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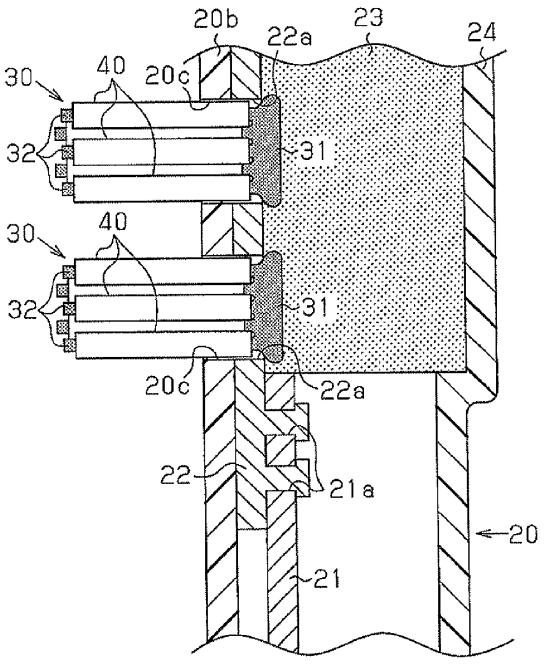
(54) Brush body and toothbrush including brush body

(57) A brush body (20) of a toothbrush (1) includes bristle bundles (30), each formed by a plurality of filaments (40). Each filament includes a core (41), which contains a conductive material, and an insulative sheath (42), which covers a side of the core. Each bristle bundle includes a basal portion at which basal ends of the cores are fused, solidified, and integrated with one another. The bristle bundle also includes a distal portion, which is formed by a distal end of each core. A ratio of the conductive material at the basal portion is equal to a ratio of the conductive material at the distal portion.

Fig.1 (b)



EP 2 394 530 A2

Description

[0001] The present invention relates to a brush body and a toothbrush including the brush body.

[0002] Japanese Laid-Open Patent Publication No. 63-249507 (patent document 1) discloses a motor-driven electric toothbrush. The electric toothbrush forms an electric circuit with the teeth and toothbrush bristles to generate a direct current (DC) pulse that improves the oral cleaning effect when brushing the teeth.

[0003] Japanese Laid-Open Patent Publication No. 6-90824 (patent document 2) discloses an electric toothbrush that decomposes plaque and stain, decomposes organic acid such as lactic acid that directly causes decalcification of the teeth, and sterilizes the mouth of bacteria that causes cavities and pyorrhea, which produce plaque, organic acid, toxin, and the like, Patent document 2 describes an arrangement in which an N-type semiconductor is connected to a positive electrode of the DC power supply. The N-type semiconductor comes into contact with moisture, such as saliva, in the mouth at either one of or both head and grip of the toothbrush. The electric toothbrush described in patent document 2 includes bristles, each obtained by vapor-depositing metallic titanium on the surface of a filament and oxidizing the surface of the metallic titanium to form a thin anatase titanium dioxide layer.

[0004] Japan National Phase Laid-Open Patent Publication No. 2000-504605 (patent document 3) discloses a device that detects plaque on the surface of a tooth or artificial tooth when brushing the teeth. This device includes an electrode, which includes an insulative outer surface and a conductive distal end placed on the surface of a tooth. The electrode is a filament formed from an elastic insulative material. The filament includes a core formed from a flexible conductive material.

[0005] Japanese Laid-Open Patent Publication Nos. 2006-102095 (patent document 4) and 2006-180953 (patent document 5) each disclose a toothbrush including a head. An electrode is arranged on the head. When current flows to the electrode, chloride ions in the mouth are transformed to effective chlorine to sterilize and clean the mouth. Patent document 4 discloses the arrangement of the electrode on the outer surface of the head near the bristles and the embedment of the electrode in the head in contact with the conductive bristles. Patent document 5 suggests the use of a conductive brush.

[0006] Japanese Laid-Open Patent Publication No. 2003-9947 (patent document 6) describes a method for manufacturing a toothbrush. The method includes bundling filaments, which are formed from an insulative material such as nylon, to form bristle bundles, fusing and solidifying basal ends of the filaments in each bristle bundle to form a fused ball, and embedding the fused balls in the bristle embedment base.

[0007] When brushing one's teeth with a toothbrush, it is difficult to completely remove plaque from fine gaps in which bacteria can easily reproduce. Such a gap may be formed between teeth or in periodontal pockets formed between the teeth and gum. Toothpaste and mouthwash containing effective sterilizing medicinal components such as cetylpyridinium chloride (CPC) are known to sterilize such gaps from bacteria.

[0008] Since medicinal components such as CPC are electrolytes, they are ionized when brushing the teeth and spread out over the entire mouth. However, it is preferable that the medicinal components be concentrated at an inflammation or lesion. Accordingly, as described in patent document 4, it is preferable for the bristles that directly contact desired locations in the mouth to be conductive and have current flow to the bristles.

[0009] Filaments having a so-called core-in-sheath structure may form a conductive bristle bundle. A filament having a core-in-sheath structure includes a conductive core and an insulative sheath, which entirely covers the side of the core.

[0010] When fusing and solidifying the basal end of a bristle bundle including core-in-sheath filaments in accordance with the manufacturing method of patent document 6, insulative components from the sheath may mix with the fused ball. As a result, the bristle bundle may not be formed with the desired conductivity.

[0011] An object of the present invention is to provide a brush body that suppresses the lowering of electrical conductivity of a bristle bundle including core-in-sheath filaments.

[0012] One aspect of the present invention in a brush body provided with a bristle bundle including a plurality of filaments. Each filament includes a core, which contains a conductive material, and an insulative sheath, which covers a side of the core. The core includes a distal end and a basal end projecting out of the sheath in a longitudinal direction. The bristle bundle includes a basal portion, at which the basal ends of the cores in the filaments are fused, solidified, and integrated with one another. The bristle bundle includes a distal portion, which is formed by the distal end of each core of the filaments. A ratio of the conductive material at the basal portion of the bristle bundle is equal to a ratio of the conductive material at the distal portion of the bristle bundle.

[0013] A further aspect of the present invention is a method for manufacturing a brush body. The method includes preparing a bristle bundle by bundling a plurality of filaments, wherein each filament includes a conductive core, which includes a distal projection and a basal projection, and an insulative sheath, which covers a portion of the core excluding the distal projection and the basal projection. The method also includes fusing and integrating the basal projections of the cores of the filaments without fusing the insulative sheaths to form a fused resin terminal of the bristle bundle. Further, the method includes electrically connecting the fused resin terminal of the bristle bundle to a head of the brush body.

[0014] Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying

drawings, illustrating by way of example the principles of the invention.

[0015] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 (a) is a cross-sectional view of a toothbrush according to a first embodiment of the present invention, and Fig. 1 (b) is an enlarged cross-sectional view of a brush body;
Fig. 2 is an exploded perspective view showing the brush body;
Figs. 3(a) to 3(c) are diagrams showing the steps for manufacturing a bristle bundle;
Figs. 4(a) to 4(d) are diagrams showing the steps for assembling the toothbrush;
Fig. 5(a) is a cross-sectional view of a toothbrush according to a second embodiment of the present invention, and Fig. 5(b) is an enlarged cross-sectional view of a brush body;
Figs. 6(a) and 6(b) are diagrams showing the steps for fixing bristle bundles to a head of the toothbrush of Fig. 5;
Fig. 7(a) is a cross-sectional view of a toothbrush according to a third embodiment of the present invention, and Fig. 7(b) is an enlarged cross-sectional view of a brush body;
Fig. 8 is an exploded perspective view showing the brush body of the toothbrush of Fig. 7;
Figs. 9(a) to 9(c) are diagrams showing the steps for assembling the toothbrush of Fig. 7;
Figs. 10(a) and 10(b) are diagrams showing the steps for fixing bristle bundles to a head of the toothbrush of Fig. 7;
Fig. 11 (a) is a cross-sectional view of a toothbrush according to a fourth embodiment of the present invention, and Fig. 11 (b) is an enlarged cross-sectional view of a brush body;
Fig. 12 is an exploded perspective view showing a brush body of the toothbrush of Fig. 11; and
Figs. 13(a) to 13(c) are diagrams showing steps for manufacturing the bristle bundle according to a comparative example.

First Embodiment

[0016] A first embodiment of the present invention will be described with reference to Fig. 1 to Fig. 4.

[0017] As shown in Fig. 1(a), an electric toothbrush 1 includes a grip 10 and a brush body 20 attached to a grip 10. The brush body 20 is vibrated by a vibration actuator 14 arranged in the grip 10. The brush body 20 is detachable from the grip 10.

[0018] The grip 10 may be cylindrical for easy grasping by a user. A grip electrode 11 that comes into contact with the user's hand is arranged on the surface of the grip 10.

[0019] A power supply unit 12, which supplies power, and a circuit unit 13, which controls the supply of power to the vibration actuator 14, are arranged in the grip 10. The circuit unit 13 electrically connects the power supply unit 12 and the vibration actuator 14 when a switch (not shown) arranged on the toothbrush 1 is operated.

[0020] The vibration actuator 14 includes a conductive output shaft 14a. The vibration actuator 14 vibrates the output shaft 14a when power is supplied from the power supply unit 12. The output shaft 14a includes a distal end, which projects from the grip 10 towards the brush body 20, and a basal end, which is electrically connected to the power supply unit 12. The distal end of the output shaft 14a is inserted into the brush body 20 when the brush body 20 is attached to the grip 10.

[0021] The brush body 20 includes a brush stem 20a and a head 20b. The head 20b includes bristle bundles 30. In the illustrated example, the brush stem 20a and the head 20b are formed integrally with each other.

[0022] A lead plate 21 is arranged in the brush stem 20a. The lead plate 21 is conductive and formed from a conductive metal material. The lead plate 21 is connected to the output shaft 14a when the brush body 20 is coupled to the grip 10.

[0023] As shown in Figs. 1(b) and 2, the head 20b includes a bristle embedment base 22 and a pad 23. The bristle bundles 30 are embedded in the bristle embedment base 22. The pad 23 applies elastic force to the bristle bundles 30 of the bristle embedment base 22.

[0024] The head 20b is formed from an insulative material. Holes 20c extend through the head 20b. The bristle bundles 30 are respectively inserted into the holes 20c. Each bristle bundle 30 projects out of the brush body 20.

[0025] The bristle embedment base 22, which receives the bristle bundles 30, is formed from a conductive metal material. The bristle embedment base 22 includes holes 22a (refer to Fig. 1 (b)), which respectively receive the bristle bundles 30.

[0026] The pad 23 is elastic and may be formed by a sponge or the like. The pad 23 forces the bristle bundles 30 against the bristle embedment base 22.

[0027] The brush body 20 includes a cover 24, which covers the lead plate 21, the bristle embedment base 22, and the pad 23. The cover 24 is preferably non-detachable from the brush stem 20a and the head 20b. The cover 24 is preferably waterproof and seals the interior of the brush stem 20a and the head 20b.

[0028] Each bristle bundle 30 is formed by a plurality of filaments 40 and includes a basal portion 31 and a distal portion 32. The basal portion 31 of the bristle bundle 30 is supported by the bristle embedment base 22. The bristle embedment base 22 electrically connects the basal portions 31 of the bristle bundles 30 to one another.

[0029] Each filament 40 is a single thin fiber, namely, a monofilament, and has a core-in-sheath structure. Each bristle bundle 30 is formed by, for example, forty filaments 40.

[0030] The structure of the filament 40 will now be described with reference to Fig. 3(a). The filament 40, which has the core-in-sheath structure, includes a core 41, which contains conductive material, and an insulative sheath 42, which covers the side of the core 41. The core 41 includes basal and distal ends, which project out opposite ends of the sheath 42 in a longitudinal direction of the sheath 42. In other words, the core 41 projects out of the two ends of the sheath 42 in the longitudinal direction of the filament 40. The basal and distal ends of the core 41 are also referred to as basal and distal projections.

[0031] The sheath 42 of the filament 40 is formed from an insulative material. The insulative material may be a resin such as polyamide resin or saturated polyester resin (polybutylene terephthalate). The sheath 42 preferably does not contain any conductive material. The core 41 contains conductive material.

[0032] Conductive material is mixed with the insulative material forming the sheath at a predetermined ratio in the core 41. The conductive material contained in the core 41 is formed by metal grains such as carbon grains, long and short carbon fibers, and silver grains.

[0033] In the present embodiment, the sheath 42 of the filament 40 is formed from nylon 6, which is a polyamide resin. The sheath 42 has a volume specific resistance value of 1×10^7 to 1×10^{13} (Ω·cm). The core 41 has carbon grains, which form the conductive material, kneaded to the nylon 6, which is the main material. The mass ratio of the carbon grains in the core 41 is 30%. Accordingly, the conductive material ratio of the core 41 is 30%, and the insulative material ratio of the core 41 is 70%.

[0034] The volume specific resistance value of the core 41 is 1×10^2 to 1×10^6 (Ω· cm), and the core 41 has higher conductivity than the sheath 42. The volume specific resistance value indicates the volume specific resistance of an object. The volume specific resistance is not the electrical resistivity at the surface of the object and is the electrical resistivity inside the object.

[0035] The steps for manufacturing the bristle bundle 30 will now be described with reference to Fig. 3. As shown in Fig. 3(a), filaments 40, each having a core 41 projecting out over a relatively long length from one end of the sheath 42, is prepared. In the preferred example, each core 41 includes a distal projection and a basal projection respectively projecting out of the distal end and the basal end of the sheath 42 in the longitudinal direction. The basal projection of the core 41 is longer than the distal projection of the core 41. In a non-limiting example, the distal projection of the core 41 projects out over two millimeters from the distal end of the sheath 42. The basal projection of the core 41 projects out over five millimeters from the basal end of the sheath 42. The core 41 may be cylindrical and have a diameter of 0.05 mm. The sheath 42 may be cylindrical and have an outer diameter of 0.18 mm.

[0036] As shown in Fig. 3(b), the filaments 40 are bundled together, and the cores 41 projecting out of the basal ends of the sheaths 42 are forced against a hot plate, which is heated to a predetermined temperature. The hot plate 9 is heated to the fusing temperature of the resin or insulative material forming the filaments 40. When the filaments 40 are formed from nylon 6, the hot plate 9 is heated to 260°C. When the cores 41 in the bundle of filaments 40 are forced against the hot plate 9, the cores 41 are fused and integrated with one another.

[0037] As shown in Fig. 3(c), the integrated cores 41 are solidified to obtain the basal portion 31 of the bristle bundle 30. In this manner, the basal portion 31 of the bristle bundle 30 is obtained by fusing and solidifying the integrated cores 41. The basal portion 31 may be referred to as a fused resin terminal. The distal end of the core 41 in each filament 40 forms the distal portion 32 of the bristle bundle 30. The distal portion 32 is the entire distal projection of each core 41.

[0038] The bristle bundle 30 has a diameter that is largest at the basal portion 31, namely, a maximum diameter R1. In other words, the diameter R1 at the basal portion 31 of the bristle bundle 30 is larger than the diameter R2 at a bundle portion 30A corresponding to the sheaths 42, that is, at a portion of the bristle bundle 30 excluding the basal portion 31 and the distal portion 32.

[0039] The sheaths 42 are not fused when forming the basal portion 31 of the bristle bundle 30. Accordingly, the conductive material ratio at the basal portion 31 is equal to the conductive material ratio at the distal portions 32. When forming the basal portion 31, the number of filaments 40 forming each bristle bundle 30, the diameter of each core 41, and the length of the basal projection in each core 41 are adjusted in advance so that the basal portion 31 is formed from only the cores 41.

[0040] The steps for manufacturing a bristle bundle 130 of a comparative example will now be described with reference to Fig. 13.

[0041] As shown in Fig. 13(a), core-in-sheath filaments 140 each include a conductive core 141 and an insulative sheath 142. Each core 141 includes a basal end that does not project out of or projects only slightly out of the sheath 142. In this case, the cores 141 and the sheaths 142 are fused as shown in Fig. 13(b) to form an integrated basal portion 131 (see Fig. 13(c)). Here, the conductive material ratio of the integrated basal portion 131 is lower than the conductive material ratio of a distal portion 132 due to the mixing of the insulative sheath 142. Thus, the volume specific resistance of the integrated basal portion 131 is larger than the volume specific resistance of the cores 141. The fusion of the sheaths 142 causes uneven distribution of the conductive material in the integrated basal portion 131. Further, the current that flows to the filaments 140 may vary between the filaments 140.

[0042] The assembly of the brush body 20 will now be described with reference to Fig. 4.

[0043] As shown in Fig. 4(a), the bristle embedment base 22 is first arranged on the head 20b with the holes 20c of the head 20b in communication with the holes 22a

of the bristle embedment base 22.

[0044] As shown in Fig. 4(b), the bristle bundles 30 are then inserted into the holes 22a and 20c from the bristle embedment base 22. The diameter R1 of the basal portion 31 of each bristle bundle 30 is greater than the diameter of the holes 22a and 20c. Thus, the bristle bundles 30 inserted into the holes 22a and 20c from above do not fall down from the head 20b and the bristle embedment base 22.

[0045] Next, as shown in Fig. 4(c), the lead plate 21 is fixed to the bristle embedment base 22. For example, projections 22b (refer to Fig. 4(b)), which project from one end of the bristle embedment base 22, are inserted apertures 21 a (refer to Fig. 1(b)) extending through the lead plate 21. Then, distal ends of the projection 22b are melted and deformed to fix the lead plate 21 to the bristle embedment base 22.

[0046] The pad 23 is arranged on the basal portion 31. Then, referring to Fig. 4(d), ultrasonic welding or the like is performed to integrate the cover 24 with the head 20b and the brush stem 20a. In this manner, the brush body 20 is obtained.

[0047] When a user operates the switch (not shown) of the toothbrush 1 to brush his or her teeth, the circuit unit 13 electrically connects the grip electrode 11 and the bristle bundle 30 through the power supply unit 12. In other words, when brushing the teeth, an electric circuit, or closed circuit, is formed connecting the power supply unit 12, the grip electrode 11, the user's hand, the user's gum, the bristle bundles 30, the bristle embedment base 22, the lead plate 21, and the output shaft 14a.

[0048] The lead plate 21 and the bristle embedment base 22 are formed from the conductive material (e.g., silver) contained in the core 41 to increase the conduction efficiency between the power supply unit 12 to the bristle bundle 30 in the electric circuit. In other words, the volume specific resistance value of the lead plate 21 and the bristle embedment base 22 is smaller than the volume specific resistance value of the basal portion 31.

[0049] The present embodiment has the advantages described below.

(1) The brush body 20 includes the bristle bundles 30, each formed by a plurality of filaments 40. Each filament 40 includes a core 41 and a sheath 42. The distal and basal ends of the core 41 project out of the sheath 42 in the longitudinal direction. The basal portion 31 of each bristle bundle 30 is where the basal ends of the cores 41 are fused and integrated to one another. The distal end of each core 41 forms a distal portion 32 of the bristle bundle 30. The conductive material ratio of the basal portion 31 is equal to the conductive material ratio of the distal portion 32. Thus, the conduction efficiency from the basal portion 31 to the distal portion 32 is higher than when the conductive material ratio of the basal portion 31 is lower than the conductive material ratio of the distal portion 32. This prevents the conductivity of the bristle bundles 30 formed by the core-in-sheath filaments 40 from decreasing. Further, the current flowing to the filaments 40 is prevented from varying between the filaments 40.

(2) The diameter R1 of the basal portion 31 of each bristle bundle 30 is larger than the diameter R2 of the bundle portion 30A corresponding to the sheaths 42 of each bristle bundle 30. Thus, when the bundle portion 30A corresponding to the sheaths 42 is inserted into the corresponding hole 22a, the movement of the bristle bundle 30 in one direction is restricted by contact between the basal portion 31 and the bristle embedment base 22. This ensures that the bristle bundle 30 does not fall out of the hole 22a.

(3) The basal portions 31 of the bristle bundles 30 are connected to one another by the bristle embedment base 22, which is a conductive member. The volume specific resistance of the bristle embedment base 22 is smaller than the volume specific resistance of the basal portion 31. Thus, when current flows to the bristle bundles 30 through the bristle embedment base 22, the conduction efficiency is increased while suppressing the generation of heat in the bristle embedment base 22.

(4) The bristle embedment base 22 serves as a base into which the bristle bundles 30 are inserted and also serves as a conductive member that connects the basal portions 31 of the bristle bundles 30 to one another. Thus, the insertion of the bristle bundles 30 into the bristle embedment base 22 so that the basal portions 31 contact the bristle embedment base 22 allows for current to flow to the bristle bundles 30 through the bristle embedment base 22.

(5) The toothbrush 1 includes the brush body 20 and thus has the advantages described above. Accordingly, the required capacity is low for the power supply unit 12 that supplies current to the bristle bundle 30 and the power supply unit 12 may be compact.

(6) The toothbrush 1 includes the vibration actuator 14, which vibrates the brush body 20.

Vibration of the head 20b improves the cleaning capacity and produces a massaging effect on the gum.

Second Embodiment

[0050] A second embodiment of the present invention will now be described with reference to Figs. 5 and 6. Like or same reference numerals are given to those components that are the same as the corresponding components of the first embodiment. Such components will not be described in detail.

[0051] As shown in Figs. 5(a) and 5(b), in the present embodiment, the bristle bundles 30 are fixed to the bristle embedment base 22 without the pad 23. More specifically, the fused and solidified basal portions 31 are integrated and fixed with the bristle embedment base 22.

[0052] The bristle embedment base 22 includes a wall 22c extending around each hole 22a. A fusing portion

22d (refer to Fig. 6(a)), or projection, is formed between the wall 22c and the edge of the hole 22a. The fusing portion 22d is covered by the fused basal portion 31 of the bristle bundle 30. Solidification of the basal portions 31 integrates the basal portions 31 with the bristle embedment base 22.

[0053] The assembly of the brush body 20 will now be described with reference to Fig. 6.

[0054] As shown in Fig. 6(a), the bristle bundles 30 are inserted to the holes 22a and 20c from the bristle embedment base 22 in the same manner as the first embodiment.

[0055] Then, referring to Fig. 6(b), in a state in which the bristle bundles 30 are fixed to the bristle embedment base 22 by a jig (not shown), the basal portions 31 are heated and pressurized with a heat plate (not shown) to refuse the basal portion 31. Each fused basal portion 31 moves within the corresponding wall 22c and covers the fusing portion 22d. Then, the basal portion 31 is solidified. This fixes the basal portions 31 to the bristle embedment base 22.

[0056] Ultrasonic welding is then performed to integrate the cover 24 with the head 20b and the brush stem 20a to obtain the brush body 20 shown in Fig. 5. The basal portions 31 of the bristle bundles 30 are directly fixed to the bristle embedment base 22. This eliminates the need for the pad 23, which forces the bristle bundles 30 against the bristle embedment base 22. Furthermore, ribs, which contact the bristle bundles 30, may be formed in the cover 24 to assist the fixing of the basal portions 31.

[0057] In addition to advantages (1) to (6), the present embodiment has the following advantage.

(7) The basal portions 31 are integrated with the bristle embedment base 22, which serves as a base. Thus, the bristle bundles 30 are fixed to the bristle embedment base 22 when the basal portions 31 and the bristle embedment base 22 are brought into contact and electrically connected to each other. This ensures the electrical connection of the basal portions 31 and the bristle embedment base 22.

Third Embodiment

[0058] A third embodiment of the present invention will now be described with reference to Figs. 7 and 10. Like or same reference numerals are given to those components that are the same as the corresponding components of the first embodiment. Such components will not be described in detail.

[0059] As shown in Figs. 7(a) and 7(b), in the present embodiment, the bristle bundles 30 are fixed without using the pad 23 and the bristle embedment base 22. More specifically, basal portions 31 are integrated with one another. The lead plate 21 forces the basal portion 31 against the head 20b.

[0060] As shown in Figs. 7(b) and 8, the head 20b functions as a base, which receives the bristle bundles 30.

[0061] The basal portions 31 of the bristle bundles 30 are fused and integrated with one another. Thus, the distal portions 32 of the bristle bundles 30 are electrically connected with the single basal portion 31.

[0062] The assembly of the brush body 20 will now be described with reference to Figs. 9 and 10.

[0063] As shown in Fig. 9(a), the brush body 20, which does not include the bristle embedment base 22, is prepared. As shown in Figs. 9(b) and 10(a), the bristle bundles 30 are respectively inserted into the holes 20c of the brush body 20.

[0064] Then, as shown in Figs. 9(c) and 10(b), in a state in which the bristle bundles 30 are fixed to the head 20b by a jig (not shown), the basal portions 31 are heated and pressurized with a heat plate (not shown) to refuse the basal portions 31. This mixes and integrates the basal portions 31 with one another. Subsequent to solidification, the single integrated basal portion 31 is obtained.

[0065] The lead plate 21 is arranged on the integrated basal portion 31. Ultrasonic welding is performed to integrate the cover 24 with the head 20b and the brush stem 20a and obtain the brush body 20 shown in Fig. 7. The lead plate 21 is preferably forced against the basal portion 31 by the cover 24.

[0066] In addition to advantages (1), (2), (5), and (6), the present embodiment has the following advantage.

(8) The basal portions 31 of the bristle bundles 30 are integrated and connected with one another. This ensures that current flows to the bristle bundles 30.

Fourth Embodiment

[0067] A fourth embodiment of the present invention will be described with reference to Figs. 11 and 12. Like or same reference numerals are given to those components that are the same as the corresponding components of the first embodiment. Such components will not be described in detail.

[0068] As shown Figs. 11 (a) and 11 (b), the bristle bundles 30 are fixed without using the bristle embedment base 22. More specifically, each basal portion 31 is forced against the head 20b, which serves as a base, by the pad 23 and the lead plate 21.

[0069] As shown in Figs. 11(b) and 12, the lead plate 21 includes a distal portion that substantially covers the basal portions 31 of the bristle bundles 30. The lead plate 21 includes bumps 21 b corresponding to the basal portions 31. The bumps 21 b of the lead plate 21 apply force to the corresponding basal portions 31. This ensures direct electrically connection of the lead plate 21 and the basal portions 31 of the bristle bundles 30.

[0070] In the present embodiment, when assembling the brush body 20, the bristle bundles 30 are inserted into the holes 20c in the same manner as in the third embodiment. Then, the lead plate 21 is arranged on the basal portion 31. The pad 23 is arranged on the lead plate 21. Further, ultrasonic welding is performed to in-

tegrate the cover 24 with the head 20b and the brush stem 20a by ultrasonic welding. This obtains the brush body 20 shown in Fig. 11.

[0071] In addition to advantages (1), (2), (5), and (6), the present embodiment has the following advantage.

(9) The basal portions 31 of the bristle bundles 30 are connected to each other by the lead plate 21, which is a conductive member. The volume specific resistance of the lead plate is smaller than the volume specific resistance of the basal portions 31. Thus, when current flows to the bristle bundles 30 through the lead plate 21, the conduction efficiency is improved while suppressing the generation of heat in the lead plate 21.

[0072] It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, it should be understood that the present invention may be embodied in the following forms.

[0073] In the third embodiment, the lead plate 21 may include a pad for elastically holding the basal portion 31. The pad may be discrete from the lead plate 21.

[0074] The bristle bundles 30 do not have to be fixed to the base 22 or head 20b as described above. For example, the cover 24 may force the basal portions 31 against the bristle embedment base 22 in the first and fourth embodiments.

[0075] The material forming the filaments 40 and the conductive material contained in the core 41 are not limited to those described in the embodiments. The materials for forming the head 20b, the lead plate 21, the bristle embedment base 22, which are included in the brush body 20, are also not limited to those described in the above embodiments. The lead plate 21 may be formed from a metal material such as stainless alloy, which differs from the conductive material contained in the core 41. The bristle embedment base 22 may be formed from a conductive resin material containing a conductive material.

[0076] The brush body 20 is attachable to the grip 10. instead, the brush body 20 may be integrated with the grip 10.

[0077] The head 20b of the brush body 20 vibrates in the toothbrush 1 of the above embodiments. However, the vibration function of the brush body 20 may be eliminated.

Claims

1. A brush body (20) comprising a bristle bundle (30) including a plurality of filaments (40), wherein
each filament includes a core (41), which contains a conductive material, and an insulative sheath (42), which covers a side of the core;
the core includes a distal end and a basal end projecting out of the sheath in a longitudinal direction;
the bristle bundle includes a basal portion (31), at which the basal ends of the cores in the filaments are fused, solidified, and integrated with one another; and
the bristle bundle includes a distal portion (32), which is formed by the distal end of each core of the filaments,
the brush body being **characterized in that** a ratio of the conductive material at the basal portion (31) of the bristle bundle is equal to a ratio of the conductive material at the distal portion (32) of the bristle bundle.

2. The brush body according to claim 1, wherein the basal portion (31) of the bristle bundle has a larger diameter (R1) than a portion (30A) of the bristle bundle corresponding to the sheaths (42).

3. The brush body according to claim 1 or 2, wherein the bristle bundle is one of a plurality of bristle bundles, and the basal portions of the bristle bundles are integrated and connected with one another.

4. The brush body according to any one of claims 1 to 3, wherein the bristle bundle is one of the plurality of bristle bundles, the brush body further comprises a conductive member that connects the basal portions of the bristle bundles are connected with one another, wherein the conductive member has a smaller volume specific resistance than the basal portions.

5. The brush body according to claim 4, wherein the conductive member is a base (22) which receives the bristle bundles.

6. The brush body according to claim 5, wherein the basal portions of the bristle bundles are integrated with the base.

7. The brush body according to claim 1, wherein the basal portion of the bristle bundle where only the basal ends of the cores are fused and integrated with one another.

8. The brush body according to claim 7, wherein the cores are formed from a mixture of the conductive material and an insulative material, and the ratio is a ratio of the conductive material in the mixture.

9. A toothbrush comprising the brush body according to any one of claims 1 to 8.

10. The toothbrush according to claims 9, further comprising a vibration actuator for vibrating the brush body.

11. A brush body (20) comprising a bristle bundle (30) including a plurality of filaments (40), wherein
each filament includes a core (41), which contains a conductive material, and an insulative sheath (42), which covers a side of the core; and
the bristle bundle includes a fused resin terminal (31), which is formed by fusing and integrating only the cores of the filaments without fusing the insulative sheath.

12. A method for manufacturing a brush body comprising:

preparing a bristle bundle (30) by bundling a plurality of filaments (40), wherein each filament includes a conductive core (41), which includes a distal projection and a basal projection, and an insulative sheath (42), which covers a portion of the core excluding the distal projection and the basal projection;
fusing and integrating the basal projections of the cores of the filaments without fusing the insulative sheaths to form a fused resin terminal (31) of the bristle bundle; and
electrically connecting the fused resin terminal (31) of the bristle bundle to a head of the brush body.

13. The manufacturing method according to claim 12, wherein the basal projection of the core is longer than the distal projection.

Fig.1 (a)

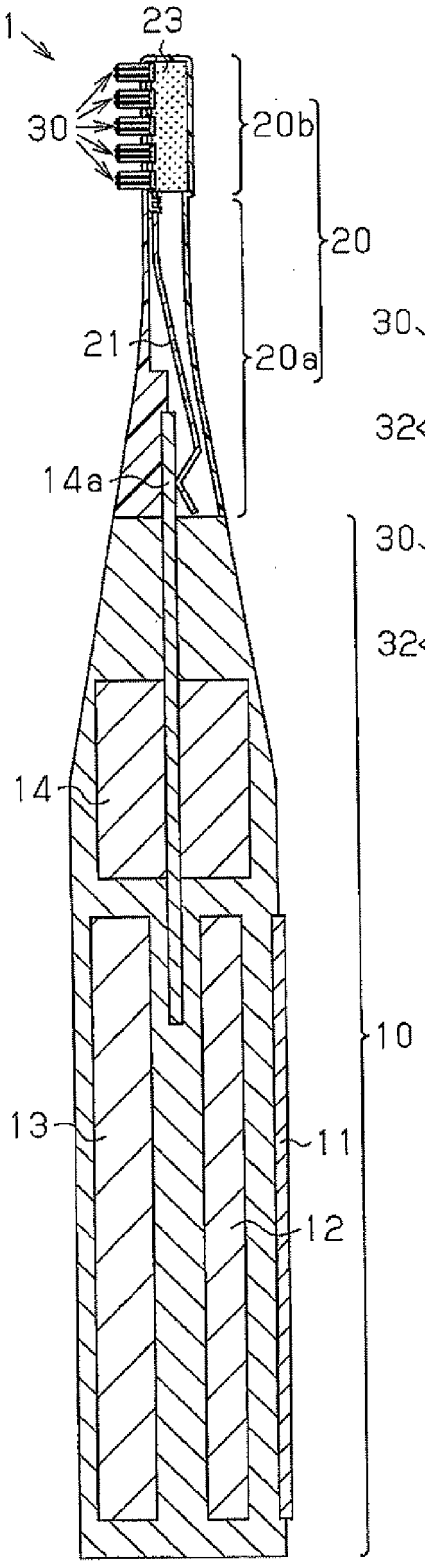
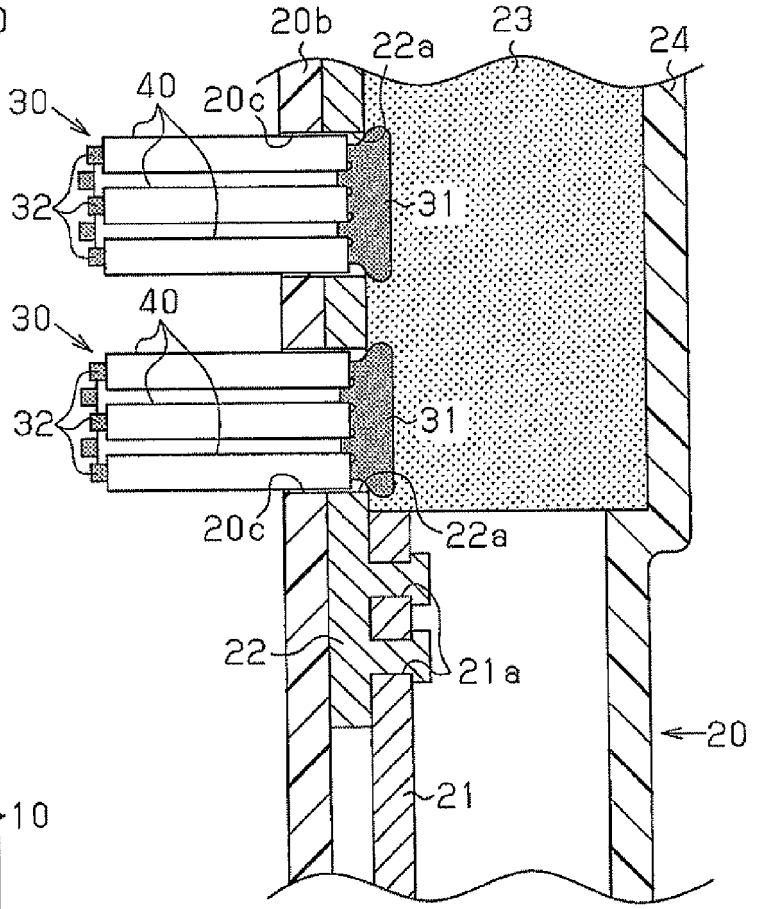

1
23
30
20b
20
21
20a
14a
14
10
13
11
12

Fig.1 (b)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22a
23
24
30
40
20c
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32
31
20c
22a
22
21a
20
21

Fig.2

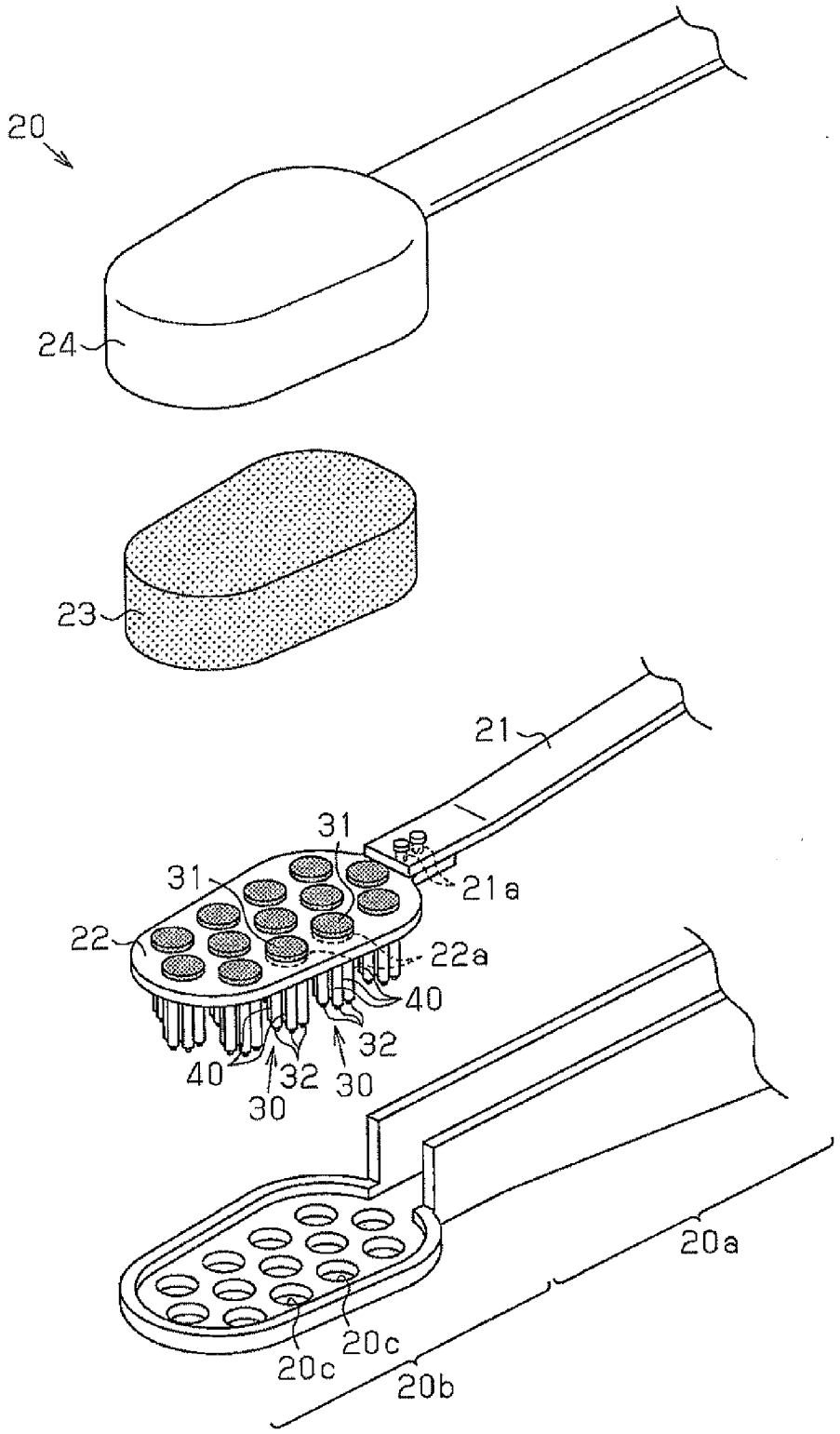


Fig.3(a)

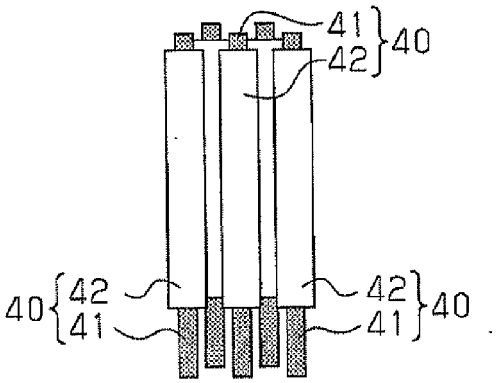


Fig.3(b)

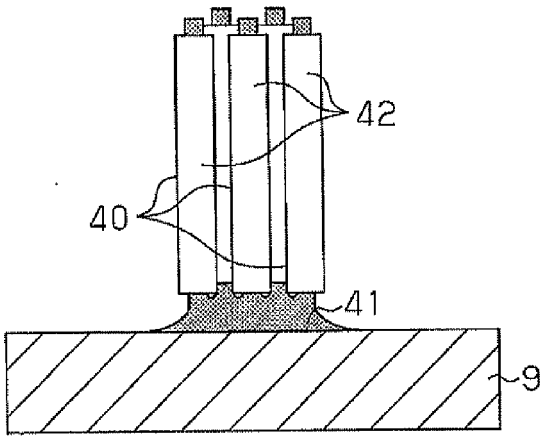


Fig.3(c)

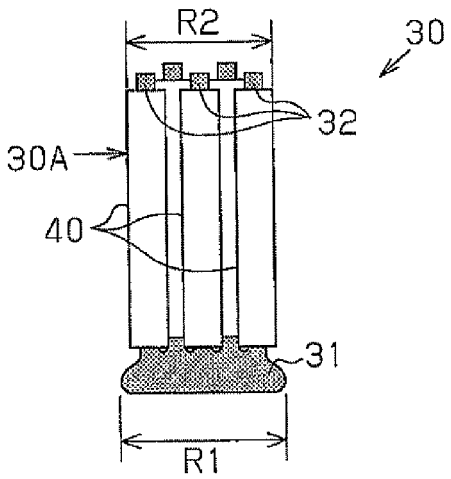


Fig.4(a)

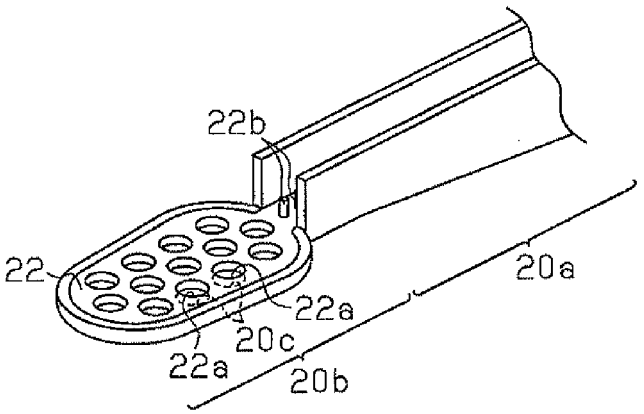


Fig.4(b)

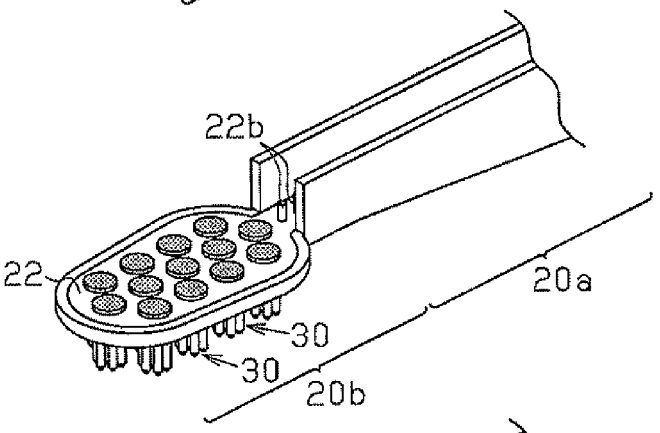


Fig.4(c)

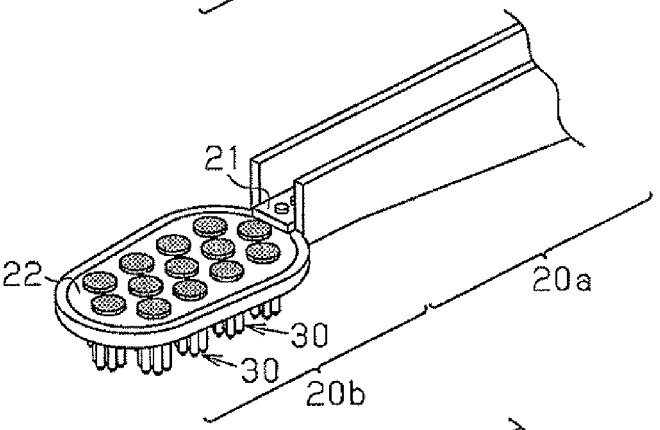
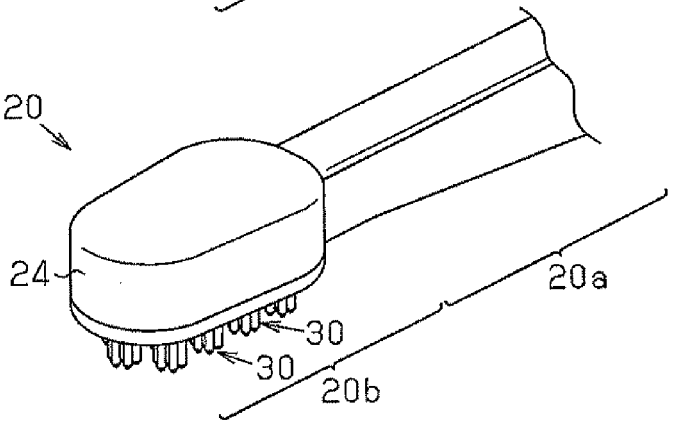


Fig.4(d)



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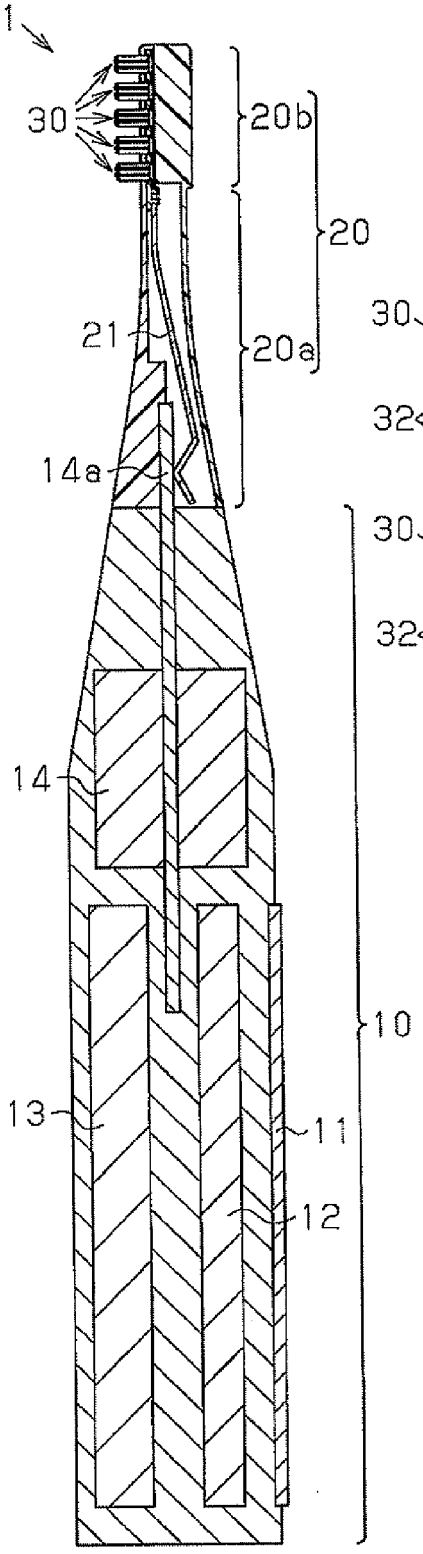
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14a
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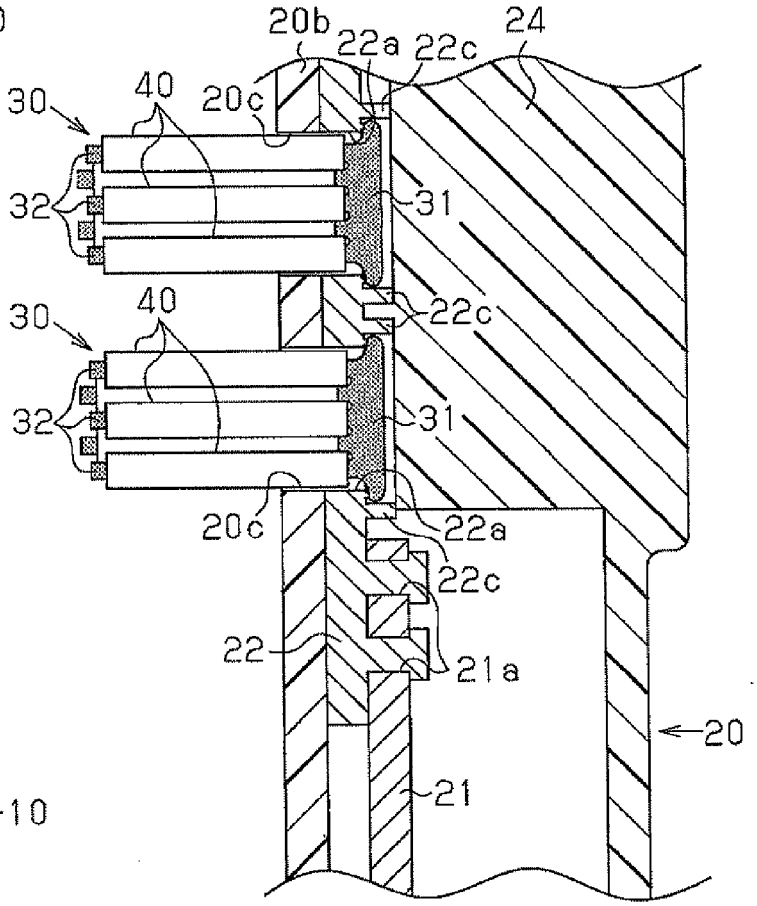
Fig.5(b)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21a
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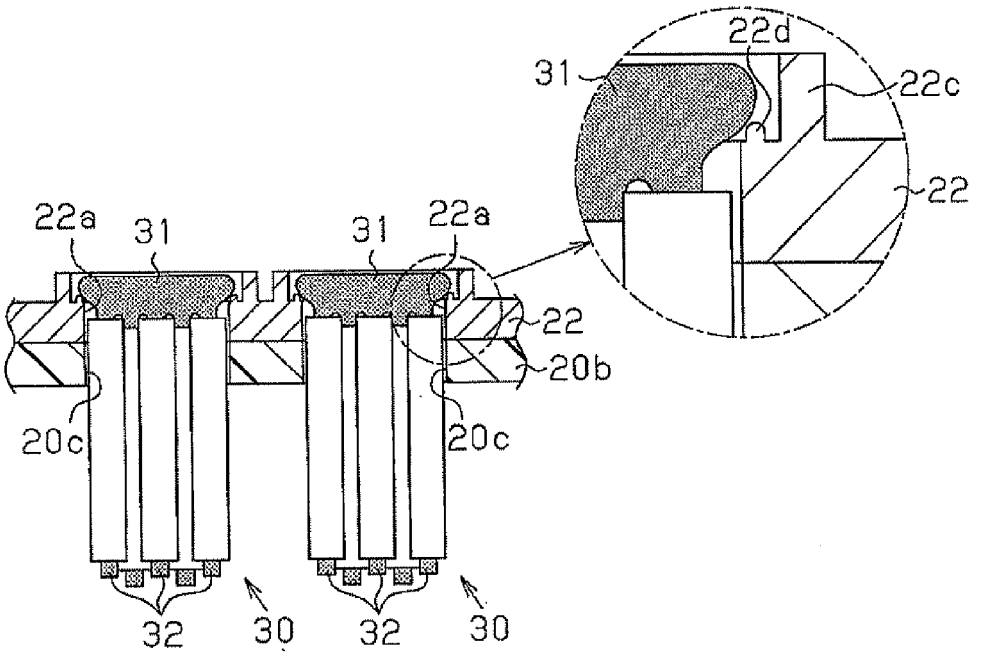
21

Fig.6(a)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20c
20c
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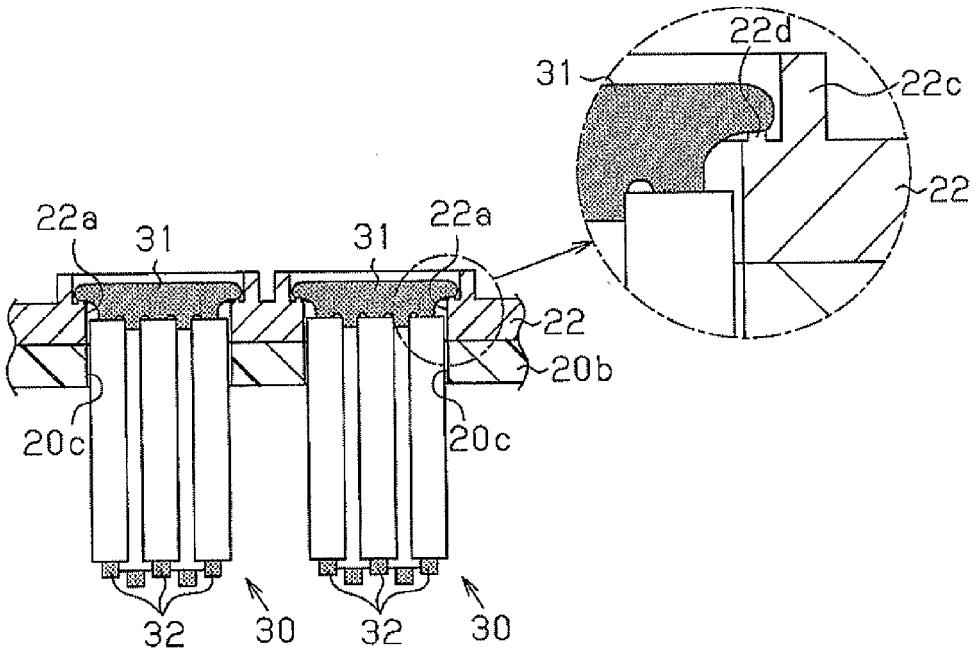
30

Fig.6(b)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30

Fig.7(a)

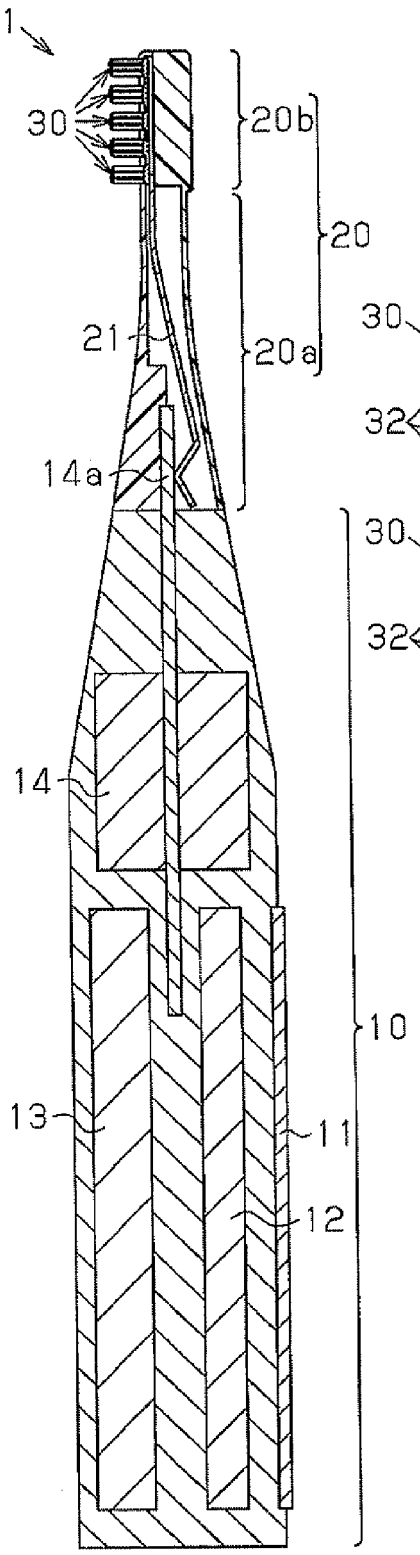
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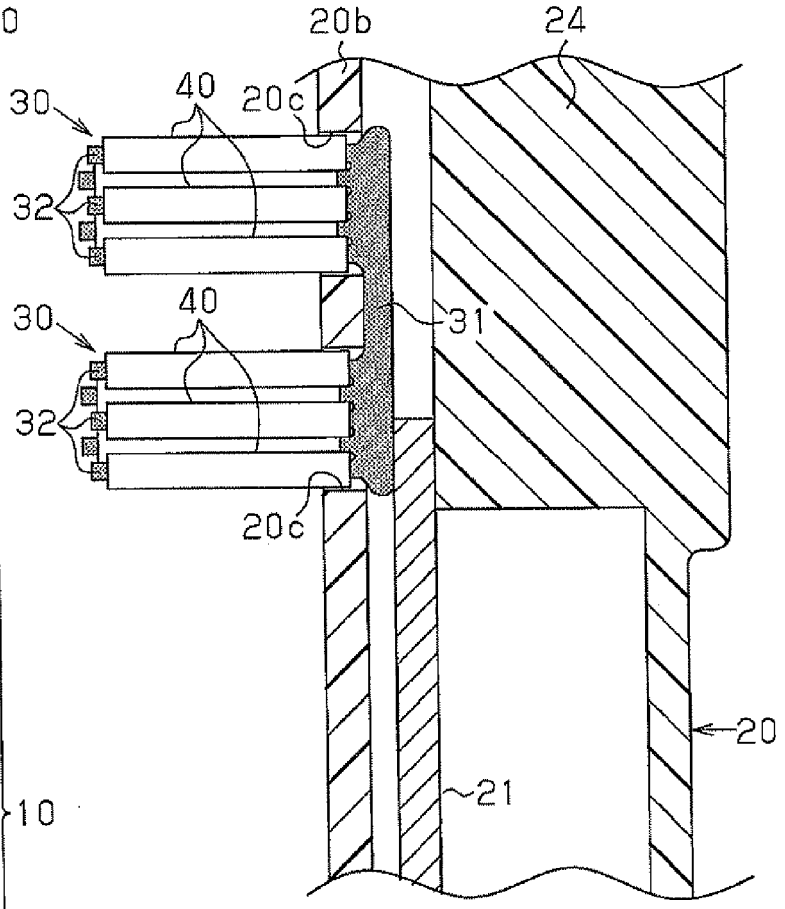
Fig.7(b)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20c
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21

Fig.8

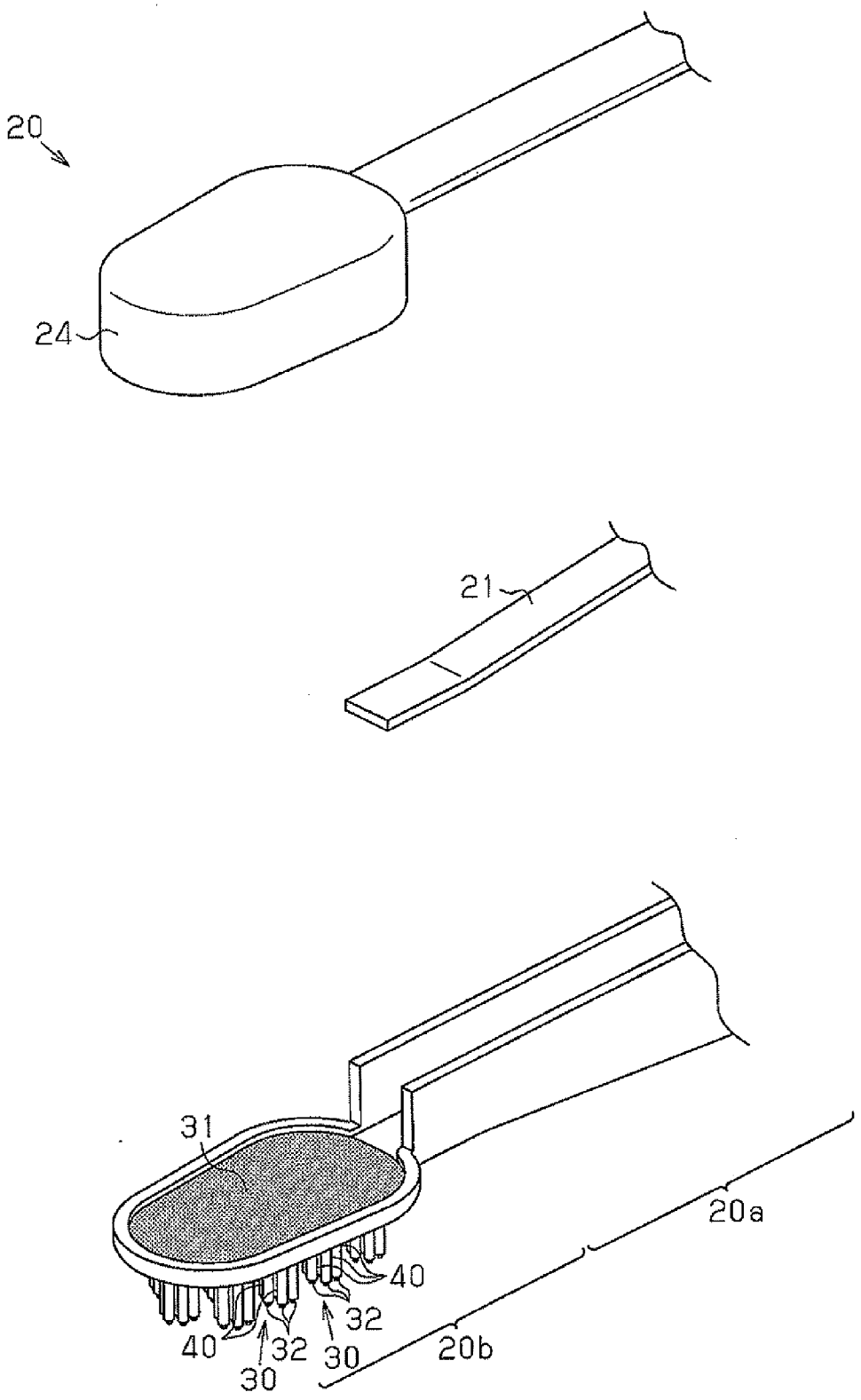


Fig.9(a)

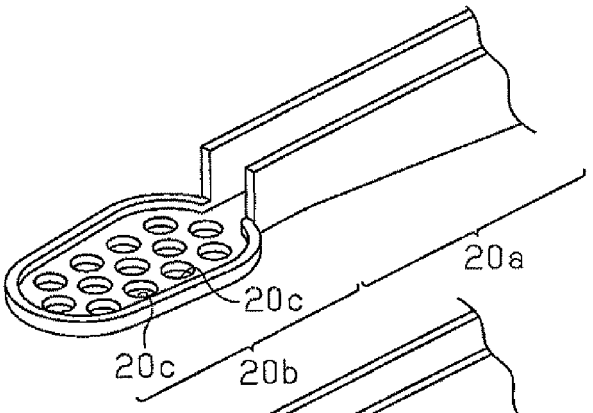


Fig.9(b)

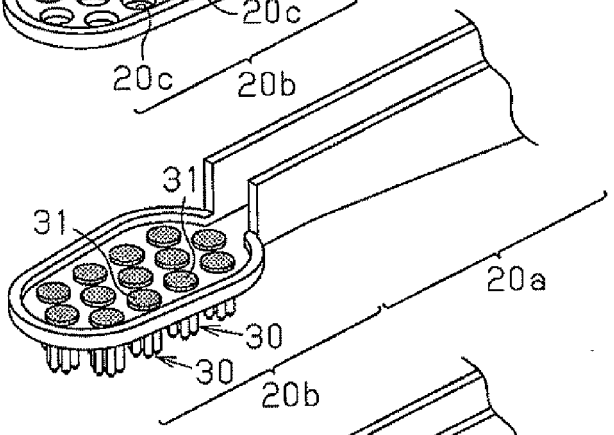


Fig.9(c)

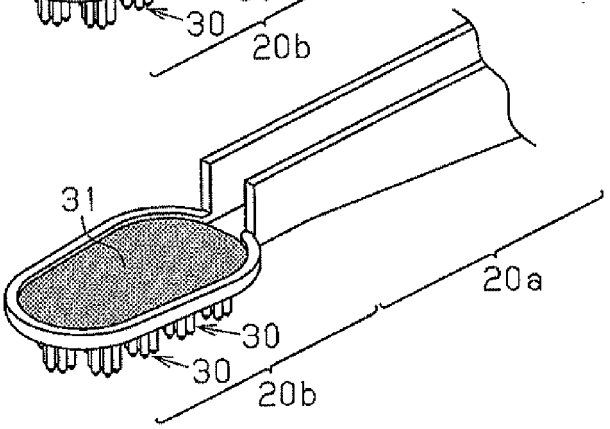


Fig.10(a)

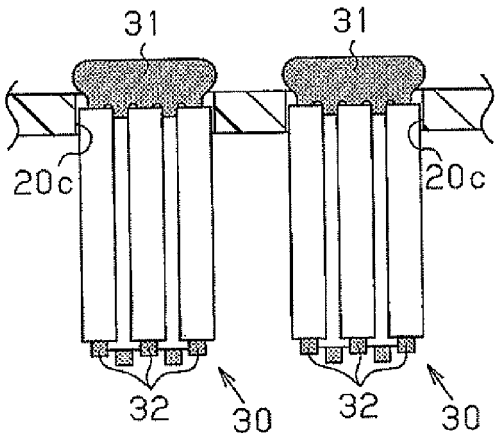


Fig.10(b)

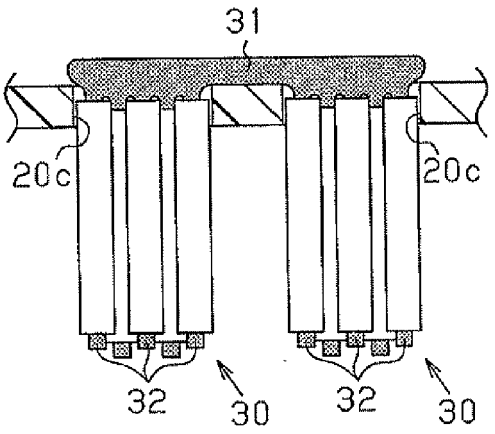


Fig.11 (a)

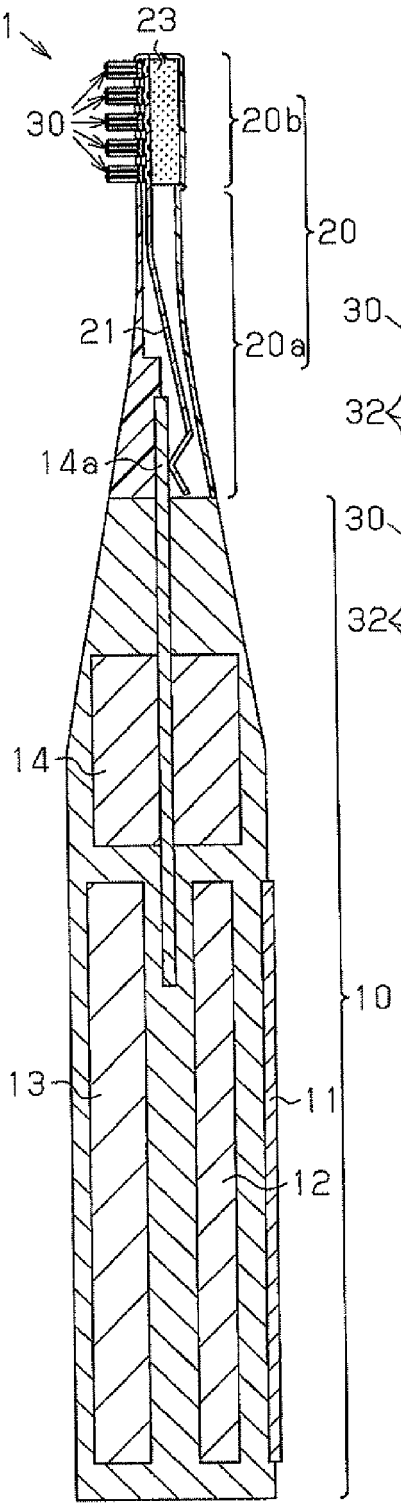


Fig.11 (b)

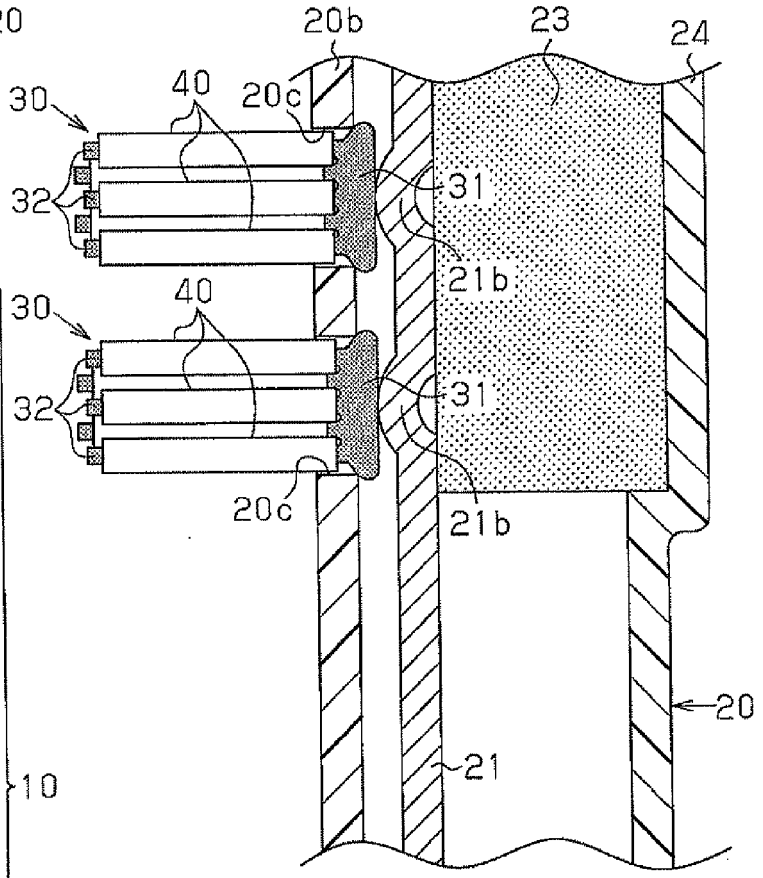


Fig.12

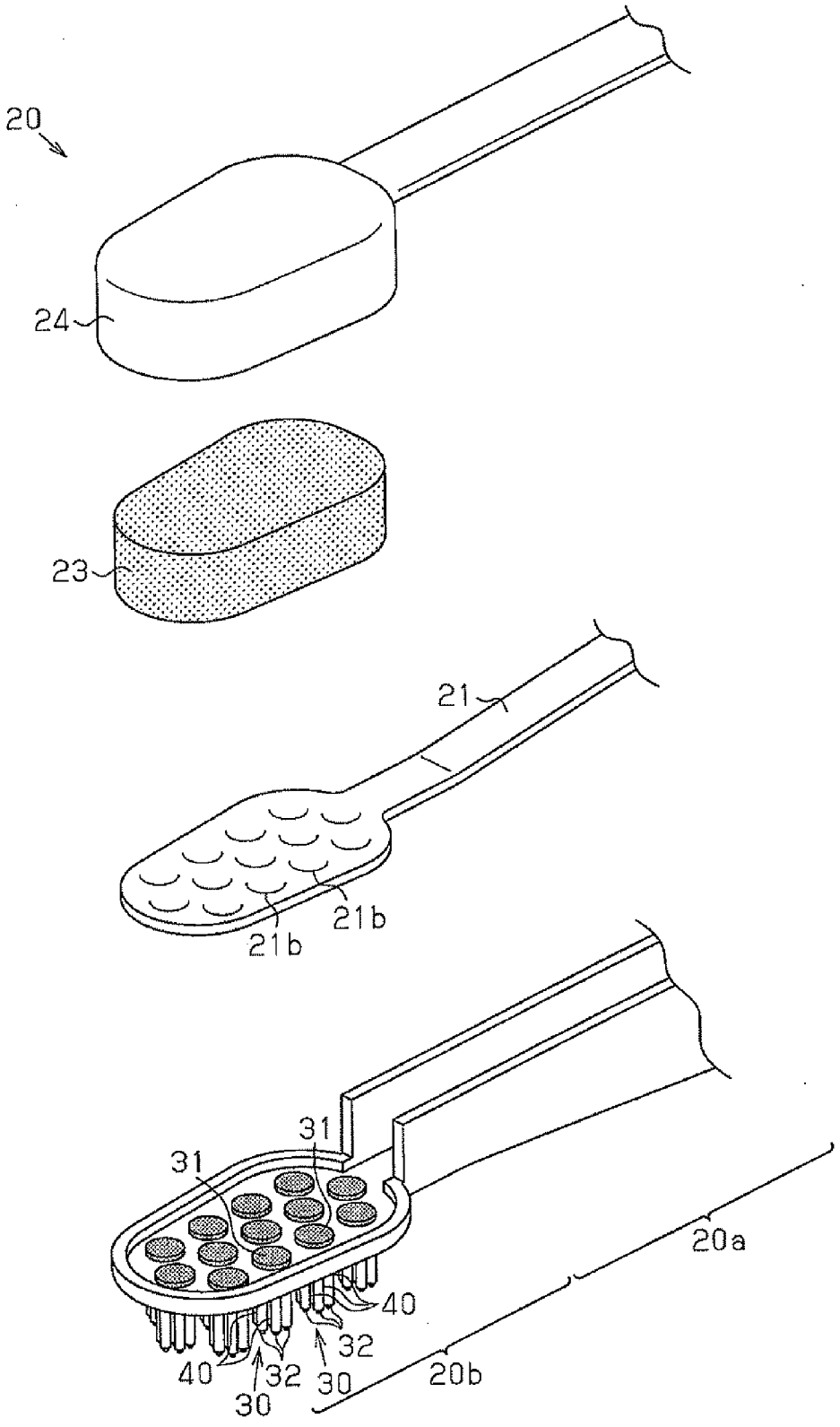
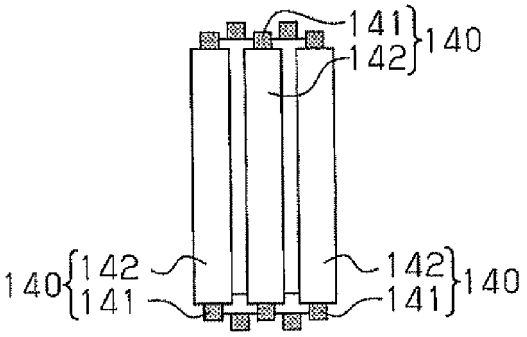


Fig.13(a)



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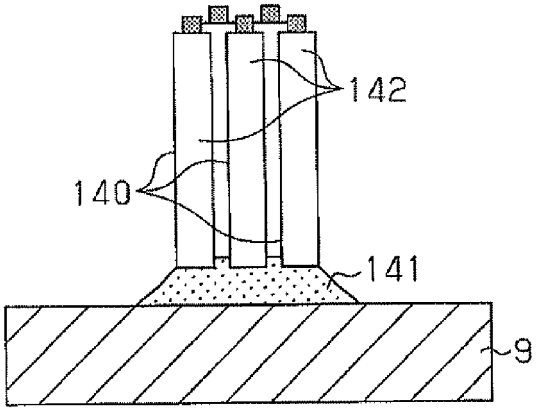
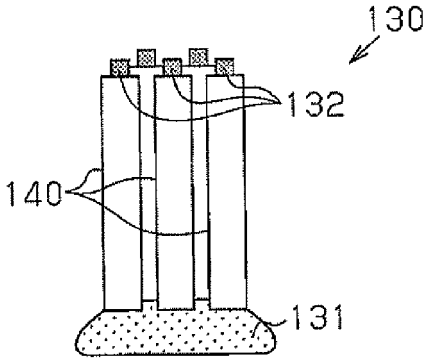


Fig.13(c)



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