 500 r.p.m. for shaft **15**, brushes **19** and **20** rotate at 1000 r.p.m. With brush heads approximately ¼ inch in outside diameter, which I have found to be a suitable size, the bristle tip speed is about 13 i.p.s., substantially an optimum cleaning speed from the standpoints of safety and effectiveness.

Referring again to FIG. 1 and also to FIG. 4, an elliptical bridge piece **28** spans drive shafts **21** and **22**, apertures **29** and **30** being slightly larger than the diameter of shafts **21** and **22**, so that the latter may rotate freely with respect to bridge **28** when driven by gear motor **14**. Solenoid shaft **27** extends through aperture **31** in bridge **28**. Ferrules or washers **32** are affixed to shafts **21**, **22** and **27** in position to constitute flanges on both sides of the bridge **28** along each of the shafts. Thus, when solenoid **25** is energized, brush shafts **21** and **22** will reciprocate with solenoid plunger **27**, gears **23** and **24** remaining in mesh and gear **24** remaining in mesh with gear **16**, the latter's face being somewhat wider than that of gear **24** to insure full engagement in any axial position of the latter within the stroke range, and with allowance for normal variations in assembly.

Operation of the gearmotor **14** and solenoid **25** is controlled by means of (1) a manual switch **33**, conveniently located in the wall of case **10** at a position readily accessible to the user's thumb when gripping the case for comfortable manipulation of the brush assembly, (2) a timer **34**, with rotary contactor **35**, in the rear of case **10**, behind gearmotor **14**, and (3) interlocking electric circuitry, best seen in the block wiring diagram in FIG. 6. Terminals T_1 and T_2 indicate the prongs of the conventional electrical plug in circuit through an external switch **33**, such as a toggle switch, serving as a safety switch, permitting the brush to be left plugged in, but guarding against accidentally energizing the brush mechanism while handling the unit when not in actual use. Closing of the switch **33** at T_3 connects T_1 to timer **34** at T_4 and to one leg of contactor **35** at T_5. T_6 on the other leg of contactor **35** is connected to solenoid **25** at T_7. The other leg of contactor **35** is connected from T_8 to T_9 on one throw of switch **13** and to T_{10} on the other throw of switch **13**.

Input terminal T_2 is directly connected to T_{11} of timer **34**, T_{12} of solenoid **25**, T_{13} on one throw of switch **13** and T_{14} on the other throw of switch **13**.

Throw-arm double-contactor **37** of switch **13** is directly connected through T_{15} and T_{16} to terminals T_{17} and T_{18} respectively of gearmotor **14**.

T_{10} and T_{14} are on a winding of gearmotor **14** for operation in one direction of rotation, while T_9 and T_{13} are on a winding of gearmotor **14** for operation in the opposite direction of rotation. Therefore, throwing switch arm **37** in one direction establishes a winding circuit for forward motor operation and throwing the arm in the other direction establishes a winding circuit for reverse rotation. However, as previously noted, one switch pole on each motor winding circuit is connected through rotary contactor **35** on shaft **38** of timer **34**. Contactor **35** is of the rotary, wiping-cam type, well-known in the timer art, thus not requiring description here in detail. The wiper cam **39** is in this case selected to establish circuit between T_5 and T_8 during a portion of a revolution. The arc of contact is selected to establish the relative portions of the revolution in each circuit contact, while the speed of the timer **34** determines the period of contact in each circuit, contact to T_8 energizing gearmotor **14** and contact to T_6 energizing solenoid **25**, while cutting off gearmotor **14**.

When solenoid **25** is energized, brush heads **19** and **20** reciprocate by virtue of the arrangement previously described. The stroke of solenoid plunger **27** is preferably quite short, on the order of 1/16" to 1/8", as determined by the selection of solenoid winding and armature according to well-known principles. With the user holding the brush bristles firmly against the teeth in the normal rotary cleaning operation of the heads **19** and **20**, the introduction of reciprocating motion, while cutting off the rotary motion, will cause the bristles to vibrate in the direction of the solenoid plunger stroke, the stroke being so short that the tips of the bristles do not move, pressure against the teeth precluding tip motion. This action may aptly be termed "vibrato." I find that this vibrato action is extremely effective in loosening particles of debris, particularly in the crevices, whereafter resumption of rotary head motion sweeps the debris from the teeth and out of the crevices. Assuming a total brushing time of **30** seconds in a given region without substantial translation of the brush heads, about 7–8 seconds is a desirable portion of the total brushing time in one region for vibrato action. Therefore, timer **34**, of the usual geared type, is selected for a shaft speed of 2 r.p.m., with motor contact during 75% of each revolution and solenoid contact during the other 25% of each revolution. However, it will be obvious that the timer and contactor can be selected in various combinations for other time cycles, such timers and contactors being available in a wide variety of combinations.

Referring again to FIG. 1, the extended portions of shafts **21** and **22**, beyond cap **11**, are journalled in sleeve **40**, which is generally elliptical in cross-section, as best seen in FIG. 2, baffles **41**, **42** supporting the shaft extensions to minimize whip and undesirable lateral vibra-

tion. An inner end portion of housing **40** extends through aperture **43** in cap **11**, bearing on wall **44** of aperture **45** in bushing **46**, while the inner end portion of baffle **42** extends through aperture **43** and bears on wall **47** thereof, anchoring the shaft housing assembly against accidental dislodgement or shift. It will be understood that brush heads **19** and **20** may be splined or otherwise removably coupled to shafts **21** and **22**, to facilitate replacement of worn brushes, or interchange for hygienic reasons, if the unit is to be used by several persons. Means for such removable brush attachment are well known in the art and therefore not here illustrated or described in detail.

A lip and cheek guard **48** is preferably provided adjacent brush heads **19** and **20**, so that the bristles thereof will not inadvertently scrape soft oral tissues. Guard **48** is preferably made of relatively rigid material, to serve its protective function, yet conform comfortably in the oral cavity in various brushing positions, and is arranged to provide for reversal of brush exposure when cleaning on opposite sides of the teeth, or changing hand, according to the direction of brush rotation, as hereinafter described.

The gear drive above described is adapted to rotate the brush heads in opposite directions. This arrangement is slightly disadvantageous for brushing behind the teeth, since, with the opening necessary for the holder, the heads must be moved up and down to reach uppers and lowers, only one brush being operative at a given instant. If desired, the brushes can be geared for rotation in the same direction by use of an idler gear, as shown in FIG. 7, wherein parts corresponding to those of previous drawings are correspondingly numbered, with the addition of **100**. Drive gears **123** and **124** are here separated, gear **124** being meshed with gear **116**, on gearmotor shaft **115**. Idler gear **150** is interposed in mesh with gears **123** and **124**, on brush head shafts **121** and **122**, so that the latter rotate in the same direction, as indicated by the arrows. The idler gear shaft **151** may be mounted on plate **17** (FIG. 1), just below bridge piece **28**. With the brush heads rotating in the same direction, both brushes are applied to the same line of teeth at one time, one operating on or near the gingiva, the other toward the tooth edges. In such case one brush in effect feeds debris to the other, providing a "conveyor" action.

With either brush drive arrangement, the reversing switch **13**, indicated diagrammatically in FIG. 6, may be conveniently incorporated into the cap **11**, in the form of a rotary switch having contactors for forward, off and reverse motor conditions, as previously described. A suitable location of switch **13**, in the arrangement shown in FIG. 1, is between cap **11** and case **10**, as indicated generally by the reference numeral **13**. Switch structures of this type are well-known in the electrical appliance arts, as used on mixers, blenders, fans and other multi-speed appliances. In this instance, suitable indicia may be provided on the cap **11** and adjacent portion of case **10**. The user can readily position the cap and switch **13** for selected motor condition by turning the cap with thumb and index finger, while holding case **10** with the palm or the other hand. However, other switch arrangements may be used.

Referring again to FIGS. 1 and 2, guard **48**, comprising arcuate wings **49** and **50**, is affixed to the outer end of shaft **47**, which extends axially of sleeve **40** from the inner end fixed in cap **11** at the center thereof. As best seen in FIG. 8, shaft **47** is free to rotate relative to sleeve **40**. Therefore, as cover switch-plate **11** rotates along contacts of switch **13**, guard wings **49** and **50**, joining at shaft **47**, rotate with plate **11** through the same angle of rotation. As best seen in FIG. 2, about 90° rotation of shaft **47** fully reverses guard **48**, bringing wing **49** from shielding position at one extreme, represented by the full lines, to the position represented by broken lines, at which latter position wing **50** shields brushes **19, 20** from the side opposite to that of wing **49**. The opening **43** in the face of cap **11** is a sector of about 90° angle, as defined by edges **51, 52**, so that the cap is free to turn the amount required to reverse guard **48**. The contacts in switch **13** are spaced 90°, positioned and connected to the motor in such manner that with contact at given terminal the motor rotates the brushes in the direction corresponding to the guard position established by turning cover **11** to such given contact.

When one guard wing is in shielding position, the other wing, by virtue of its retraction and relatively stiff material, is maintained in such attitude relative to the user's oral cavity as may be comfortable at selected brushing position.

It will be apparent from the foregoing description that the power toothbrush of this invention is highly advantageous in providing for effective tooth cleaning with minimum manipulation by the user, by virtue of programming dual brush action for the stages of loosening and removing debris from the teeth and gingiva, safely and fully. While I have illustrated and described a preferred embodiment of the invention, it will be understood that those skilled in the art will thereby be enabled to devise variations and modifications without departing from the spirit and scope of the invention, as defined in the appended claims.

The invention may be embodied in a unit having a single brush, should a more compact and less expensive appliance be desired. In such case, the housing, caps, drive parts, shaft sleeve may be simplified or reduced in size, as appropriate to the reduced mechanical and space requirements, although the general construction and mode of operation remain in principal aspects as heretofore described.

I claim and desire to secure by Letters Patent the following:

1. A power toothbrush comprising: a rotary brush; a shaft carrying said brush; reversible drive means connected to said brush; switch means associated with a portion of said drive means for selectively establishing the direction of rotation of said brush; a reversible guard for said brush, said guard having a first shielding position relative to one portion of said brush, corresponding to one direction of brush rotation, and having a second shielding position relative to a second portion of said brush, corresponding to the other direction of brush rotation; means shiftably supporting said guard independently of said shaft; and means associating said guard with said switch means for shifting said guard to said first position as said switch means establishes said one direction of brush rotation and shifting said guard to said second position as said switch means establishes said other direction of brush rotation.

2. A power toothbrush according to claim **1**, further including a second rotary brush adjacent to said first-named brush, said second brush being connected to said drive means, said brushes being rotatable on substantially parallel axes, said guard shielding both said brushes simultaneously when said guard is in either of said positions.

3. A power toothbrush according to claim **2**, wherein said guard comprises first and second wings, said first wing shielding said brushes when said guard is in said first position, said second wing shielding said brushes when said guard is in said second position.

4. A power toothbrush according to claim **2**, wherein said switch and guard shift associating means includes a rotatable shaft substantially parallel to said brush shafts, said guard being affixed to said shifting shaft.

5. A power toothbrush according to claim **4**, wherein said guard comprises a pair of wings affixed to a hub therebetween, said guard being affixed to said shifting shaft at said hub.

6. A power toothbrush comprising: a handle; a reversible motor in said handle; a brush shaft driven by said

motor, said brush shaft extending from said handle; a rotary brush on said brush shaft outwardly of said handle; a switch carried by said handle, said switch being adapted for selectively conditioning said motor to drive said brush shaft in either direction of rotation; a guard shaft connected to said switch, said guard shaft being substantially parallel to said brush shaft; a guard carried by said guard shaft outwardly of said housing in position to shield said brush, said guard comprising a pair of wings affixed to a hub therebetween, said hub being affixed to said guard shaft, said wings and hub being so configured that when a first one of said wings is in shielding position relative to a first portion of said brush, the second one of said wings is in a retracted position, exposing a second portion of said brush; and said guard shaft being so connected to said switch that when said switch is in a first position conditioning said motor to drive said brush in one direction, said first wing shields said first brush portion, and when said switch is in a second position conditioning said motor to drive said brush in the other direction, said second wing shields said second brush portion.

7. A power toothbrush according to claim **6**, further including a second rotary brush on a second brush shaft adjacent and parallel to said first-named brush shaft, said second brush shaft being driven by said motor simultaneously with said first brush shaft, said guard being adapted simultaneously to shield both said brushes.

8. A power toothbrush according to claim **7**, wherein said brushes rotate in the same direction when said motor runs in a given direction.

9. A power toothbrush according to claim **7**, wherein said brushes rotate in opposite directions when said motor runs in a given direction.

10. In a power toothbrush having a pair of closely spaced brushes rotatable on parallel axes and a guard shaft pivotable on an axis parallel to said brush axes, all said axes being substantially in a common plane, with said guard shaft laterally of said brush pair, a brush guard comprising a pair of wings affixed to a hub, said wings projecting generally in opposite directions from said hub, said hub being affixed to said guard shaft, each said wing being of a shape and size suitable for hooding said brush pair at a side thereof when said guard shaft is in a predetermined pivot position.

11. In a power toothbrush, a guard according to claim **10**, wherein said wings and said hub are so configured relative to said brushes that with said guard shaft in a first rotary position, a first wing extends generally parallel to said plane in a shield position along one side of said brush pair, the other side of said brush pair being exposed for brushing action, and, with said guard shaft in a second rotary position the second of said wings is in shield position along the other side of said brush pair, said one side being exposed for brushing action.

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EDWARD L. ROBERTS, Primary Examiner