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(54) **Method for manufacturing brushes and brush manufacturing machine applying this method**
Verfahren zum Herstellen von Bürsten sowie Bürstenherstellungsmaschine zur Durchführung dieses
Verfahrens
Procédé de fabrication de brosses et machine de fabrication de brosses pour l'application de ce procédé

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(73) Proprietor: **FIRMA G.B. BOUCHERIE,**
naamloze vennootschap
8870 Izegem (BE)

(72) Inventor: **Boucherie, Bart Gerard**
8870 Izegem (BE)

(74) Representative: **Donné, Eddy**
M.F.J.Bockstael
Arenbergstraat 13
2000 Anvers (BE)

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Description

[0001] This invention relates to a method for manufacturing brushes, as well as to a device, more particularly a brush manufacturing machine, applying this method.

[0002] For manufacturing brushes, more particularly toothbrushes, substantially two techniques are known.

[0003] According to a first known technique, fiber bundles are fixed by means of anchoring plates in openings or holes in a brush body.

[0004] A big disadvantage of this technique consists in that it is only possible to work with fiber bundles of a single well-defined diameter, unless one and the same brush is manufactured on different machines.

[0005] According to a second known technique, as for example described in EP-A-056 672 and EP-A-0 405 204, fiber bundles are provided in holes or openings in brush bodies or in a portion of brush bodies, after which the fibers, at the extremities provided in the openings, are mutually connected. In consideration of the fact that no anchoring plates are applied therewith, the shape of the openings in which the fiber bundles are provided may be of any form.

[0006] The invention relates to a method which allows the realization of brushes according to the aforementioned second technique in a fast manner, whereby a variety of patterns of fibers to be inserted can be realized in a simple way.

[0007] To this aim, the invention relates to a method for manufacturing brushes, wherein a device is applied consisting of at least one carrier with openings which are mutually arranged according to a certain pattern, whereby the fiber bundles which have to be provided in a brush body can be put in this carrier, and whereby this method further consists in the combination of at least four steps, respectively, the lateral separation of fiber bundles from at least one quantity of loose fibers by means of at least one fiber bundle take-up device provided of at least one recess in which fibers can be taken up as the recess passes alongside the fiber magazine; the provision, in a mechanical manner, step-by-step, of the aforementioned fiber bundles in the aforementioned carrier by a mutual positioning between each respective fiber bundle and the opening in which it has to be provided, and subsequently pushing the separated fiber bundles in longitudinal direction into the aforementioned openings; the transfer of the fiber bundles which are placed in the carrier by means of this carrier to a holder; and, by means of this holder, the fixation of the fiber bundles in the brush body, or at least in a portion of the brush body.

[0008] By using a step-by-step working method for providing the fiber bundles in the carrier, a systematic filling is obtained which allows for a large number of applications, whereby, during the provision of fiber bundles in a carrier, it is easy to supply successively fiber bundles with different fibers, amongst others of different kind, colour or dimensions, to the carrier.

[0009] As use is made of a carrier which, in itself, does

not fulfil any shaping function for the brush body and which cooperates with a holder which preferably forms a preshaped part of a brush body, the requirements set for such carrier are less stringent, as a result of which it can easily be manipulated and can be manufactured in a very simple manner.

[0010] The use of a fiber bundle take-up device which, when passing alongside a fiber magazine, takes up fibers by means of a recess, either adjustable in size or not, in the take-up device, has as an advantage that it is possible to work at high speeds, which is very important within the scope of the method according to the present invention, considering that the carrier has to be filled step-by-step.

[0011] It is preferred that the separated fiber bundles are presented to the carrier at one location or a limited number of locations and that the carriers are positioned systematically with the respective openings opposite the aforementioned locations, which, in a practical form of embodiment, may be performed by placing the carriers on a positioning table, more particularly a table which can be positioned in two directions.

[0012] Preferably, carriers with through openings are applied, whereby the separated fiber bundles are pushed into the openings and, after the carrier is filled with fiber bundles and is presented to the aforementioned holder, the fiber bundles taken up in the fiber holder are removed from the openings in order to be placed directly or indirectly in the aforementioned holder. Hereby, preferably use is made of carriers in the form of transport plates or small blocks, whereby the openings consist of through bores.

[0013] Further, the fiber bundles provided in the aforementioned holder preferably are provided from each respective carrier in the aforementioned holder by pushing them out of the carrier by means of ejection pins, which increases the universality of the method, as, by different choice of the applied ejection pins, it is easy to obtain different effects, such as, for example, a profile at the free extremities of the brush hair.

[0014] In consideration of the fact that, according to the invention, carriers are applied which fulfil no shaping function for the formation of the brush bodies, it is possible to place additional accessories, for example, fiber guidances, between these carriers and the holders. Hereby, fiber guidances can be applied which serve for different purposes, such as the combining of fiber bundles, the displacement of fiber bundles, or the provision of the fiber bundles in the brush bodies at an angle.

[0015] In the case that the holder forms a portion of the brush body, this holder can be attached at the actual brush body in any manner, either by means of a connection which is realized during manufacturing, for example, by ultrasonic welding, or by a connection which is realized by the user, for example, as he attaches the portion provided with the fiber bundles in a brush handle or such, more particularly, clicks it into the latter.

[0016] The present invention also relates to a device which applies the aforementioned method and which

consists in the combination of at least one fiber magazine with loose fibers; means for the lateral separation of fiber bundles from the fibers in the fiber magazine consisting of a fiber bundle take-up device which is provided with a recess; a mechanism with at least one carrier in which openings are formed in which the aforementioned fiber bundles can be provided and with at least means that permit the mutual positioning between each respective fiber bundle and the opening in which it has to be provided, and means that permit to subsequently pushing the separated fiber bundles in longitudinal direction into the aforementioned openings; and transfer means for presenting the carrier, carriers respectively, filled with fiber bundles, to a holder by means of which the fiber bundle can be fixed into a brush body, or at least a portion of a brush body in an appropriate manner.

[0017] With the intention of better showing the characteristics of the invention, hereafter, as an example without any limitative character, several preferred forms of embodiment are described, with reference to the accompanying drawings, wherein:

figure 1 schematically represents the method according to the invention;
 figures 2 and 3 schematically represent means for the separation of fiber bundles;
 figures 4 and 5 represent two particular forms of embodiment of the means depicted in figures 2 and 3;
 figure 6, at a larger scale and in perspective, represents a view according to arrow F6 in figure 5;
 figures 7 and 8 schematically represent how the separated fiber bundles can be placed in a carrier;
 figure 9 schematically represents how different carriers successively can be filled with separated fiber bundles in a systematic manner;
 figures 10 and 11 represent how the fiber bundles can be transferred from the aforementioned carrier into a holder;
 figures 12 and 13 represent a variant of the embodiment according to figures 10 and 11;
 figures 14 and 15, in two positions, represent an embodiment whereby use is made of an additional fiber guidance;
 figures 16 and 17 represent a variant whereby another fiber guidance is used;
 figures 18 to 22 represent different brush bodies which can be manufactured with the method according to the invention;
 figures 23, 24 and 25 schematically represent a number of possibilities for fixing the fiber bundles in a holder;
 figures 26 and 27 in cross-section represent two brush bodies which are manufactured with the method according to the invention;
 figure 28 represents a complete brush manufacturing machine applying the method of the invention.

[0018] In figure 1, the method according to the inven-

tion for manufacturing brushes is represented schematically, whereby for the supply of fibers, use is made of a device 1 with at least one carrier which is provided with openings 3 which are mutually arranged according to a certain pattern, whereby in this carrier 2, the fiber bundles 4 can be collected which have to be provided in a brush body 5.

[0019] Further, this method substantially consists in the combination of at least four steps, respectively, a first step 6 consisting in the lateral separation of fiber bundles 4 from at least one quantity of loose fibers 7; a second step 8 consisting in the step-by-step mechanical filling of the aforementioned carrier 2 with the aforementioned fiber bundles 4; a third step 9 consisting in the transfer of the fiber bundles 4 which are placed in the carrier 2 by means of this carrier 2 to a holder 10; and a fourth step 11 consisting in the fixation, by means of this holder 10, of the fiber bundles 4 in the brush body 5, or at least in a portion of the brush body 5.

[0020] The holder 10 represented in figure 1 consists in a preshaped portion of the brush body 5.

[0021] For the lateral separation of the fiber bundles 4, as represented in figures 2 to 5, use shall be made of at least one fiber magazine 12 and a fiber bundle take-up device 13 cooperating therewith which is moved along the fibers 7 provided in the fiber magazine 12, whereby this fiber bundle take-up device 13 is provided with a recess 14 in which fibers 7 can be taken up as this recess 14 passes alongside the fiber magazine 12.

[0022] In the embodiment according to figures 2 and 4, the fiber bundle take-up device is designed rotative, whereas in the embodiments according to figures 3, 5 and 6, the fiber bundle take-up device 13 is designed straight.

[0023] In figures 4, 5 and 6, it is represented in a schematic manner that the recess 14 in the fiber bundle take-up device 13 can be adjusted in size, by shifting a slide 15 or such, in order to take up more or less fibers off a magazine 12.

[0024] In figure 7, it is represented schematically that the separated fiber bundles 4 are brought into the openings 3 of the carrier 2 by positioning these fiber bundles 4 in an appropriate manner in respect to the respective openings 3 and subsequently pushing these fiber bundles axially into the respective openings 3, for example, by means of a punch 16.

[0025] In order to position the fiber bundles 4 even better in respect to the openings 3 of the carrier 2, use shall be made of transfer means 17 which, in this case, are formed by a central lath 18 and two exterior laths 19, 20, whereby the extremities thereof facing each other show recesses, respectively 21 for lath 18 and 22 for the laths 19 and 20, whereby in this case these recesses have a semicircular shape.

[0026] As the openings 3 may show other shapes than a cylindric shape, also the shape of the recesses 21 and 22 may correspond to the shape of the openings 3, in such a manner that the fiber bundles 4 which are sepa-

rated by a fiber bundle take-up device 13 are pushed, by means of the laths 18, 19 and 20, into the appropriate shape before being inserted into the openings 3.

[0027] In figure 9, a device is represented schematically whereby the carriers 2 are moved in an appropriate manner by means of a device 23, in longitudinal direction as well as in perpendicular direction, in order to bring the openings 3 thereof successively under a location where the fiber bundles 4 are removed from the fiber bundle separation device 13 in order to be provided in the openings 3 and thus providing successively a fiber bundle 4 in the different openings, whereby carriers 2 can be supplied to this device 23 one by one in an appropriate manner.

[0028] In figures 10 and 11, an embodiment is represented schematically whereby a carrier 2 filled with fiber bundles 4 is brought against a holder 10 by means of transfer means not represented in the figures, and whereby at the other side of the carrier 2, a device 24 is provided which is intended for moving the fiber bundles 4 from the carrier 2 into the holder 10.

[0029] To this aim, this device 24 consists of a guidance plate 25 on which ejection pins 26 are provided, according to a pattern which corresponds to the pattern of the openings 3 in the carrier 2, the pattern of the holes or passages 27 provided in the holder 10, respectively, whereby these ejection pins 26 are attached, for example, on a common support 28.

[0030] It suffices, as represented in figure 11, to move the ejection pins 26 in the openings 3 of the carrier 2 in order to move the fiber bundles 4 into the holder 10, in such a manner that the free extremities of these fiber bundles 4 protrude from the aforementioned openings 27 with an appropriate length.

[0031] In figures 12 and 13, an embodiment is represented similar to that of figures 10 and 11, but whereby the ejection pins 26 show an inclination 29 at their free extremity, in such a manner that the fiber bundles 4 are positioned in the holder 10 corresponding to the inclinations 29.

[0032] In dash-dot line, a pressure element 30 is represented in figure 13 with which the same result can be obtained, by treating the fiber bundles 4, after their insertion into the holder 10, by beating thereupon and/or subjecting them to a vibration in order to obtain the appropriate end position. This pressure element 30 may also be applied in combination with the ejection pins 26, as a beating element for positioning the fibers against the extremities of the ejection pins 26.

[0033] Finally, by varying the length of the pins 26, the fiber bundles shall be brought more or less into the holder 10, as a result of which, in this respect, too, a certain profile of the extremities of the fiber bundles can be obtained.

[0034] In figures 14 and 15, an embodiment is represented whereby between the carrier 2 and the holder 10 a fiber guidance 31 is provided which is intended, as becomes clear from the drawings, to bring together two or

more fiber bundles 4 in the holder 10, by means of a, for example, funnel-shaped guidance 32.

[0035] In the embodiment according to figures 16 and 17, the fiber guidance 31 has as a function to guide the fiber bundles 4 to another location, whether or not with the intention of placing these fiber bundles in the holder 10 at a certain angle.

[0036] In figures 18 to 22, examples of, in this case, toothbrushes are represented schematically, whereby, in accordance with the aforementioned manner, the fiber bundles 4 are provided in an appropriate manner, in order to realize certain patterns in the horizontal plane as well as in the vertical plane.

[0037] In figure 22, a particular embodiment is represented whereby at certain locations, by the combination of fiber bundles, certain continuous fiber bundle arrangements are obtained.

[0038] When the fiber bundles 4, in the manner as described in the foregoing, are provided in a holder 10, the free extremities of the fibers, as represented, for example, in figure 23, will be melted together, for example, under the influence of heat, whereby it is obtained at the same time that, in this way, the fiber bundles are retained in the holder.

[0039] In figure 24, an application is represented whereby the extremities of the fiber bundles protruding in the holder 10 are chosen with such a length that not only the fibers of a single fiber bundle are melted together, but, at the same time, the fibers of adjacent fiber bundles are connected to each other, such that one whole is obtained which, in heated condition, preferably is compressed.

[0040] In a particular embodiment, as represented in figure 25, the openings 27 in the holder 10 will show an enlargement 33, as a result of which the fiber bundles 4 are additionally fixed in the openings 25.

[0041] In figures 26 and 27 finally is represented that the holder 10 may form a part of the brush body 5, whereby a covering element 34 is provided above the melted-together extremities of the fiber bundles 4, whether or not after a certain substance, such as glue or synthetic material, has been provided additionally between this element 34 and the holder 10, in other words, around the fiber bundle extremities, or whereby the fiber bundles 4 are provided in a loose holder 10 which is fixed in the brush body 5, whether or not after the melted-together fiber bundle extremities are mutually connected by glue, synthetic material or such.

[0042] It is clear that, instead of providing a covering element 34, the entire space above the fiber bundle extremities can be filled by any kind of suitable material.

[0043] It is also clear that for the aforementioned four steps, different combinations of the techniques described in the foregoing can be applied, which, amongst others, also becomes clear from the mutual references between the claims following hereafter.

[0044] In figure 28, a brush manufacturing machine 35 is represented in top view, in which machine the afore-

mentioned device 1 is integrated.

[0045] This machine comprises a closed circuit 36 of clamping devices 37 which are provided at a rotating table 38. These clamping devices 37 are provided with clamps 39 for keeping holders 10 clamped.

[0046] Hereby, the clamping devices 37 pass through at least four stations, respectively a station 40 where the feeding of the holders 10 is performed, a station 41 where the holders 10 are filled with fiber bundles 4, a station 42 where the additional part of the toothbrush, either the covering element 34, or a part of the brush handle, is provided, and a station 43 where the brush bodies 5 provided with fiber bundles 4 are transported off for a possible finishing in a finishing device 44.

[0047] The station 40 for feeding the holders 10 can be made such that it is suitable for manual feeding or for automatic feeding, or for both. In the represented example, the station 40 comprises a part 40A for manual feeding and a part 40B for automatic feeding. With automatic feeding, the holders 10 are supplied from a stack magazine 45 or such by means of an automatic supply device 46, such as a vibratory feeding device. Such systems are sufficiently known in themselves and therefore will not be discussed in detail in the following.

[0048] The station 41 for inserting the fiber bundles 4 into the holders 10 preferably consists, as represented, of a machine part with various circulating carriers, in this case, three carriers 2A, 2B, and 2C. Each carrier comprises several groups of openings 3, in this case, for four filling patterns.

[0049] These carriers 2A, 2B, and 2C circulate between, on one hand, a filling station 47 where the fiber bundles 4, as mentioned before, are separated laterally from one or more fiber magazines 12 by means of one or more fiber bundle take-up devices 13 and are placed in the openings 3 and, on the other hand, a discharge station 48 where the fiber bundles 4 are brought from the respective carrier 2A-2B-2C into the holders 10 situated below. As represented, preferably more than two carriers, in this case, the three carriers 2A-2B-2C, will circulate in order to render the process continuous.

[0050] It is noted that each clamping device 37 preferably can comprise more than one holder 10. In the represented example, this is two holders at a time. The advantage thereof is that several holders 10 can be filled simultaneously in the station 41 and a larger production speed can be guaranteed.

[0051] Preferably, in station 41 the fibers of the fiber bundles 4 also are adhered to the holders 10 by means of heat, glue, resin or such. The fixation of the fibers in the holders 10, however, may take several processing stations. So, for example, it is possible to provide for an additional melting together at the height of the indicated station 49.

[0052] In station 42, each holder 10 is combined with a complementary part. In the case of figure 28, this means that brush bodies 5, as represented in figure 27, are provided and attached at the clamped holder 10. In the part

42A, the brush bodies 5 are supplied to the holders 10, in this case automatically by means of an automatic supply device 50, from a stack magazine or such. In part 42B, the complementary parts are attached to each other, either by means of a click-on system, or by means of ultrasonic welding, or in any other manner.

[0053] It is, of course, also possible to provide, according to a variant, in a manual or semi-automatic supply of the complementary parts, more particularly the brush bodies 5.

[0054] In station 43, the obtained products are transported off, either simply ejected, or guided on to the already mentioned finishing device 44.

[0055] It is noted that in the circuit 36, apart from the already mentioned stations 40-41-42-43, other stations may also be included, such as, for example, a cleaning station 51, where fiber scraps and dust from previous cycles are removed.

[0056] In the finishing device 44, various treatments may be performed. In the case that one is working with fibers with fiber extremities which have not been rounded off in advance, those can be rounded off in the finishing device 44.

[0057] Other treatments which can be performed in this finishing device 44 are, amongst others, the provision of markings, such as date, machine number, production data, trademark, etc.; the finishing of the handle, for example, by providing a heat-sensitive film or by printing over the handle; and the inspection of the end product for its quality. As all these different treatments take place spread over several stations, this machine preferably shall consist of a closed circuit of clamping devices which transport the products from one processing station to the following.

[0058] In the case that the fibers are already rounded off in advance, it is clear that no rounding off will be required subsequently, but the other steps, of course, still can be applied.

Claims

1. Method for manufacturing brushes, in that a device is applied consisting of at least one carrier (2) with openings (3) which are mutually arranged according to a certain pattern, whereby the fiber bundles which have to be provided in a brush body (5) can be put in this carrier (2), and whereby this method further consists in the combination of at least four steps (6-8-9-11), respectively, the lateral separation of fiber bundles (4) from at least one quantity of loose fibers (7) by means of at least one fiber bundle take-up device (13) provided with a recess (14) in which fibers (7) can be taken up as the recess (14) passes alongside the fiber magazine (12); the provision, in a mechanical manner, step-by-step, of the aforementioned fiber bundles (4) in the aforementioned carrier by a mutual positioning between each respec-

tive fiber bundle (4) and the opening (3) in which it has to be provided, and subsequently pushing the separated fiber bundles (4) in longitudinal direction into the aforementioned openings (3); the transfer of the fiber bundles (4) which are placed in the carrier by means of this carrier (2) to a holder (10) ; and, by means of this holder (10), the fixation of the fiber bundles (4) in the brush body (5), or at least in a portion of the brush body.

2. Method according to claim 1, **characterized in that**, for the lateral separation of fiber bundles (4), use is made of at least one fiber magazine (12) and a fiber bundle take-up device (13) cooperating therewith which is moved along the fibers (7) taken into the fiber magazine (12) and which is provided with a recess (14), in such a manner that fiber bundles (4) are separated which subsequently are provided in the carrier (2).
3. Method according to claim 1 or 2, **characterized in that** the size, more particularly the thickness, of the separated fiber bundles (4) is changed during the filling of the aforementioned pattern, in particular, is controlled according to a certain cycle, to which aim use is made of a bundle take-up device (13), whereby the size of the aforementioned recess (14) thereof can be adjusted.
4. Method according to claim 1, **characterized in that** the separation of the fiber bundles (4) is performed by means of a fiber bundle take-up device (13) and that the fiber bundles (4) are pushed from the fiber bundle take-up device (13) immediately into the openings of the carrier (2).
5. Method according to claim 1, **characterized in that** the separation of the fiber bundles (4) is performed by means of a fiber bundle take-up device (13) and that the separated fiber bundles (4) are provided in the respective openings of the carrier (2) by taking them by means of transfer means (17) out of the fiber bundle take-up device (13) and placing them in the openings (3).
6. Method according to claim 4 or 5, **characterized in that** one or more carriers (2) are used, comprising at least a number of openings (3), the shape of which differs from the cross-section of the separated fiber bundles (4) and that the separated fiber bundles (4), in respect to the cross-section, are re-shaped during the transfer to the carrier (2) in order to obtain a shape which is adapted to the shape of the respective openings (3).
7. Method according to any of the preceding claims, **characterized in that** the separated fiber bundles (4), at one or more well-defined locations, are pre-

sented to the carriers (2) and that the respective carriers (2) are subjected to a positioning cycle such that separated fiber bundles (4) are systematically presented to the openings (3) thereof.

8. Method according to any of the preceding claims, **characterized in that** use is made of one or more carriers (2) with through openings (3), whereby the separated fiber bundles (4) are pushed into the openings (3) and, after such carrier (2) is filled with fiber bundles (4) and has been presented to a holder (10), the fiber bundles (4) taken up in the carrier (2) are removed from the openings (3) in order to be placed directly or indirectly into the aforementioned holder (10).
9. Method according to claim 8, **characterized in that** fiber bundles (4) provided in each respective carrier (2) are brought from this carrier (2) into the respective holder (10) by pushing them out of the carrier (2) by means of ejection pins (26).
10. Method according to any of the preceding claims, **characterized in that** during the transfer of the fiber bundles (4) from a carrier (2) to a holder (10), the fiber bundles (4) with their extremities which are intended to form the free extremities of the brush hair, are arranged according to a desired profile.
11. Method according to any of the preceding claims, **characterized in that** use is made of a fiber guidance (31) which either places certain fiber bundles (4) in a well-defined direction, or brings certain fiber bundles (4) together, or still guides certain fiber bundles (4) to another location, or provides in a combination of two or three of these actions.
12. Method according to any of the preceding claims, **characterized in that** for the holder (10), use is made of an already previously formed portion of a brush body (5).
13. Method according to any of the preceding claims, **characterized in that** for a holder (10), use is made of a portion which is provided with through openings (27); that the fiber bundles (4) with their respective extremities are brought through these openings (27); and that the fibers (7) of the fiber bundles (4), at their extremities protruding through the aforementioned portion, subsequently are adhered to each other and/or fixed in the respective portion.
14. Method according to claim 13, **characterized in that** the extremities of the fibers 7, the fiber bundles (4), respectively, which protrude through the aforementioned portion, are subjected to one or more of the techniques from the following series:

- the melting together of the fibers (7) by means of heat;
 - the melting to each other of the fiber bundles (4) by heating and flattening the respective extremities;
 - the mutual connection of the fibers (7) and/or fiber bundles (4) by means of a substance, such as glue or synthetic material;
 - the casting of the fibers (7) and fiber bundles (4) to a single whole;
 - the sealing of the fibers (7), at least next to the foot with which they protrude through the aforementioned holder (10);
 - each combination of two or more of abovesaid techniques.
15. Device for manufacturing brushes, in particular with a method according to any of the preceding claims, consisting in the combination of at least one fiber magazine (12) with loose fibers (7); means (13) for the lateral separation of fiber bundles (4) from the fibers (7) in the fiber magazine (12) consisting of a fiber bundle take-up device (13) which is provided with a recess (14); a mechanism with at least one carrier (2) in which openings are formed in which the aforementioned fiber bundles (4) can be provided and with at least means that permit in a mechanical manner the mutual step by step positioning between each respective fiber bundle (4) and the opening (3) in which it has to be provided, and means that permit to subsequently pushing the separated fiber bundles (4) in longitudinal direction into the aforementioned openings (3); and transfer means for presenting the carrier (2), carriers (2) respectively, filled with fiber bundles (4), to a holder (10) by means of which the fiber bundles (4) can be fixed into a brush body (5), or at least a portion of a brush body (5) in an appropriate manner.
16. Device according to claim 15, **characterised in that** the means (13) for the lateral separation of fiber bundles (4) consist of a to-and-fro movable fiber bundle take-up device (13) which is provided with a recess (14); that the carrier (2) consists of a plate with through openings (3); and that the device further is provided with means (24) in the form of ejection pins (26) or such in order to transfer the fiber bundles (4) from the carrier (2) to the holder (10).
17. Device according to claim 15 or 16, **characterized in that** it comprises a closed circuit (36) of clamping devices (37) which pass at least four stations, respectively a station (40) where the feeding of the holders (10) takes place, a station (41) where the holders (10) are filled with fiber bundles (4), a station (42) where the additional portion of the toothbrush, either the covering element (34), or a portion of the brush handle, is attached, and a station (43) where

the brush bodies (5) provided with fiber bundles (4) are transported off, whether or not for a finishing treatment in a finishing device (44).

18. Device according to claim 17, **characterized in that** the station (42) for the insertion of the fiber bundles (4) into the holders (10) consists of a machine part with different carriers (2A-2B-2C) circulating between, on one hand, a filling station (47) where the fiber bundles (4) are separated laterally from one or more fiber magazines (12) by means of one or more fiber bundle take-up devices (13) and are placed into the openings (3) of the carriers (2), and, on the other hand, a discharge station (48) where the fiber bundles (4) are brought from the respective carrier (2A-2B-2C) into the holders (10).
19. Device according to claim 18, **characterized in that** each clamping device (37) comprises several places for the clamping of holders (10) and that each carrier (2A-2B-2C) has different filling patterns, whereby from such carrier (2A-2B-2C) several holders (10) of one clamping device (37) can be filled simultaneously.

Patentansprüche

1. Verfahren zum Herstellen von Bürsten, in dem eine Vorrichtung angewendet ist, bestehend aus mindestens einem Träger (2) mit Öffnungen (3), die zueinander gemäß einem bestimmten Muster angeordnet sind, wobei die Faserbündel, die in einem Bürstenkörper (5) bereit gestellt werden müssen, in diesen Träger (2) platziert werden können, und wobei dieses Verfahren weiterhin aus der Kombination von mindestens vier Schritten (6-8-9-11) besteht, jeweils dem lateralen Trennen von Faserbündeln (4) von mindestens einer Menge loser Fasern (7) mittels mindestens einer Faserbündel-Aufnahmevorrichtung (13), versehen mit einer Aussparung (14), in welche Fasern (7) aufgenommen werden können, wenn die Aussparung (14) am Fasermagazin (12) passiert; der Bereitstellung in mechanischer Weise, Schritt für Schritt, der zuvor genannten Faserbündel (4) in den zuvor genannten Träger durch eine gegenseitige Positionierung zwischen jedem einzelnen Faserbündel (4) und der Öffnung (3), in welcher es bereit gestellt werden muss, und anschließend dem Ausdrücken der getrennten Faserbündel (4) in Längsrichtung in die zuvor genannten Öffnungen (3); die Übertragung der Faserbündel (4), die in den Träger platziert sind, mittels dieses Trägers (2) zu einem Halter (10); und mittels dieses Halters (10) dem Befestigen der Faserbündel (4) im Bürstenkörper (5) oder zumindest in einem Teil des Bürstenkörpers.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** für die laterale Trennung der Faserbündel (4) Gebrauch gemacht wird von mindestens einem Fasermagazin (12) und einer mit diesem zusammen arbeitenden Faserbündel-Aufnahmevorrichtung (13), die an den in das Fasermagazin (12) aufgenommenen Fasern (7) entlang geführt wird und die mit einer Aussparung (14) in einer solchen Weise versehen ist, dass Faserbündel (4), die anschließend im Träger (2) bereit gestellt werden, getrennt werden. 5
3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Größe, insbesondere die Dicke der getrennten Faserbündel (4), während des Füllens des zuvor genannten Musters geändert wird, insbesondere gemäß einem bestimmten Zyklus kontrolliert wird, zu welchem Zweck eine Bündelaufnahmevorrichtung (13) verwendet wird, wobei die Größe der zuvor genannten Aussparung (14) angepasst werden kann. 10
4. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Trennung der Faserbündel (4) mittels einer Faserbündel-Aufnahmevorrichtung (13) durchgeführt wird und dass die Faserbündel (4) aus der Faserbündel-Aufnahmevorrichtung (13) sofort in die Öffnungen des Trägers (2) gedrückt werden. 15
5. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Trennung der Faserbündel (4) mit Hilfe einer Faserbündel-Aufnahmevorrichtung (13) durchgeführt wird und dass die getrennten Faserbündel (4) in den jeweiligen Öffnungen des Trägers (2) bereit gestellt sind, indem sie mit Hilfe von Übertragungsmitteln (17) aus der Faserbündel-Aufnahmevorrichtung (13) genommen und in die Öffnungen (3) platziert werden. 20
6. Verfahren nach Anspruch 4 oder 5, **dadurch gekennzeichnet, dass** einer oder mehrere der Träger (2) verwendet sind, die mindestens eine Anzahl von Öffnungen (3) umfassen, deren Form sich von dem Querschnitt der getrennten Faserbündel (4) unterscheidet, und dass die getrennten Faserbündel (4) in Bezug auf den Querschnitt während der Übertragung zu dem Träger (2) umgeformt werden um eine Form zu erhalten, die an die Form der jeweiligen Öffnungen (3) angepasst ist. 25
7. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die getrennten Faserbündel (4) an einer oder mehreren wohldefinierten Stellen den Trägern (2) vorgelegt werden und dass die jeweiligen Träger (2) einem Positionierungszyklus unterzogen werden, so dass getrennte Faserbündel (4) systematisch dessen Öffnungen (3) vorgelegt werden. 30
8. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** einer oder mehrere Träger (2) mit durchgehenden Öffnungen (3) verwendet sind, wobei die getrennten Faserbündel (4) in die Öffnungen (3) gedrückt werden und, nachdem ein solcher Träger (2) mit Faserbündeln (4) gefüllt ist und einem Halter (10) vorgelegt worden ist, die im Träger (2) aufgenommenen Faserbündel (4) aus den Öffnungen (3) entfernt werden, um direkt oder indirekt in den zuvor genannten Halter (10) platziert zu werden. 35
9. Verfahren nach Anspruch 8, **dadurch gekennzeichnet, dass** Faserbündel (4), die in jedem einzelnen Träger (2) bereit gestellt sind, von diesem Träger (2) in den jeweiligen Halter (10) gebracht werden, indem sie mittels Ausdrückstiften (26) aus dem Träger (2) heraus gedrückt werden. 40
10. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** während der Übertragung der Faserbündel von einem Träger (2) zu einem Halter (10) die Faserbündel (4) mit ihren Enden, die dazu bestimmt sind, die freien Enden des Bürstenhaars zu bilden, gemäß einem gewünschten Profil angeordnet sind. 45
11. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** eine Faserführung (31) verwendet ist, die entweder bestimmte Faserbündel (4) in einer wohldefinierten Richtung platziert oder bestimmte Faserbündel (4) zusammenbringt oder aber bestimmte Faserbündel (4) an eine andere Stelle führt, oder eine Kombination von zwei oder drei dieser Aktionen bereit stellt. 50
12. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** für den Halter (10) ein bereits vorher geformte Abschnitt eines Bürstenkörpers (5) verwendet ist. 55
13. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** für einen Halter (10) ein Teil verwendet ist, das mit durchgehenden Öffnungen (27) versehen ist; dass die Faserbündel (4) mit ihren jeweiligen Enden durch diese Öffnungen (27) gebracht werden; und dass die Fasern (7) der Faserbündel (4), die an ihren Enden durch den zuvor genannten Teil ragen, anschließend aneinander gehängt werden und/oder in dem jeweiligen Abschnitt befestigt werden.
14. Verfahren nach Anspruch 13, **dadurch gekennzeichnet, dass** die Enden der Fasern (7), genauer gesagt die Faserbündel (4), die durch den zuvor genannten Abschnitt ragen, einem oder mehreren Ver-

fahren aus der folgenden Serie unterzogen werden:

- Verschmelzen der Fasern (7) mittels Wärme;
 - Aneinanderschmelzen der Faserbündel (4) mittels Wärme und Abflachen der jeweiligen Enden;
 - Gegenseitiges Verbinden der Fasern (7) und/oder Faserbündel (4) mittels einer Substanz wie z.B. Klebstoff oder synthetisches Material;
 - Formen der Fasern (7) und der Faserbündel (4) zu einem einzigen Ganzen;
 - Versiegeln der Fasern (7), zumindest neben dem Fuß, mit dem sie durch den zuvor genannten Halter (10) ragen;
 - jede Kombination von zwei oder mehr der oben genannten Verfahren.
15. Vorrichtung für die Herstellung von Bürsten, insbesondere mit einem Verfahren gemäß einem der vorhergehenden Ansprüche, bestehend aus der Kombination von mindestens einem Fasermagazin (12) mit losen Fasern (7); Mitteln (13) für die laterale Trennung von Faserbündeln (4) von den Fasern (7) in dem Fasermagazin (12), bestehend aus einer Faserbündel-Aufnahmevorrichtung (13), die mit einer Aussparung (14) versehen ist; einem Mechanismus mit mindestens einem Träger (2), in dem Öffnungen geformt sind, in welchen die zuvor genannten Faserbündel (4) bereit gestellt werden können, und mit mindestens Mitteln, die auf mechanische Weise die gegenseitige schrittweise Positionierung zwischen jedem einzelnen Faserbündel (4) und der Öffnung (3), in der es bereit zu stellen ist, ermöglichen, und Mitteln, die es ermöglichen, anschließend die getrennten Faserbündel (4) in Längsrichtung in die zuvor genannten Öffnungen (3) zu drücken; und Übertragungsmitteln zum Präsentieren des Trägers (2) bzw. der Träger (2), gefüllt mit Faserbündeln (4) zu einem Halter (10), mit dessen Hilfe die Faserbündel in einer geeigneten Weise (4) in einem Bürstenkörper (5) oder zumindest einem Abschnitt eines Bürstenkörpers (5) befestigt werden können.
16. Vorrichtung gemäß Anspruch 15, **dadurch gekennzeichnet, dass** die Mittel (13) für die laterale Trennung von Faserbündeln (4) aus einer hin und her beweglichen Faserbündel-Aufnahmevorrichtung (13) besteht, die mit einer Aussparung (14) versehen ist; dass der Träger (2) aus einer Platte mit durchgehenden Öffnungen (3) besteht; und dass die Vorrichtung weiterhin mit Mitteln (24) in der Form von Ausdrückstiften (26) oder dergleichen versehen ist, um die Faserbündel (4) von dem Träger (2) zum Halter (10) zu übertragen.
17. Vorrichtung nach Anspruch 15 oder 16, **dadurch gekennzeichnet, dass** sie einen geschlossenen Kreislauf (36) von Klemmvorrichtungen (37) um-

fasst, die mindestens vier Stationen passieren, nämlich eine Station (40), wo die Zuführung der Halter (10) erfolgt, eine Station (41), wo die Halter (10) mit Faserbündeln (4) gefüllt werden, einer Station (42), wo der zusätzliche Abschnitt der Zahnbürste, entweder das bedeckende Element (34) oder ein Abschnitt des Bürstengriffs, befestigt wird, und einer Station (43), wo die Bürstenkörper (5), versehen mit Faserbündeln (4), abtransportiert werden oder auch nicht, für eine Fertigbearbeitung in einer Fertigbearbeitungsvorrichtung (44).

18. Vorrichtung nach Anspruch 17, **dadurch gekennzeichnet, dass** die Station (42) für das Einsetzen der Faserbündel (4) in die Halter (10) aus einem Maschinenteil mit verschiedenen Trägern (2A-2B-2C) besteht, die zirkulieren zwischen einerseits einer Füllstation (47), wo die Faserbündel (4) mit Hilfe von einer oder mehreren Faserbündel-Aufnahmevorrichtungen (13) lateral von einem oder mehreren Fasermagazinen getrennt werden und in die Öffnungen (3) der Träger (2) platziert werden, und andererseits einer Entladestation (48), wo die Faserbündel (4) von dem jeweiligen Träger (2A-2B-2C) in die Halter (10) gebracht werden.

19. Vorrichtung nach Anspruch 18, **dadurch gekennzeichnet, dass** jede Klemmvorrichtung (37) mehrere Stellen für das Klemmen von Haltern (10) umfasst, und dass jeder Träger (2A-2B-2C) verschiedene Füllmuster hat, wobei von solchen Trägern (2A-2B-2C) mehrere Halter (10) von einer Klemmvorrichtung (37) gleichzeitig gefüllt werden können.

Revendications

1. Procédé pour fabriquer des brosses, dans lequel on applique un dispositif constitué par au moins un chariot (2) comportant des ouvertures (3) qui sont arrangées les unes par rapport aux autres conformément à un certain modèle, les faisceaux de fibres qui doivent être insérés dans un corps de brosse (5) pouvant être placés dans ce chariot (2), et ce procédé étant constitué en outre par la combinaison d'au moins quatre étapes (6 - 8 - 9 - 11) respectivement, consistant à séparer latéralement des faisceaux de fibres (4) par rapport à au moins une quantité de fibres lâches (7) à l'aide d'au moins un dispositif de prélèvement de faisceaux de fibres (13) muni d'un évidement (14) dans lequel des fibres (7) peuvent être prélevées lorsque l'évidement (14) passe le long du magasin de fibres (12) ; à insérer, d'une manière mécanique, étape par étape, les faisceaux de fibres susmentionnés (4) dans le chariot susmentionné via un positionnement réciproque entre chaque faisceau de fibres respectif (4) et l'ouverture (3) dans laquelle ce dernier doit venir s'insérer, et à

pousser par la suite les faisceaux de fibres séparés (4) en direction longitudinale pour pénétrer dans les ouvertures susmentionnées (3) ; le fait de transférer des faisceaux de fibres (4) qui sont placés dans le chariot à l'aide de ce chariot (2) au support (10) ; et à l'aide de ce support (10), la fixation des faisceaux de fibres (4) dans le corps de brosse (5), ou au moins dans une portion du corps de brosse.

2. Procédé selon la revendication 1, **caractérisé en ce que**, pour la séparation latérale des faisceaux de fibres (4), on fait usage d'au moins un magasin de fibres (12) et d'un dispositif de prélèvement de faisceaux de fibres (13) coopérant avec le premier cité, qui se déplace le long des fibres (7) prélevées dans le magasin de fibres (12) et qui est muni d'un évidement (14), de telle sorte que des faisceaux de fibres (4) sont séparés pour être inséré par la suite dans le chariot (2).
3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** la dimension, plus particulièrement l'épaisseur, des faisceaux de fibres séparés (4) est soumis à une modification lors du remplissage du modèle susmentionné, en particulier, est commandé en fonction d'un certain cycle ; à cet effet, on fait usage d'un dispositif de prélèvement de faisceaux (13) par lequel on peut régler l'évidement susmentionné (14).
4. Procédé selon la revendication 1, **caractérisé en ce que** la séparation des faisceaux de fibres (4) est mise en oeuvre à l'aide d'un dispositif de prélèvement de faisceaux de fibres (13) et **en ce que** les faisceaux de fibres (4) sont poussés à partir du dispositif de prélèvement de faisceaux de fibres (13) immédiatement dans les ouvertures du chariot (2).
5. Procédé selon la revendication 1, **caractérisé en ce que** la séparation des faisceaux de fibres (4) est mise en oeuvre à l'aide d'un dispositif de prélèvement de faisceaux de fibres (13) et **en ce que** les faisceaux de fibres séparés (4) sont insérés dans les ouvertures respectives du chariot (2) en les prélevant à l'aide d'un moyen de transfert (17) à l'extérieur du dispositif de prélèvement de faisceaux de fibres (13) et en les plaçant dans les ouvertures (3).
6. Procédé selon la revendication 4 ou 5, **caractérisé en ce qu'on** utilise un ou plusieurs chariots (2) comprenant au moins un certain nombre d'ouvertures (3) dont la forme en section transversale diffère de celle des faisceaux de fibres séparés (4), et **en ce que** les faisceaux de fibres séparés (4), en ce qui concerne leur section transversale, sont soumis à un nouveau façonnement au cours du transfert au chariot (2) dans le but d'obtenir une configuration qui épouse la configuration des ouvertures respectives

(3).

7. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les faisceaux de fibres séparés (4), à un ou plusieurs endroits bien définis, sont présentés au chariot (2), et **en ce que** les chariots respectifs (2) sont soumis à un cycle de positionnement, de telle sorte que des faisceaux de fibres séparés (4) sont présentés de manière systématique aux ouvertures (3) desdits chariots.
8. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'on** fait usage d'un ou de plusieurs chariots (2) comprenant des ouvertures traversantes (3), les faisceaux de fibres séparés (4) étant poussés dans les ouvertures (3) et, après avoir rempli ledit chariot (2) avec des faisceaux de fibres (4) et après l'avoir présenté à un support (10), les faisceaux de fibres (4) prélevés dans le chariot (2) sont retirés des ouvertures (3) afin de les placer directement ou indirectement dans le support (10) susmentionné.
9. Procédé selon la revendication 8, **caractérisé en ce que** des faisceaux de fibres (4) insérés dans chaque chariot respectif (2) sont amenés, à partir de ce chariot (2) dans le support respectif (10) en les poussant hors du chariot (2) à l'aide de broches d'éjection (26).
10. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'au** cours du transfert des faisceaux de fibres (4) d'un chariot (2) à un support (10), les faisceaux de fibres (4), dont les extrémités sont destinées à former les extrémités libres des poils de brosse, sont arrangés en fonction d'un profil désiré.
11. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'on** fait usage d'un dispositif de guidage de fibres (31) qui, soit place un certain nombre de faisceaux de fibres (4) dans une direction bien définie, soit amène un certain nombre de faisceaux de fibres (4) les uns contre les autres, ou encore guide un certain nombre de faisceaux de fibres (4) vers un autre endroit, ou encore met en oeuvre une combinaison de deux ou trois de ces actions.
12. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que**, pour le support (10), on fait usage d'une portion d'un corps de brosse (5) déjà formée au préalable.
13. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que**, pour un support (10), on fait usage d'une portion qui est munie d'ouvertures traversantes (27) ; en ce que les fais-

ceaux de fibres (4) avec leurs extrémités respectives sont amenés à travers ces ouvertures (27) ; et en ce qu'on fait adhérer les unes aux autres les fibres (7) des faisceaux de fibres (4), à leurs extrémités faisant saillie à travers la portion susmentionnée, et/ou on les fixe dans la portion respective.

14. Procédé selon la revendication 13, **caractérisé en ce que** les extrémités des fibres (7), les faisceaux de fibres (4), respectivement qui font saillie à travers la portion susmentionnée, sont soumis à une ou plusieurs des techniques choisies parmi la série ci-après :

- le fait de joindre les fibres (7) les unes aux autres par fusion à l'aide de chaleur ;
- le fait de joindre les faisceaux de fibres (4) les uns aux autres par fusion à l'aide de chaleur et d'aplatissement des extrémités respectives ;
- le fait de connecter mutuellement les fibres (7) et/ou les faisceaux de fibres (4) à l'aide d'une substance, telle que de la colle ou une matière synthétique ;
- le moulage de fibres (7) et des faisceaux de fibres (4) pour obtenir une seule entité ;
- le scellement des fibres (7), au moins à proximité de la base avec laquelle elles font saillie à travers le support (10) susmentionné ;
- chaque combinaison de deux des techniques susmentionnées ou plus.

15. Dispositif pour fabriquer des brosses, en particulier avec un procédé selon l'une quelconque des revendications précédentes, consistant en la combinaison d'au moins un magasin de fibres (12) comprenant des fibres lâches (7) ; d'un moyen (13) pour la séparation latérale des faisceaux de fibres (4) par rapport aux fibres (7) dans le magasin de fibres (12), constitué d'un dispositif de prélèvement de faisceaux de fibres (13) qui est muni d'un évidement (14) ; d'un mécanisme comprenant au moins un chariot (2) dans lequel sont pratiquées des ouvertures dans lesquelles on peut insérer les faisceaux de fibres (4) susmentionnés et comprenant au moins un moyen qui permet, d'une manière mécanique, de mettre en oeuvre un positionnement réciproque étape par étape entre chaque faisceau de fibres respectif (4) et l'ouverture (3) dans laquelle il doit venir s'insérer, et un moyen qui permet de pousser par la suite les faisceaux de fibres séparés (4) en direction longitudinale dans des ouvertures susmentionnées (3) ; et d'un moyen de transfert pour présenter le chariot (2), les chariots (2), respectivement, remplis de faisceaux de fibres (4), à un support (10) à l'aide duquel, les faisceaux de fibres (4) peuvent être fixés dans un corps de brosse (5) ou au moins dans une portion d'un corps de brosse (5) d'une manière appropriée.

16. Dispositif selon la revendication 15, **caractérisé en ce que** le moyen (13) pour la séparation latérale des faisceaux de fibres (4) est constitué d'un dispositif de prélèvement de faisceaux de fibres (13) apte à effectuer un mouvement de va et vient, qui est muni d'un évidement (14) ; et **en ce que** le dispositif est muni en outre d'un moyen (24) sous la forme de broches d'éjection (26) ou analogues dans le but de transférer des faisceaux de fibres (4) du chariot (4) au support (10).

17. Dispositif selon la revendication 15 ou 16, **caractérisé en ce qu'il** comprend un circuit fermé (36) de dispositif de serrage (37) qui passe par au moins quatre postes, respectivement un poste (40) dans lequel a lieu l'alimentation des supports (10) ; un poste (41) dans lequel les supports (10) sont remplis avec des faisceaux de fibres (4) ; un poste (42) dans lequel on fixe la portion supplémentaire de la brosse à dents, soit l'élément de recouvrement (34), soit une portion du manche de brosse, et un poste (43) dans lequel les corps de brosses (5) munis des faisceaux de fibres (4) sont évacués, le cas échéant pour un traitement de finition dans un dispositif de finition (44).

18. Dispositif selon la revendication 17, **caractérisé en ce que** le poste (42) pour l'insertion des faisceaux de fibres (4) dans les supports (10) est constitué d'une partie de machine comportant différents chariots (2A - 2B - 2C) circulant entre, d'une part, un poste de remplissage (47) dans lequel les faisceaux de fibres (4) sont séparés latéralement par rapport à un ou plusieurs magasins de fibres (12) à l'aide d'un ou de plusieurs dispositifs de prélèvement de faisceaux de fibres (13) et sont placés dans des ouvertures (3) des chariots (2), et d'autre part un poste d'évacuation (48) dans lequel les faisceaux de fibres (4) sont amenés, depuis le chariot respectif (2A - 2B - 2C) jusque dans les supports (10).

19. Dispositif selon la revendication (18), **caractérisé en ce que** chaque dispositif de serrage (37) comprend plusieurs endroits pour le serrage des supports (10), et **en ce que** chaque chariot (2A - 2B - 2C) possède différents modèles de remplissage, par lequel, à partir d'un tel chariot (2A - 2B - 2C), plusieurs supports (10) d'un dispositif de serrage (37) peuvent être remplis de manière simultanée.

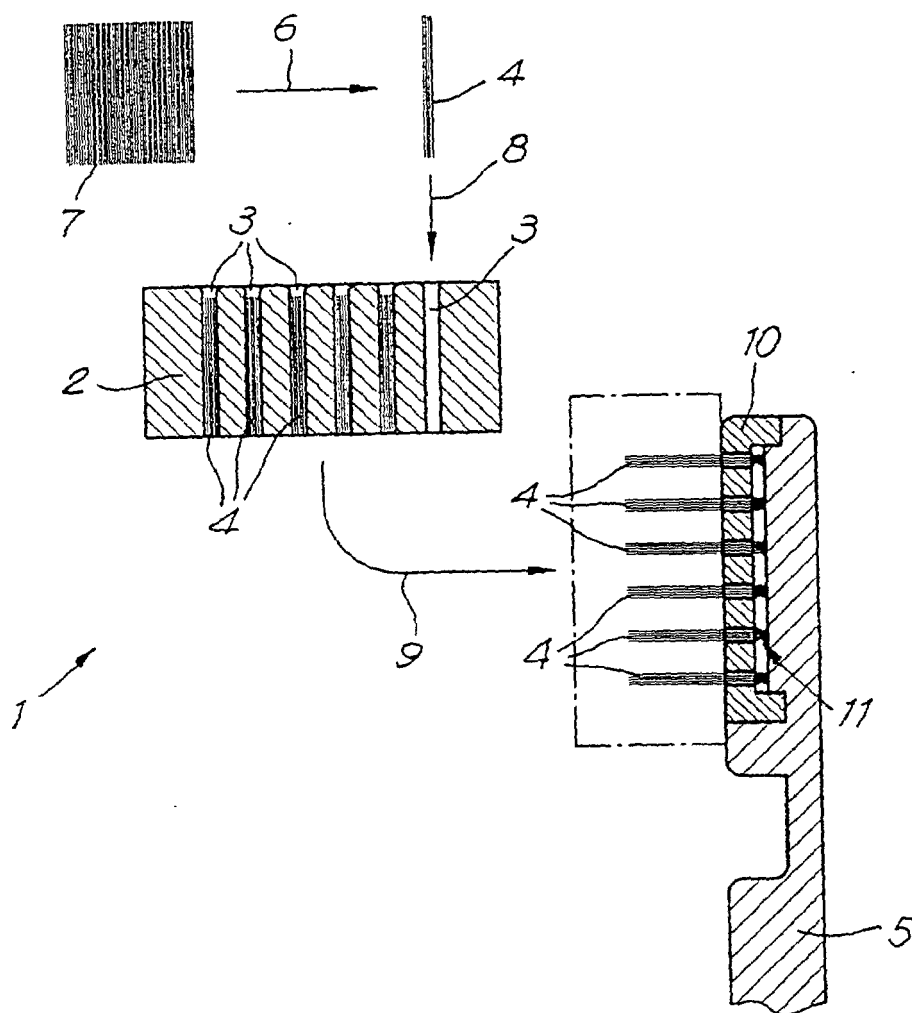


Fig. 1

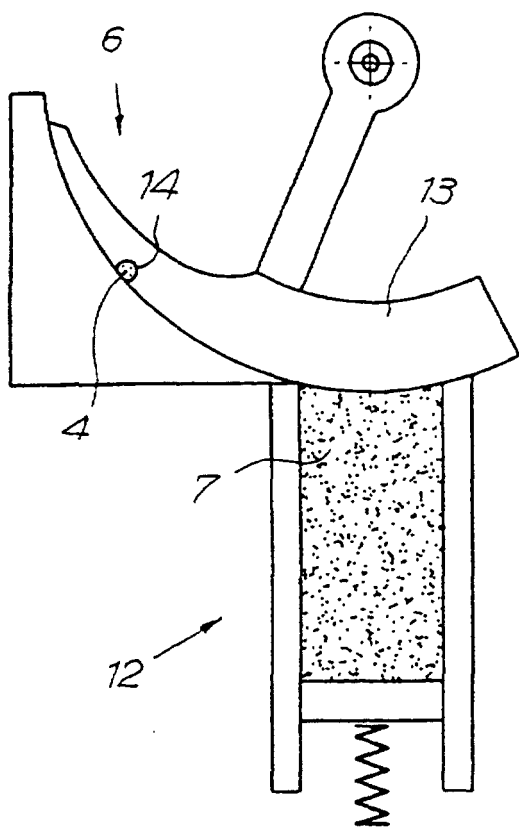


Fig. 2

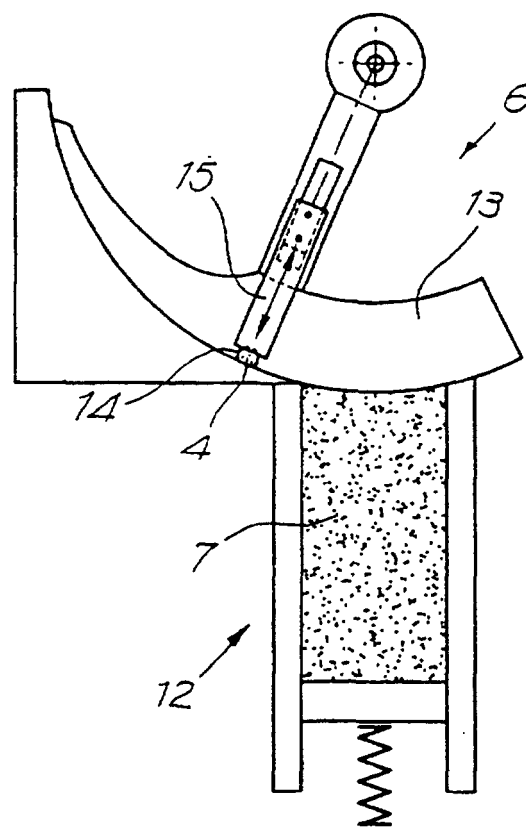


Fig. 4

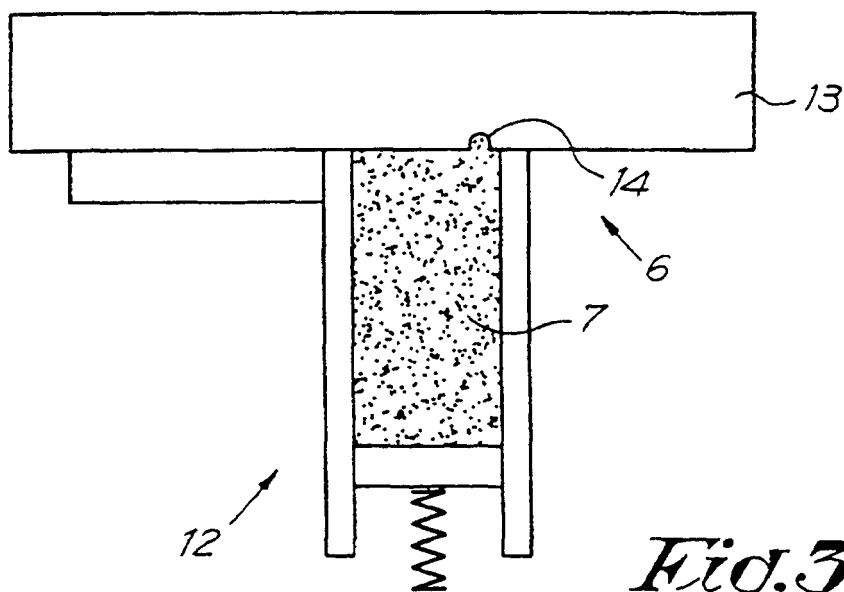


Fig. 3

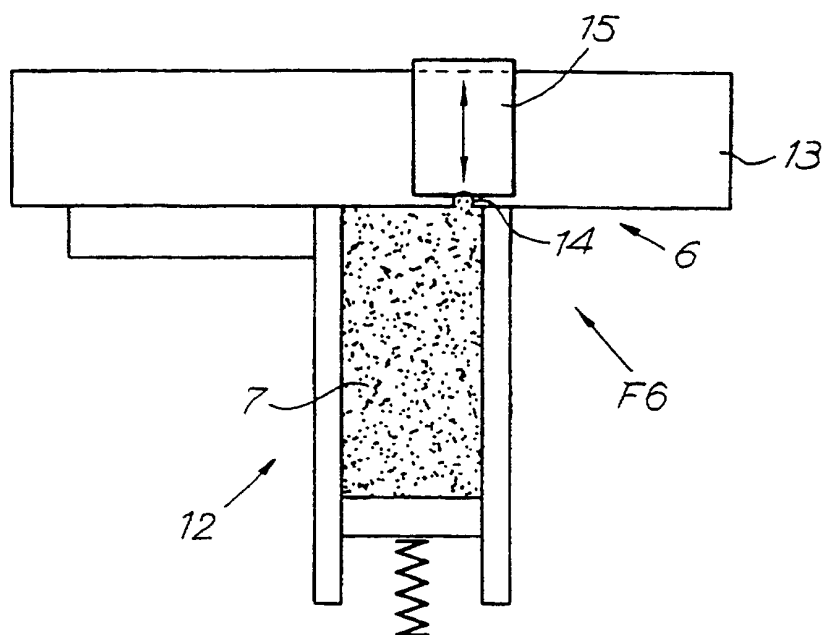


Fig. 5

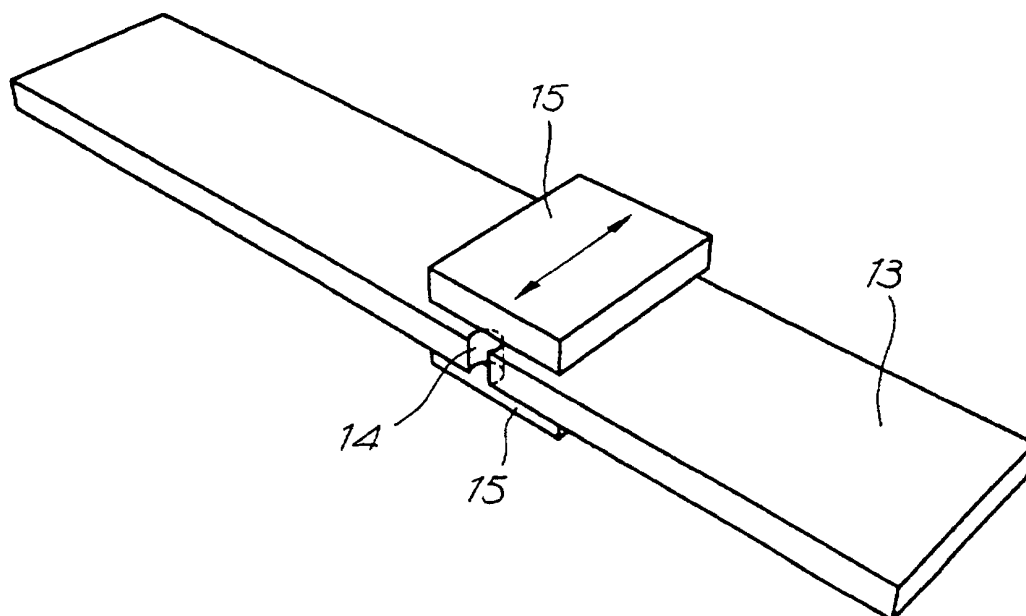


Fig. 6

Fig.7

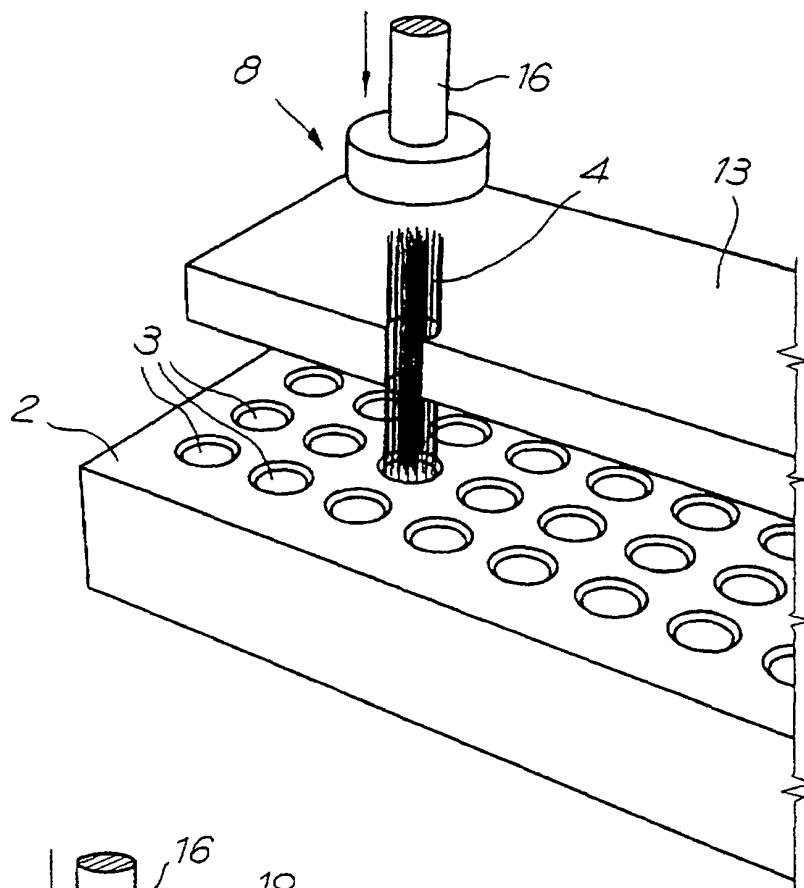
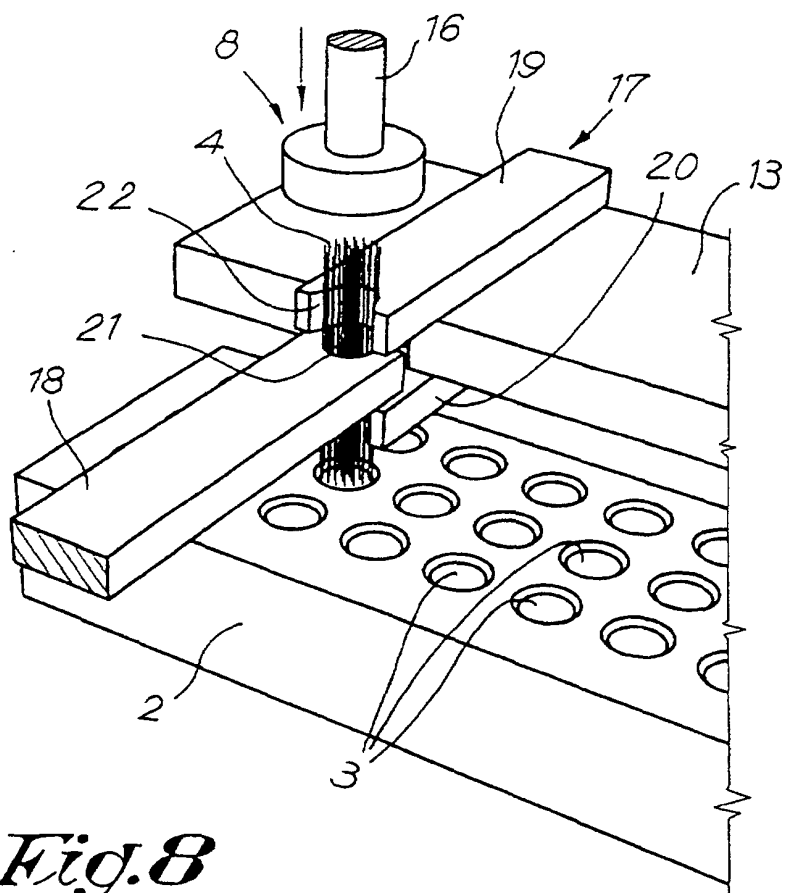


Fig.8



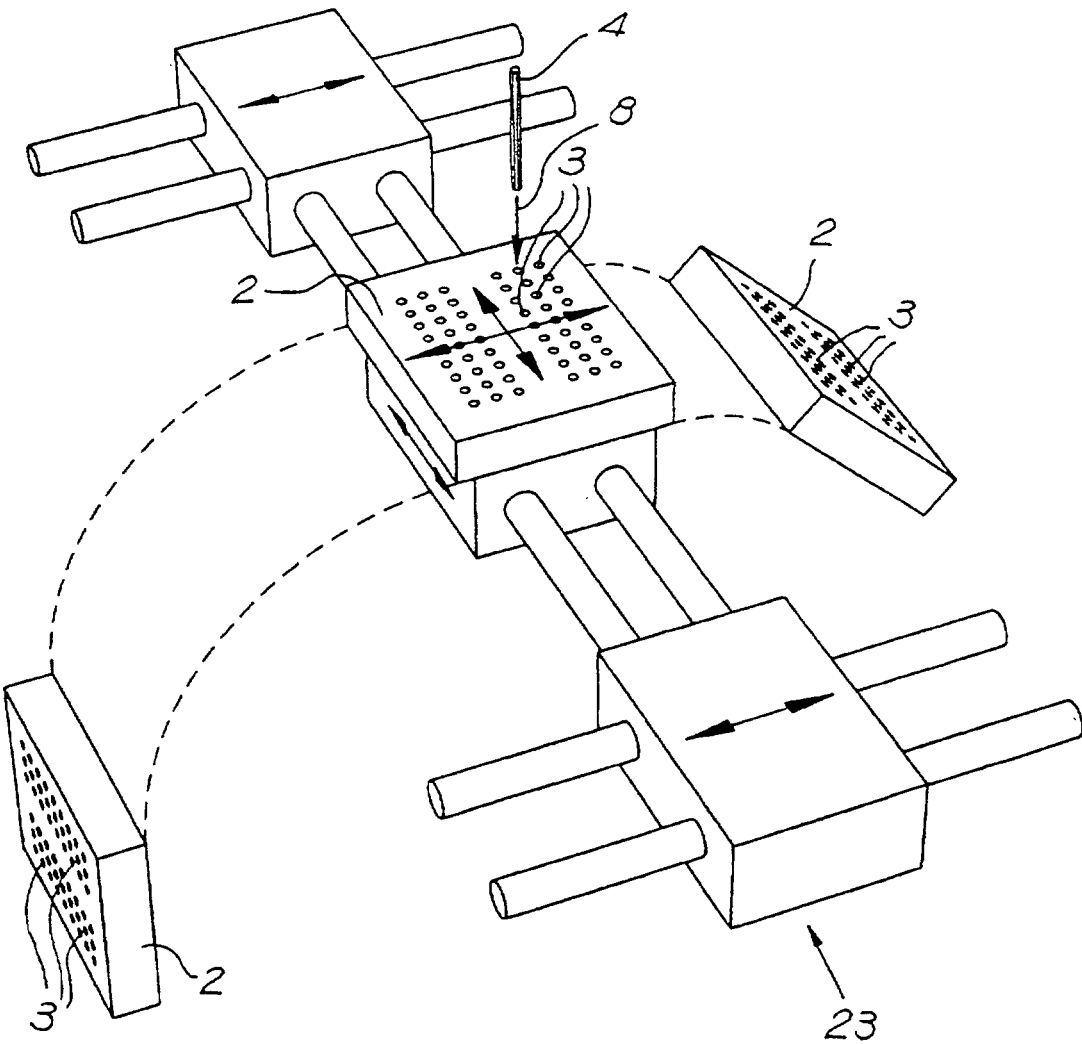


Fig.9

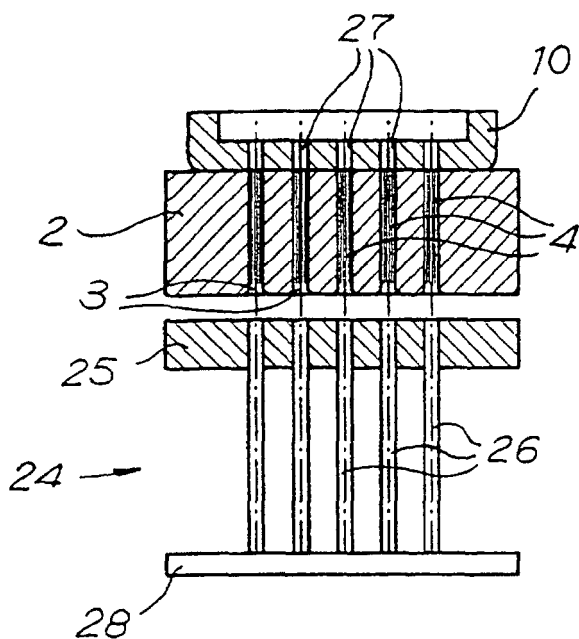


Fig. 10

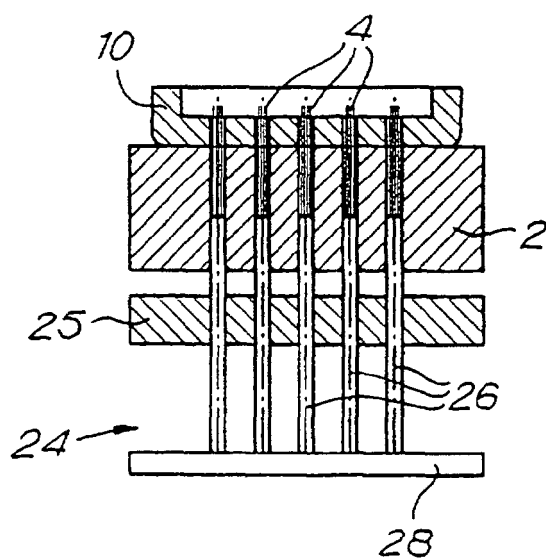


Fig. 11

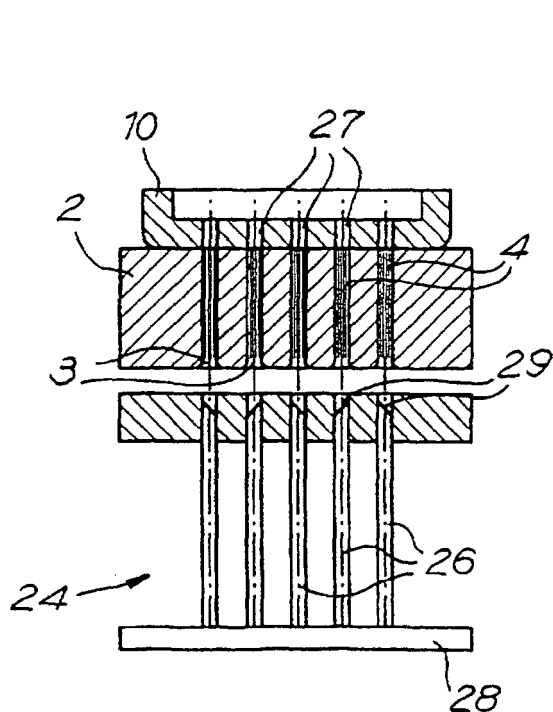


Fig. 12

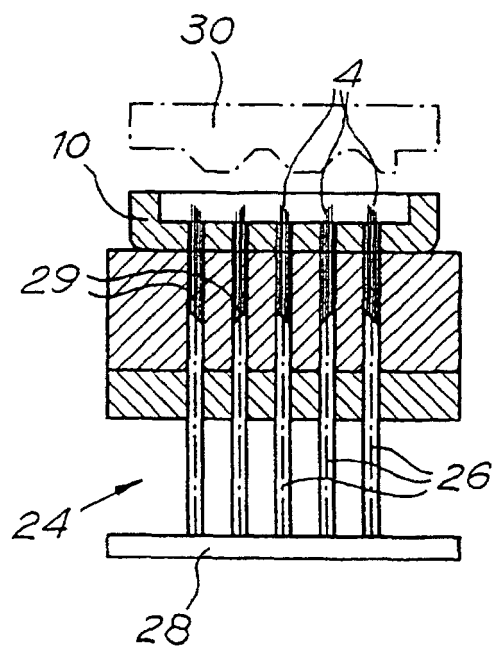


Fig. 13

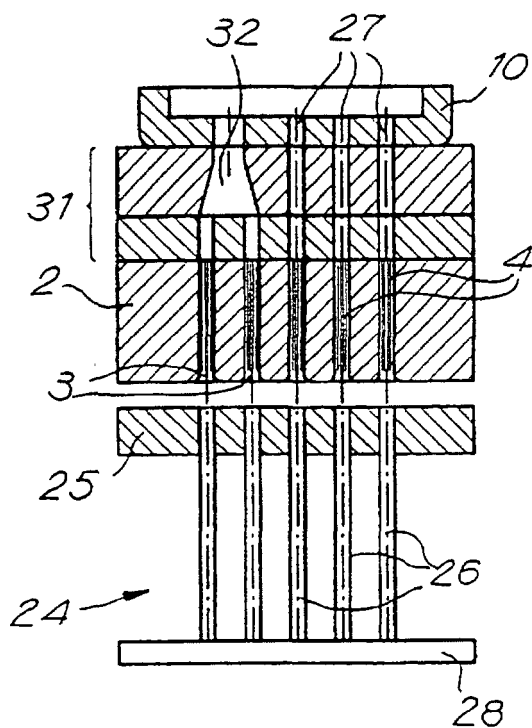


Fig. 14

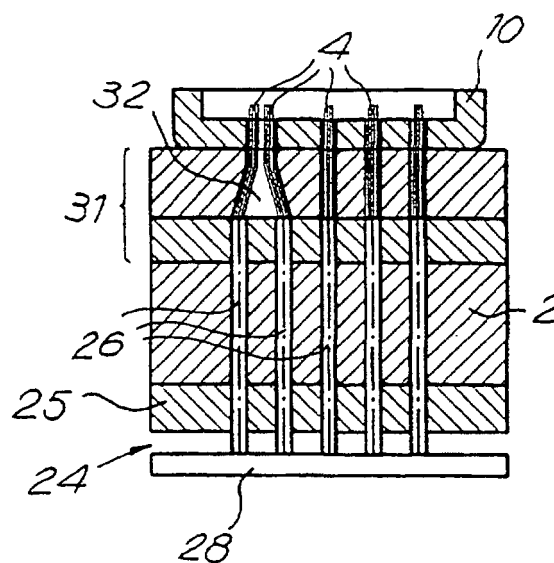


Fig. 15

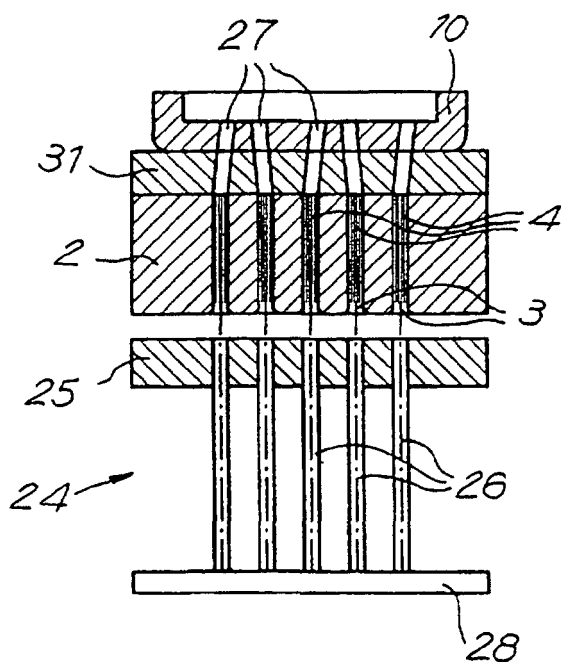


Fig. 16

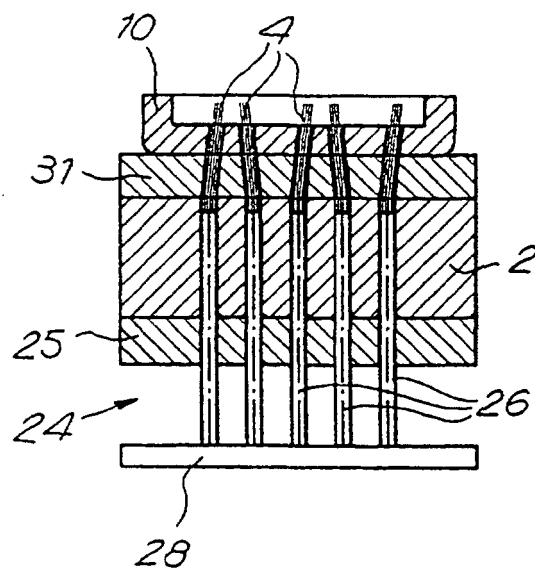


Fig. 17

Fig. 18

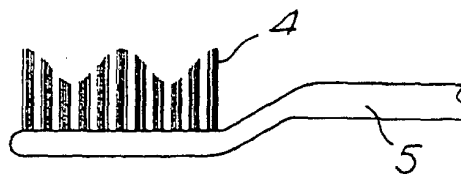


Fig. 19

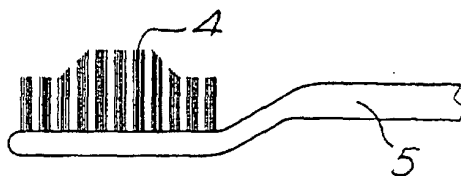


Fig. 20

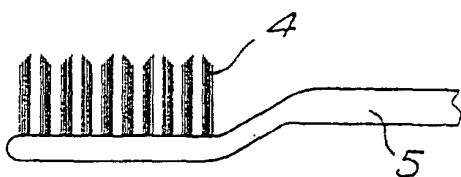


Fig. 21

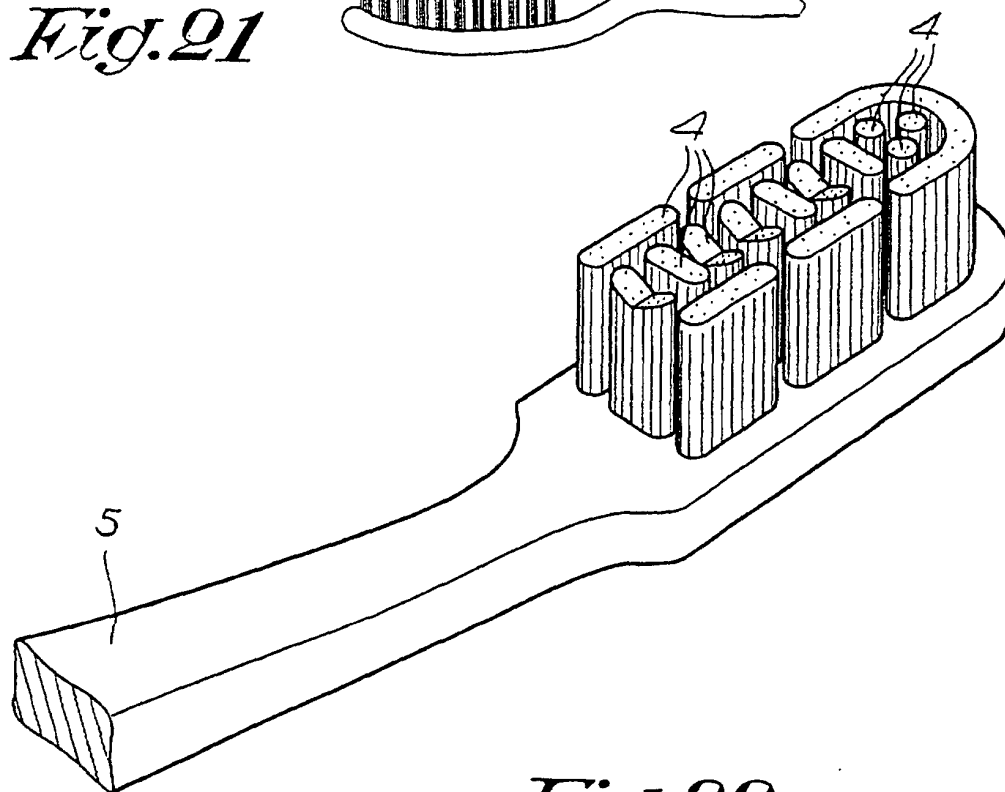
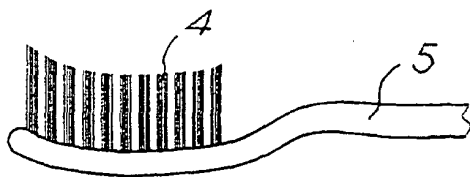


Fig. 22

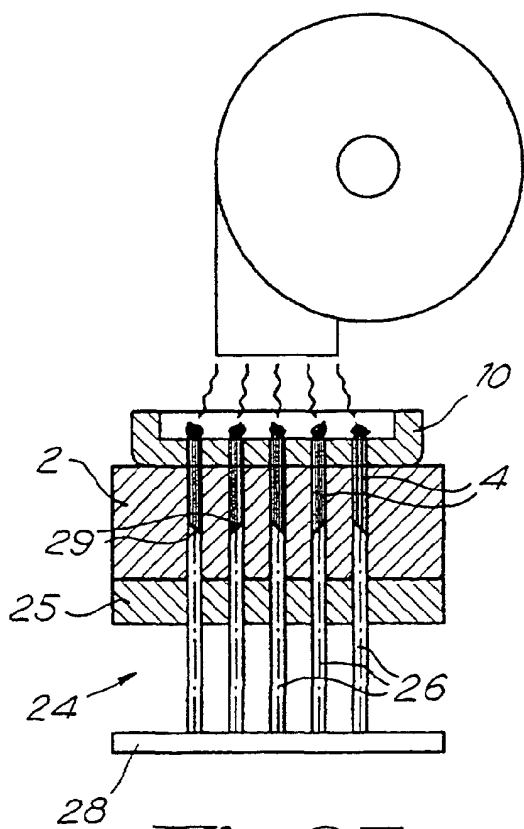


Fig. 23

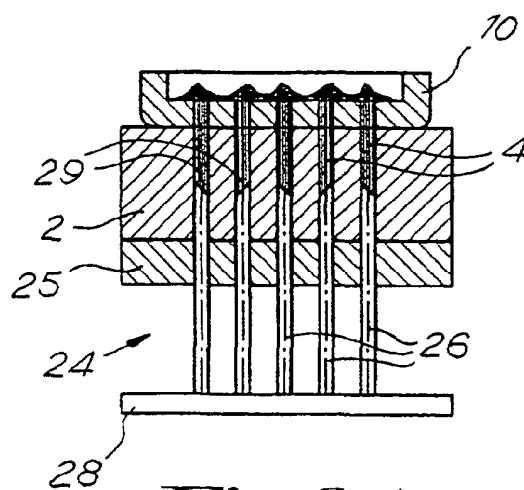


Fig. 24

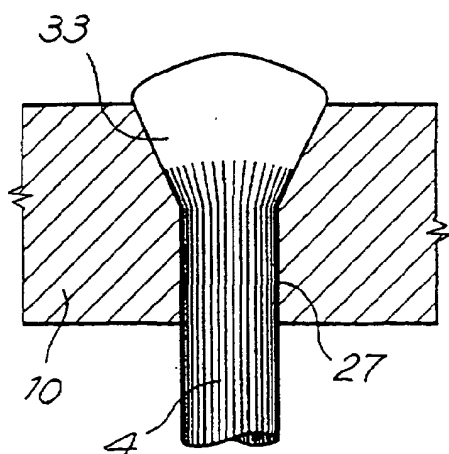


Fig. 25

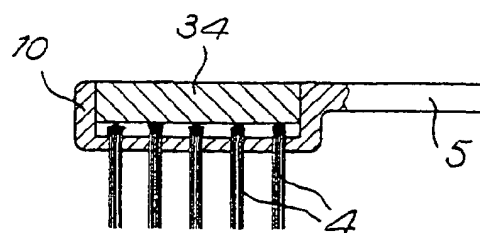


Fig. 26

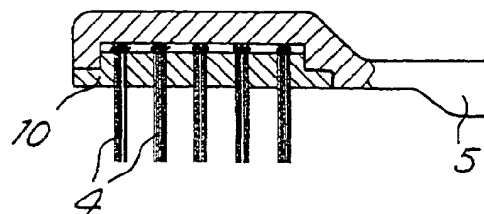


Fig. 27

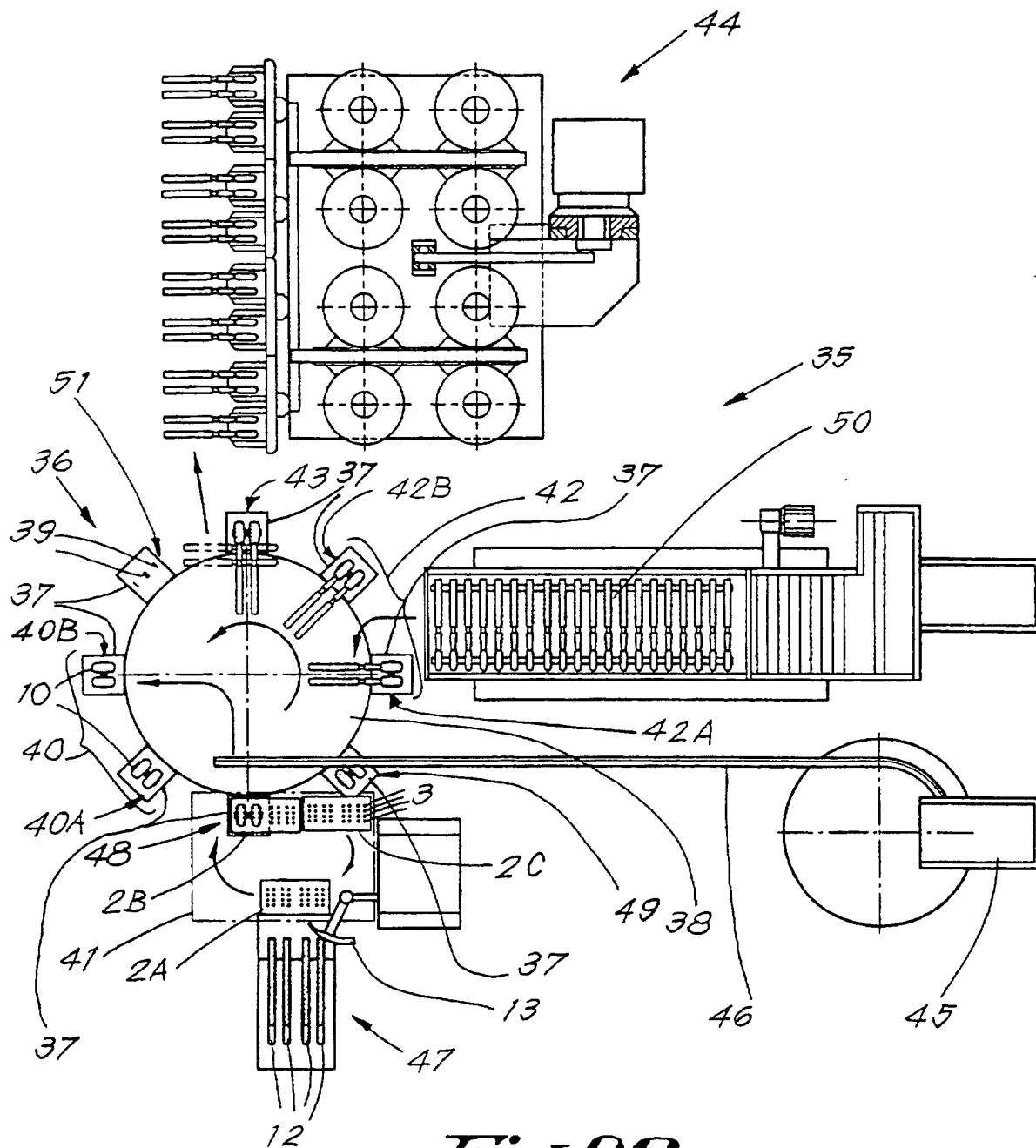


Fig.28

REFERENCES CITED IN THE DESCRIPTION

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