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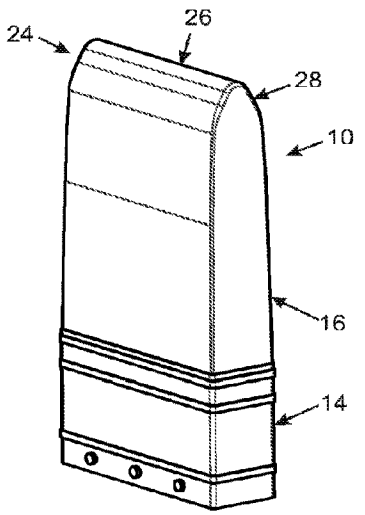


Fig. 2

(57) **Abrégé/Abstract:**
A paint brush comprising: a handle; a ferrule secured to the handle; and a brush head comprising a plurality of synthetic bristle filaments extending in a longitudinal direction from the ferrule. The brush head has a width dimension and a thickness dimension in a plane perpendicular to the longitudinal direction, with the width dimension being greater than the thickness dimension. Each filament has a fixed end secured at the ferrule and an opposite free end longitudinally distant from the ferrule. The free ends of at least a portion of the filaments collectively define a substantially chisel-shaped tip profile in a plane perpendicular to the width dimension such that an apex of the chisel-shaped tip extends across the width of the brush head. Every filament in the brush head is tapered over at least 60% the filament length.

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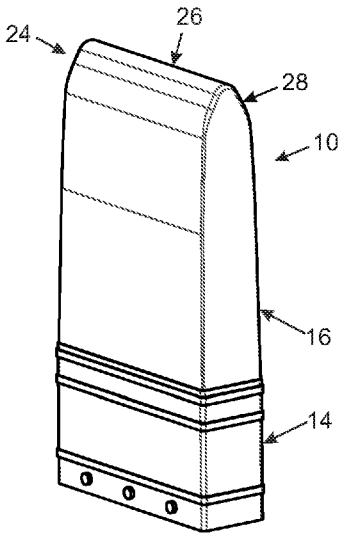


Fig. 2

(57) Abstract: A paint brush comprising: a handle; a ferrule secured to the handle; and a brush head comprising a plurality of synthetic bristle filaments extending in a longitudinal direction from the ferrule. The brush head has a width dimension and a thickness dimension in a plane perpendicular to the longitudinal direction, with the width dimension being greater than the thickness dimension. Each filament has a fixed end secured at the ferrule and an opposite free end longitudinally distant from the ferrule. The free ends of at least a portion of the filaments collectively define a substantially chisel-shaped tip profile in a plane perpendicular to the width dimension such that an apex of the chisel-shaped tip extends across the width of the brush head. Every filament in the brush head is tapered over at least 60% the filament length.

WO 2022/226586 A1

# PAINT BRUSH

## FIELD OF THE INVENTION

[0001] The present invention relates generally to paint brushes, and in particular to paint brushes of the type used for architectural painting and decorating.

## BACKGROUND TO THE INVENTION

[0002] Most conventional paint brushes are made of bristles, with a plurality of bristles forming a brush head. The brush head is generally connected to a handle by means of a metal ferrule together with one or more plugs and an epoxy adhesive to hold the individual bristles within the ferrule. While bristles may be made of natural fibres (e.g. animal hair) or synthetic filaments, most modern paint brushes use synthetic filaments. These can be produced from a wide variety of thermoplastic polymers, in a wide variety of configurations including solid and hollow, and in a wide variety of cross sections, including circular, oval, triangular, cruciform, and other shapes.

[0003] The brush head is able to hold paint therein by adhesion of paint to the bristles as well as by capillary forces. When painting, the brush head is pressed by a user against a surface to be painted, thereby bending the bristles such that the paint held between the bristles is forced to flow out of the brush head and spread along the surface to be painted.

[0004] There has been much work done in recent years to improve the performance of synthetic paint brushes, with regard to paint pickup and paint release, and much of this work has been focused on blends of different polymers, different configurations, and different cross sections of the synthetic filaments.

Nevertheless, further improvements are desired to achieve a higher quality finish using synthetic paint brushes.

[0005] Any discussion of documents, devices, acts or knowledge in this specification is included to explain the context of the invention. It should not be taken as an admission that any of the material formed part of the prior art base or the common general knowledge in the relevant art on or before the priority date of the claims herein.

## SUMMARY OF THE INVENTION

[0006] An object of the present invention is to improve upon prior art paint brushes having synthetic filaments, for example in relation to the quality of finish produced and/or coverage performance.

[0007] Accordingly, one aspect of the present invention provides a paint brush comprising: a handle; a ferrule secured to the handle; and a brush head comprising a plurality of synthetic bristle filaments extending in a longitudinal direction from the ferrule. The brush head has a width dimension and a thickness dimension in a plane perpendicular to the longitudinal direction, with the width dimension being greater than the thickness dimension. Each filament has a fixed end secured at the ferrule and an opposite free end longitudinally distant from the ferrule. The free ends of at least a portion of the filaments collectively define a substantially chisel-shaped tip profile in a plane perpendicular to the width dimension such that an apex of the chisel-shaped tip extends across the width of the brush head.

[0008] With this arrangement the chisel-shaped tip profile spans the thickness of the brush head and extends across its width. In preferred embodiments the apex of the chisel-shaped tip extends along substantially the whole width of the

brush head. The chisel tip is ideal for the sharp & accurate painting work a brush has to do for architectural type painting, cutting in around where different edges meet or intersect. It is also beneficial when the brush needs to be “poked” into deeper spaces, crevices, or cracks where paint needs to be applied in these areas. A softer or much more plush brush, does not have the ability to poke into these spaces as the filaments simply flex out of the way due to no structure vs the firmed chisel shape brush that can be manoeuvred into these areas, without the risk of deforming & damaging the filament.

[0009] The chisel tip of the brush also has less filament at the tip, allowing a lesser amount of filament to be involved at the final stage where the paint separates from the brush. This is the case in both painting orientations of broad stroke (width) & cutting in (thin side) painting actions. It provides more precision and control of the brush. The chisel shape is also more likely to have the tip in contact with the surface. If the tip is not in contact with the surface, the brush then relies on other areas further along the length of the filaments to release the paint, which is not ideal. Prior art brushes with more filament at the tip, with filaments that are closer to the same length, still work and provide a good surface finish. However, even though they often include a crowned/curved tip profile , the brush can still be difficult to manage with this bulkier payload of paint or to manipulate the brush into the ideal orientation for detailed sharp edge painting work.

[0010] In one embodiment, the brush head may be rectangular in cross section, in the plane perpendicular to the longitudinal direction, with a major dimension of the rectangle defining the width of the paint brush and a minor dimension defining its thickness. Such brushes may be produced in a variety of shapes and sizes, with typical widths of brushes intended for general use being in the range of 25mm to 75mm and typical thicknesses in the range of 10 to 20mm, although larger or smaller brushes are possible. In other embodiments the brush

head may be oval in cross section, such as in a conventional “oval cutter” used for cutting in around edges of a painted surface, or any other desired shape.

[0011] In some embodiments, the lengths of the longest filaments along the apex of the chisel-shaped tip (measured from the ferrule to the tip of each filament) across the width of the brush head may be substantially the same, such that the brush head forms a generally rectangular shape. In other embodiments the lengths of the bristles along the apex of the chisel-shaped tip may vary such that the longitudinal end of the brush head is angled or slanted, thereby creating an “angled sash cutter” or “angled oval cutter, or it may be rounded to form an arc, when viewed from the flat front face of the brush.

[0012] In preferred embodiments, each filament has a round cross-section, although other options include cruciform, square, rectangle, triangle, elliptical. In preferred embodiments, all of the filaments are solid, but in other embodiments all or some of the filaments may be hollow so as to form thin tubes.

[0013] In preferred embodiments, the chisel-shaped tip is a symmetrical, V-shape tip with a rounded apex. This shape puts the apex of an inverted “V” as a midpoint through the thickness of the brush head, thereby making the brush equally usable in either direction for improved functionality. However, in other embodiments it is possible that the apex may be offset to the front or back such that the chisel shape is asymmetrical rather than symmetrical.

[0014] Advantageously, the sides of the V-shaped tip form an internal angle of less than 90 degrees, and preferably less than 75 degrees. The inventors have found an internal angle of the V-shaped of about 60 degrees to be particularly advantageous. Any angle less than this offers less structure and body/substance to the brush head and it becomes too thin for this style of painting work. Paint brushes wear out over time and when the brush starts off thinner the longevity is decreased, so this needs to be balanced to provide an adequately durable brush

that can handle all of the surfaces it is used to paint on. Any angle greater than 75 degrees takes the brush tip shape closer to more conventional style brushware.

[0015] Another aspect of the invention provides a paint brush comprising: a handle; a ferrule secured to the handle; and a brush head comprising a plurality of synthetic bristle filaments extending in a longitudinal direction from the ferrule. Each filament has a fixed end secured at the ferrule and an opposite free end longitudinally distant from the ferrule, and every filament in the brush head is tapered from its fixed end to its free end, with the taper of each filament extending over at least 60% of the length of the filament. Preferably each filament is tapered over at least 75% of the length of the filament.

[0016] The inventors have found that tapering all the filaments within the brush head is advantageous in providing a desired level of overall stiffness to the brush head while providing soft filament ends to produce a fine and uniform paint finish.

[0017] In some embodiments, each filament is tapered along its entire length. Preferably, each filament is substantially linearly tapered along substantially its entire length.

[0018] Particularly preferred embodiments of the invention combine the above-described chisel-shaped tip profile and tapered filaments. This combination has been found to be advantageous in improving paint flow. Some key benefits of the combination include:

1. Consistent paint release: The inventors have found the filament releases paint consistently. The brush performance reaches an optimum level quickly from its unused stage and, once performing, continues to deliver the same high quality results.
2. Gradual paint release: The inventors have found the filaments release

paint gradually, rather than suddenly. Unloading paint evenly during the painting stroke rather than dumping paint when the brush is applied to the surface.

3. Longer painting distance: Due to the above qualities, the inventors have found the distance covered by the paint application is longer than what is provided by a conventional paint brushes.

In some embodiments, the thickness of each filament at its fixed end is substantially the same as the thickness of all other filaments. Where the filaments have a round cross-section, the thickness is defined by the diameter of the filament, measured at a particular point along its length. However, where the cross-section of the filament is cross-shaped, rectangular, oval, or some other shape, then the "thickness" may be considered to be defined by the maximum dimension of the filament at that point along its length. The thickness of each filament at its fixed end (namely the diameter for a round solid filament) may be in the range of 0.15 to 0.30, preferably in the range of 0.18 to 0.25, and more preferably about 0.23 mm.

[0019] In the case of round cross-section filaments, the inventors have found that a diameter greater than would be used for conventional paint brushes is advantageous because this gives slightly greater stiffness to the overall feel of the paint brush, and hence greater control and precision.

[0020] In some embodiments, the thickness of each filament at its free end is in the range of 0.01 to 0.1, and preferably about 0.05 mm. However, given the nature of the preferred chemical process used to create the taper, the thickness of the filaments at their free ends could all be slightly different.

[0021] Each of the filaments may be made of a synthetic polymer such as PET, PBT or Nylon®. In some embodiments the same polymer is used for all filaments whereas in other embodiments more than one type of polymer may be used. A blend of polymers may be used according to the application and

intended use of each paint brush. For example, the inventors have found that more PBT than PET may be preferable in a PBT/PET blend for certain applications.

[0022] In some embodiments, the filaments within the brush head vary in length and at least a portion of the filaments may have free ends which stop short of the chisel-shaped tip profile. Preferably, filaments of varying length are distributed throughout the width and thickness of the brush head. In some embodiments a length of the shortest filaments is 30% to 60% of a length of the longest filaments, each measured from the ferrule to the filament tips, and preferably about 40%.

[0023] For a paint brush intended for general use, the length of the longest filaments may be about 80 to 90 mm and the length of the shortest filaments may be about 30 to 40 mm, each being measured from the ferrule to the filament tips. Thus, the shortest filaments may be less than half of the length of the longest filaments. A variety of lengths between these limits may be provided within the brush head, and the blend of filament lengths may be chosen to further “fine tune” the properties of the brush, such as its overall stiffness, tip stiffness/flexibility, overall size and weight, and hence its paint pickup and paint release characteristics.

[0024] In a preferred embodiment, the length of the filaments within the brush head have infinitely varying lengths. As a rough guide, the filaments could be grouped into three different length groups. A “long filament group” may make up about 70% of all filaments. A “medium filament group” may be about 10mm shorter than the long filament group, with a total portion of about 15%. A “short filament group” may be about 7mm shorter than the medium filament group, and also make up about 15%. It should be understood however that each filament length “group” is not separate and distinct from each other group but is part of a continuum of lengths. Thus, the transition from one length group to another is

more gradual. This is in contrast to prior art brushes which have filaments more even in length. In a preferred embodiment of the invention, filaments of the various length groups are evenly distributed within the brush head.

[0025] Accordingly, a paint brush made in accordance with preferred embodiments of the invention may combine numerous factors such as the overall chisel shape of the brush tip, the “sharpness” of the chisel shape, individual filament shape, length and blend, degree of tapering of the filaments, different polymer selection, and filament volume. These factors can all be varied to fine tune the characteristics of a particular paint brush for a specific purpose, such as for painting flat surfaces including walls and doors or for painting along edges and around obstacles such as architraves, skirting boards, electrical fittings and the like. The improved performance of paint brushes made in accordance with the most preferred embodiments of the invention arise from combinations of the various factors, including greater filament stiffness at the base, extra-long tapering at the filament tips, chisel shape of the brush tip profile, slightly more filaments, blend of various lengths, etc.

[0026] Compared to prior art paint brushes, brushes made in accordance with preferred embodiments of the present invention have quite a different brush tip profile, being a chisel-shape or rounded V-shape when compared to the flatter curved profile of conventional brushes. The V-shape is determined by the blend of filaments of different lengths. Brushes made according to embodiments of the invention may have a slightly “messier” look to the tip compared to regular brushes, which may look somewhat “neater”. This is because of the variation in filament lengths in brushes made according to embodiments of the invention. In contrast, conventional brushes have filament lengths which are closer to each other and thus look more uniform at the brush tip. All of these differences contribute to a more gradual release of paint from the brush, which improves painting performance and enhances the final finish of the painted surface with virtually no brush marks.

[0027] A further aspect of the invention provides a method of making a paint brush comprising the steps of: providing a plurality of bristle filaments; forming the filaments into a brush head; placing the brush head into a ferrule; and shaping an end of the brush head such that free ends of at least a portion of the filaments collectively define a substantially chisel-shaped tip profile in a plane perpendicular to a width dimension of the brush head, with an apex of the chisel-shaped tip extending across the width of the brush head.

[0028] The chisel-shaped tip of the brush head may be formed using a mould or mandrel having the desired chisel-shaped profile. In preferred embodiments the mould/mandrel is an inverted V-shape having a desired internal angle within the "V" shape, such as 60° for the described embodiment. Once the filaments have been cut to length and tapered, a bundle of filaments of different lengths are gathered together and blended so as to distribute the various length filaments throughout the brush head. The blending process may be performed by hand so as to achieve a desired distribution of filament lengths within the bundle. The bundle of filaments is then inserted into the ferrule and formed over a V-shaped mandrel/mould to form the free ends of the filaments in a corresponding V-shaped tip profile. The fixed ends of the filaments may then be fixed into the ferrule with plugs and an epoxy adhesive.

[0029] In the claims which follow and in the description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

[0030] In this description of the invention, all orientational terms, such as vertical, horizontal, upper, lower, left, right, longitudinal, lateral, length and width,

are used in relation to the drawings and should not be interpreted as limiting on the invention.

[0031] Preferred embodiments of the invention will now be described with reference to the accompanying drawings. These embodiments are presented for the purposes of illustration only and the invention is not to be limited by this illustration.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0032] Figure 1 shows a front view of a paint brush in accordance with an example embodiment of the invention

[0033] Figures 2 and 3 show perspective and side views of the brush head and ferrule of the paint brush shown in Figure 1.

[0034] Figure 4 is a side cross-sectional view of the paint brush shown in Figures 1 to 3 and highlighting certain parameters of the overall profile and tip shape.

[0035] Figure 5 shows a side view of a tip portion of the paint brush depicted in Figures 1 to 3 (left-hand side) alongside a tip portion of a conventional paint brush (right-hand side).

[0036] Figure 6 shows a partial cutaway perspective view of the brush head and ferrule portions of the paint brush depicted in Figures 1 to 3.

[0037] Figure 7 shows a side view of a single filament of the paint brush shown in Figures 1 to 3.

[0038] Figures 8A to 8C show perspective, front and side views of another paint brush in accordance with an alternative embodiment of the invention.

[0039] Figures 9A to 9C show perspective, front and side views of another paint brush in accordance with a further alternative embodiment of the invention.

[0040] Figures 10A to 10C show perspective, front and side views of another paint brush in accordance with a further alternative embodiment of the invention.

[0041] Figures 11 and 12 show performance test results for the paint brush shown in Figures 1 to 3 compared to a typical prior art paint brush, the tests being carried out using the same painting program/actions of a robotic painting system.

## DESCRIPTION OF PREFERRED EMBODIMENTS

[0042] Referring firstly to Figure 1 of the drawings, there is shown a front view of a paint brush 10 in accordance with an example embodiment of the invention. This paint brush 10 comprises a handle 12, a ferrule 14 secured to the handle 12, and a brush head 16 comprising a plurality of synthetic bristle filaments 18 (best seen in Figure 6) extending in a longitudinal direction (vertically in Figure 1) from the ferrule 14.

[0043] It will be appreciated by persons skilled in the art that the drawings show a somewhat idealised shape of the brush head 16, given the dynamic and somewhat undefined nature of thousands of individual flexible bristle filaments 18. However, in general, the drawings show the overall shape of a dry unused paint

brush. This shape would of course change somewhat when the brush is wet with paint.

[0044] Figure 2 shows a perspective view and Figure 3 shows a side view of brush head 16 and ferrule 14 of the paint brush 10, although in these figures the brush is up the other way with the brush head 16 held upwardly from the ferrule 14.

[0045] The brush head 16 and ferrule 14 have a generally rectangular cross-sectional profile, in a plane perpendicular to the longitudinal direction, with a width W greater than a thickness T. Other cross-sectional profiles are possible and, in general, the width W extending across the front face of the brush 10 as shown in Figure 1 is greater than the thickness T extending from front to back as shown in the side view of Figure 3.

[0046] Each filament 18 of the brush head 16 has a fixed end 20 secured at the ferrule 14, thus forming a base of the filament 18, and an opposite free end 22 longitudinal distant from the ferrule 14. In one method of construction, each filament 18 may be held within the ferrule 14 using one or more blocks or wedges (not shown) and an epoxy adhesive, in a conventional manner.

[0047] The free ends 22 of at least a portion of the filaments 18, and more specifically the longest filaments within the brush head 16, collectively define a substantially V-shaped chisel tip 24 of the brush head. As can be best seen in Figures 3 and 4, this V-shape lies in a plane perpendicular to the width W of the brush head, across its thickness direction T, to form a rounded apex 26 at a midpoint of the brush head 16. The chisel is thus symmetrical in this instance. It should be appreciated however that the “V” may be made asymmetrical such that the apex is positioned towards one face or the other of the brush head. As can be seen in Figure 2, the apex 26 extends across the full width W of the brush head, in this example.

[0048] Referring now to Figure 4, there is shown a side cross-sectional view of the brush head 16 and ferrule 14 of the brush 10 shown in Figures 1-3. The brush head 16 comprises a plurality of synthetic bristle filaments with a fixed end secured to the ferrule 14. Each filament extends upwardly from the ferrule 14 and the longest of the filaments collectively define an inverted "V" shaped tip profile 24, in a vertical plane extending across the thickness dimension T. The V-shaped tip 24 has a rounded apex 26 and somewhat "flat" side faces 28 extending from the rounded apex 26 to the front and rear faces of the brush head 16.

[0049] While the apex 26 is shown with a somewhat rounded contour, given the dynamic nature of all the movable individual bristle filaments, the primary "V" shape of the chisel tip 24 is illustrated by the overlaid inverted "V" 27 having an internal angle Θ which, in this preferred embodiment, is about 60°. It will be appreciated however that a sharper or flatter "V" shape could instead be employed, according to the particular requirements of a specific brush. This is one of the many factors which can be used to fine tune the characteristics of the brush.

[0050] For comparison purposes, Figure 5 shows a side view of the tip portion of two paint brushes, with the brush 10 on the left hand side being made in accordance with an example embodiment of the present invention and the brush 50 on the right hand side being a conventional paint brush. As can be seen in this side view of the two brushes, the brush 10 has a V-shaped chisel tip 24 with an apex 26, in contrast to the brush 50 having a rounded end surface 52.

[0051] Referring now to Figure 6, there is shown a partial cross section of the brush 10 of Figures 1-3 with a portion of its filaments 18 being cut away so that a central cross-section across the thickness of the brush head 16 can be seen. It is to be noted that the filaments 18 within the brush head 16 vary in length and a portion of the filaments have free ends which stop short of the V-shaped chisel

tip. For example, the filaments labelled 19 stop significantly short of the tip, even though many of them are located within a central region of the brush head 16. In the preferred embodiment, filaments of various lengths are distributed throughout the width and thickness of the brush head 16.

[0052] Referring now to Figure 7, there is shown a side view of a single filament 118 having a first end 120, which in the finished paint brush is fixed to the ferrule, and a second end 122, which in the finished paint brush is free and thus forms a tip of the filament 118. As can be seen, the filament 118 has a length L and is tapered, with its first end 120 being thickest and its second end 122 being thinnest. Accordingly, if the cross-section of the filament 118 is round, the filament forms a very long and fine cone shape. In some embodiments, the filament 118 is tapered in a linear manner along its entire length L, however achieving this is a challenge given the very small dimensions of the filaments involved, and slight variations inevitably occur in the tapering process.

[0053] The inventors have found that tapering of the filaments is best performed chemically. In this regard, each filament, after being extruded and cut to length, is immersed in a strong alkali solution for a period of time, such that the alkali solution “eats away” part of the polymer leaving it with one end tapered. Greater tapering is achieved by greater length of the filament being immersed in the solution and for a longer period. Achieving a desired or uniform taper thus requires careful positioning and monitoring of the length of the filament immersed in the solution and the period of immersion.

[0054] The inventors have found that with tapered filaments it is possible to provide an optimum combination of stiffness at the base of the filaments (near the ferrule) and softness at the tips. The greater stiffness at the base provides greater control of the brush head while the softer tips in contact with the surface give an improved surface coverage and smoother finish with minimal brush strokes visible in the surface once the paint is dry. The amount of taper employed

for each bristle can be selected, and effectively "tailored" for a particular type of brush, including type of paint/coating or intended use. Combinations of filaments having greater and lesser tapered filaments can be created for specific purposes.

[0055] In preferred embodiments of the paint brush, every filament within the brush head is tapered. However, all filaments need not all be tapered to the same degree or with the same profile. It is considered that a person skilled in the art would readily be able to conduct the necessary experiments, without undue burden, to optimise the degree and length of taper desired for any specific purpose.

[0056] Compared to conventional paint brushes, the inventors have found that it may be advantageous for the thickness of each filament at its fixed end (i.e. where it meets the ferrule) to be slightly greater than the thickness of conventional synthetic filaments used in the manufacture of prior art paint brushes. For example, in the preferred embodiment, the thickness of each filament at its fixed end is at least around 0.20 mm and preferably around 0.23 mm. In contrast, filaments used in prior art paint brushes are typically less than 0.20 mm.

[0057] The inventors have found that increased thickness, and hence stiffness, of the filaments towards the ferrule gives more structure to the brush head and a stiffer overall feel to the brush. In turn, this gives better control of the filaments' free ends, enabling greater precision when cutting in around edges. At the same time, the fine and soft tips of the filaments enable a painter to more easily apply very light pressure when "laying off" the wet paint on the surface, thereby delivering a smoother and more even finish with virtually no brush marks. The V-shaped tip profile of the brush head further enhances this effect by reducing the number of filament tips which make final contact with the paint surface.

[0058] Turning now to Figures 8A to 8C, there is shown an “oval cutter” paint brush 60 made in accordance with an alternative embodiment of the invention. In the oval cutter 60, the brush head 62 has an ovular cross-sectional profile (in a horizontal plane in the drawings) but is otherwise similar to the brush 10 show in Figures 1-3. Again, the brush 60 has a V-shaped chisel tip 64 having an apex 66 extending across the full width of the brush head 62. However, the oval cross section of the brush head 62 causes the flat “sides” 68 of the V-shaped chisel tip 64 to become crescent shaped as the surfaces divert away when viewed from the front (see Figure 8B).

[0059] Figures 9A to 9C show an “angled oval cutter” paint brush 70 made in accordance with another alternative embodiment of the invention. The angled oval cutter 70 is similar to the oval cutter 60 shown in Figures 8A to 8C except that the tip is angled, or sloped, across the width of the brush, as best seen in the front view of Figure 9B. Again, the brush 70 has a V-shaped chisel tip 74 having an apex 76 extending across the full width of the brush head 72. The oval cross section of the brush head 72 again causes the flat “sides” 78 of the V-shaped chisel tip 74 to become crescent shaped, although slightly lopsided in this instance, when viewed from the front (see Figure 9B).

[0060] Figures 10A to 10C show an “angled sash” paint brush 80 made in accordance with yet another alternative embodiment of the invention. The angled sash 80 has a substantially rectangular cross-sectional profile (in a horizontal plane in the drawings) but with rounded ends 81. This brush is similar to the brush 10 shown in Figures 1-3 except that it has a V-shaped chisel tip 84 angled across the width of the brush head 82, as best seen in the front view of Figure 10B. In this regard, the angled sash 80 is similar to the angled oval cutter 70 shown in Figures 9A to 9C but the flat “sides” 88 of the V-shaped chisel tip 84 form a somewhat trapezoidal shape rather than a crescent shape. Again, the V-shaped chisel tip 84 has an apex 86 extending across the full width of the brush head 82.

Performance Testing

[0061] The inventors have conducted various tests on a sample paint brush manufactured in accordance with a preferred embodiment of the present invention and compared its performance to more conventional paint brushes. More specifically, the sample brush was tested for its paint application performance using an automatic robot painting test system. This system ensures uniform and repeatable test conditions for each sample brush. A robot arm grasps each brush, loads it with paint and then applies the paint to a surface. The system captures before and after weight measurements and builds up a set of performance data of a predefined painting action. Each test takes place on a wall such that the painted surface is vertical in each test.

[0062] Figures 11 and 12 show photographs of two test samples of paint applied to white paper using 63 mm wide paint brushes. In each photograph, the left-hand set of paint stripes was produced by a conventional paint brush and the right-hand set of paint stripes was produced by a paint brush made in accordance with a preferred embodiment of the present invention.

[0063] Figure 11 shows the result of a single cycle (i.e. a single coat of paint) from the very first use of each paint brush and Figure 12 shows three cycles (i.e. three coats of paint) with each cycle overlaid and all other criteria being equal for comparison.

[0064] In each instance the robot arm grips the paint brush and, after loading with paint, applies four paint stripes to the paper, using an identical action in each instance, without reloading the brush with paint between stripes. As can be seen from the resulting paint pattern shown in the images, the brush commences at the upper left-hand corner, paints vertically downward to create a first stripe, then lifts and moves horizontally to the right, paints upwardly to create a second stripe, moves horizontally to the right and repeats the action to thereby produce four

stripes in total. The same painting sequence is then repeated for the other brush, using an identical painting motion.

[0065] The test results shown in Figure 12 result from the same sequence of motions as the test shown in Figure 11 but three coats of paint are overlaid. The two brushes tested are the same as the two brushes used in the test of Figure 11.

[0066] In each test sequence, the same paint is used (from the same paint pot) and hence the same viscosity. The test sequence is conducted on the same time/day and thus the temperature and humidity are the same. The robot follows a pre-programmed series of broad stroke motions to apply paint at the same speed, same angle and same pressure, from the beginning of the first paint stripe for the nominated distance. The paint stripe therefore shows:

- coverage qualities
- crispness of the painted edge
- rate at which the paint is released
- the level of finish relating to brush marks
- paint delivery distance
- brush performance per side.

[0067] The test criteria are summarised in Table 1 below.

**Table 1: Test Criteria**

| **Date** | **11-Mar-21** |
|---|---|
| Test number | ART01 |
| Test type | Robotic |
| Brush Width | 63 mm |
| Brush Thickness | 20 mm |
| Paint Type | Low Sheen |
| Paint Solvent | Water |
| Substrate - Material | Paper |
| Substrate - Surface Finish | High Gloss |

| | |
|---|---|
| Brush prep time | 10 min soak |
| Cycle Type | Painting |
| Cycles (coats) | 1 |
| Repeat Tests | 0 |
| Coverage area | Pre-set program |
| Test Temperature | 22° |
| Brush / Roller | BRUSH |
| Brush ID | Competitor vs HX3 |
| Brush Dip Depth | 35 mm |
| Soak Time | 30 sec |
| Drip Time | 5 sec |
| Application Location | 2 (vertical wall) |
| Application Width | 63 mm |
| Application Length | 750 mm |
| Application Speed | 100 mm/s |
| Application Pressure | 25 mm |
| Application Angle | 30° |
| Number of Strokes | 4 |

[0068] It can be seen in both the single cycle and three cycle test results that the paint brush of the present invention significantly outperformed the conventional paint brush.

[0069] Given the painting motion of the robot was identical in each test, the “coverage” performance of each brush can be measured by analysing the images to determine the proportion of the test area, within a digitised image of each sample, painted versus not painted (black versus white in the images shown in Figures 11 and 12). This analysis shows that the sample paint brush of the present invention achieved a coverage performance of between 75% and 77%. In contrast, most conventional mid-level paint brushes produced a coverage performance of only around 60% to 64%. Only the very best competing paint brushes have achieving up to about 69%. The sample paint brush of the present invention therefore outperformed the very best available prior art paint brush by

around 8%. As a reference, medium to low brushware tended to rate between 50%-60% coverage.

[0070] Paint brushes made in accordance with preferred embodiments of the invention have also been found to work surprisingly well when completely new and straight out of the packaging, and do not need much time to build up to an optimum painting level. In this regard, it can be seen in the test of Figure 12, involving three coats of paint, that the right-hand paint brush (being the preferred embodiment of the present invention) didn't really need the third coat applied; it looked much the same after the second coat had been applied. The third coat simply applied more paint which, in most instances, would be unnecessary. Accordingly, it can be concluded that the paint brush of the present invention spread the paint much more efficiently than the conventional brush.

CLAIMS:

1. A paint brush comprising:

a handle;

a ferrule secured to the handle; and

a brush head comprising a plurality of synthetic bristle filaments extending in a longitudinal direction from the ferrule,

the brush head having a width dimension and a thickness dimension in a plane perpendicular to the longitudinal direction, with the width dimension being greater than the thickness dimension, and

each filament having a fixed end secured at the ferrule and an opposite free end longitudinally distant from the ferrule,

wherein the free ends of at least a portion of the filaments collectively define a substantially chisel-shaped tip profile in a plane perpendicular to the width dimension such that an apex of the chisel-shaped tip extends across the width of the brush head.

2. The paint brush of claim 1 wherein the chisel-shaped tip is a symmetrical, rounded V-shaped tip with a rounded apex .

3. The paint brush of claim 2 wherein sides of the V-shaped tip form an internal angle of less than 90 degrees, preferably less than 75 degrees, and more preferably about 60 degrees.

4. The paint brush of any one of the preceding claims wherein every filament in the brush head is tapered from its fixed end to its free end, with the taper of each filament extending over at least 60% of its length.

5. The paint brush of claim 4 wherein each filament is tapered over at least 75% of its length, and preferably over its entire length.

6. The paint brush of claim 4 or claim 5 wherein each filament is substantially linearly tapered.

7. The paint brush of any one of claims 4 to 6 wherein the thickness of each filament at its fixed end is substantially the same as the thickness of all other filaments.

8. The paint brush of any one of claims 4 to 7 wherein the thickness of each filament at its fixed end is in the range of 0.15 to 0.30, preferably in the range of 0.18 to 0.25, and more preferably about 0.23 mm.

9. The paint brush of any one of claims 4 to 8 wherein the thickness of each filament at its free end is in the range of 0.01 to 0.1, and preferably about 0.05 mm.

10. The paint brush of any one of the preceding claims wherein the filaments within the brush head vary in length and at least a portion of the filaments have free ends which stop short of the chisel-shaped tip.

11. The paint brush of claim 10 wherein filaments of varying length are distributed throughout the width and thickness of the brush head.

12. The paint brush of claim 11 wherein a length of the shortest filaments is 30% to 60% of a length of the longest filaments, each measured from the ferrule to the filament tips, and preferably about 40%.

13. The paint brush of claim 12 wherein the length of the longest filaments is about 90mm and the length of the shortest filaments is about 30 to 40 mm, each measured from the ferrule to the filament tips.

14. A paint brush comprising:

a handle;

a ferrule secured to the handle; and

a brush head comprising a plurality of synthetic bristle filaments extending in a longitudinal direction from the ferrule,

the brush head having a width dimension and a thickness dimension in a plane perpendicular to the longitudinal direction, with the width dimension being greater than the thickness dimension, and

each filament having a fixed end secured at the ferrule and an opposite free end longitudinally distant from the ferrule,

wherein every filament in the brush head is tapered from its fixed end to its free end, with the taper of each filament extending over at least 60% of its length .

15. The paint brush of claim 14 wherein each filament is tapered over at least 75% of its length, and preferably over its entire length.

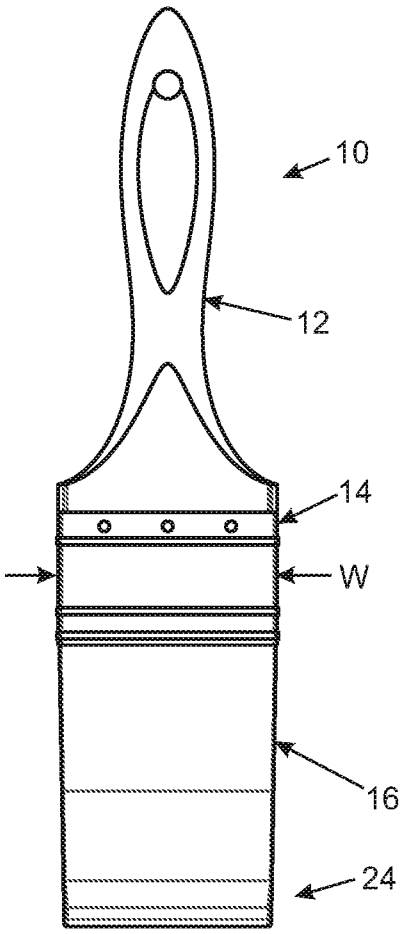


Fig. 1

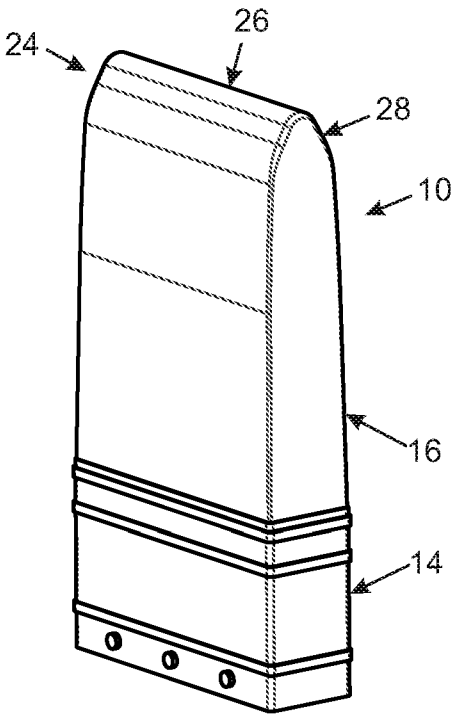


Fig. 2

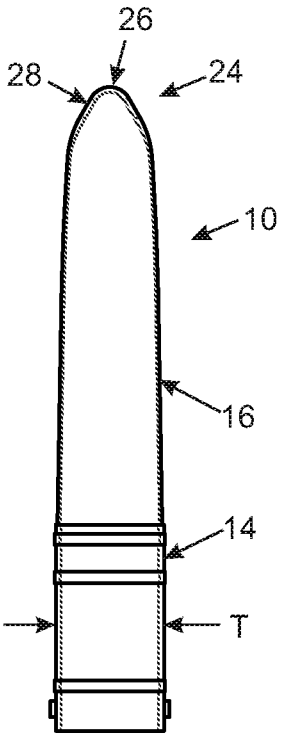


Fig. 3

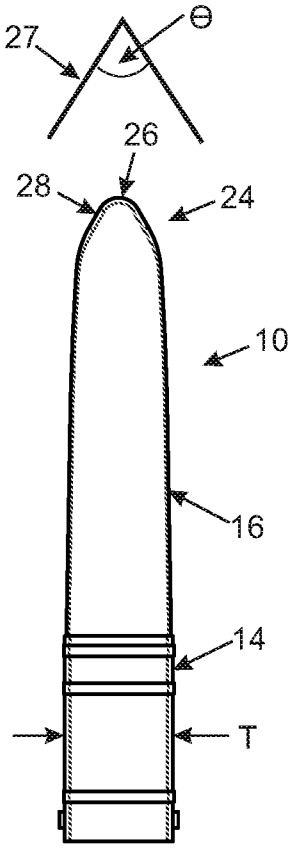


Fig. 4

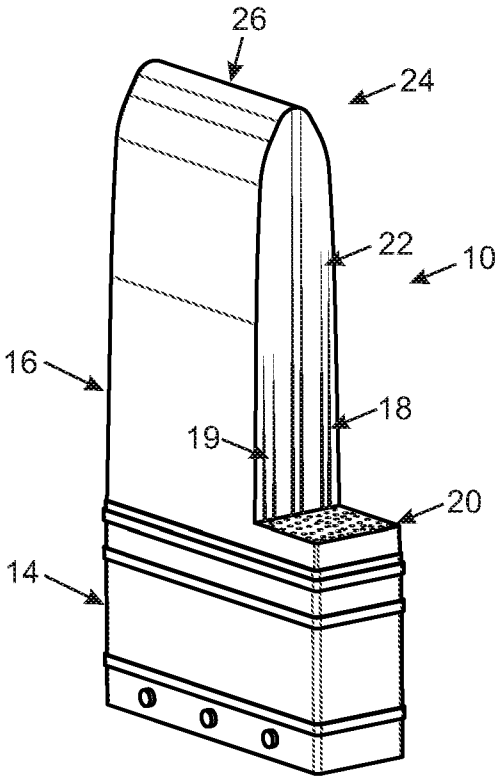


Fig. 6

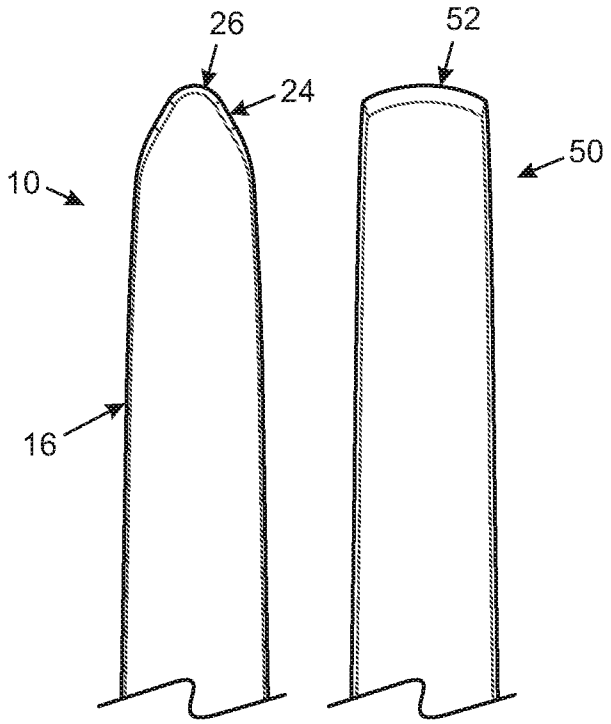


Fig. 5

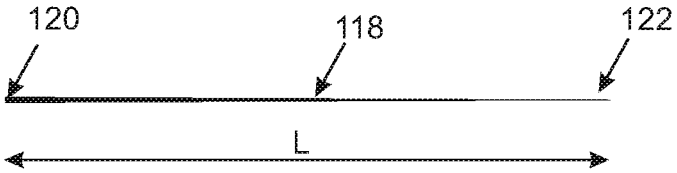


Fig. 7

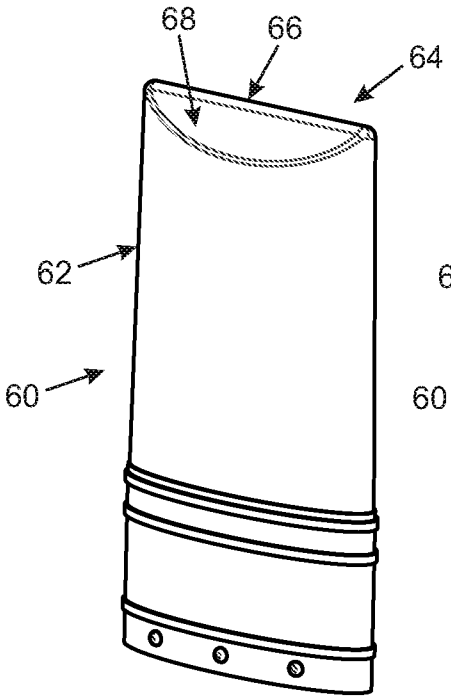


Fig. 8a

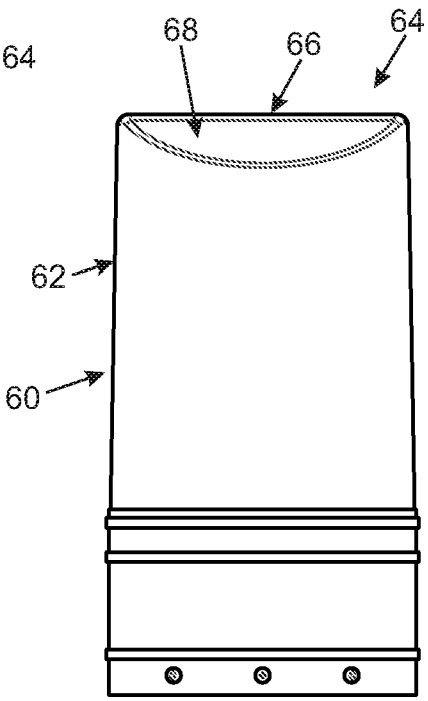


Fig. 8b

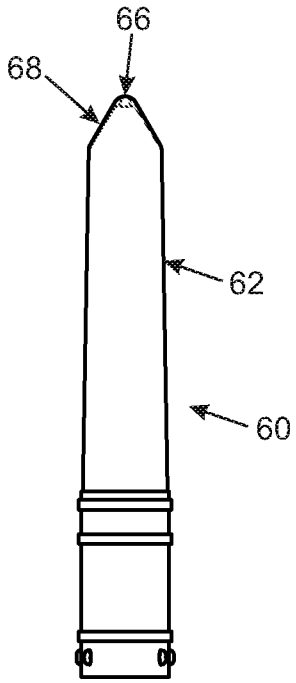


Fig. 8c

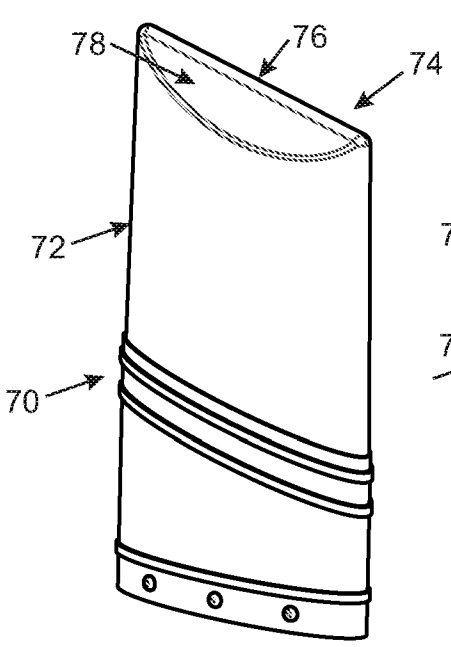


Fig. 9a

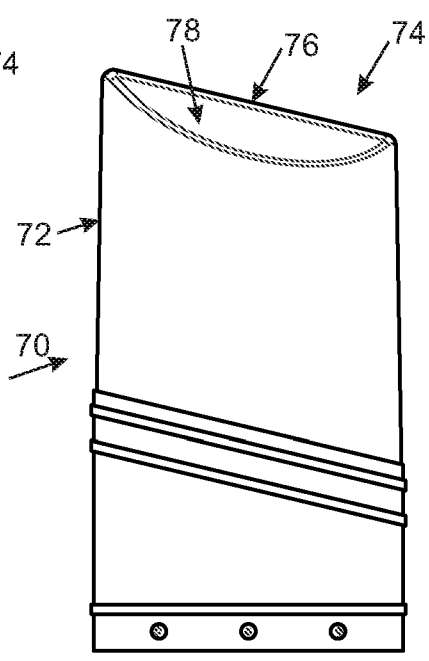


Fig. 9b

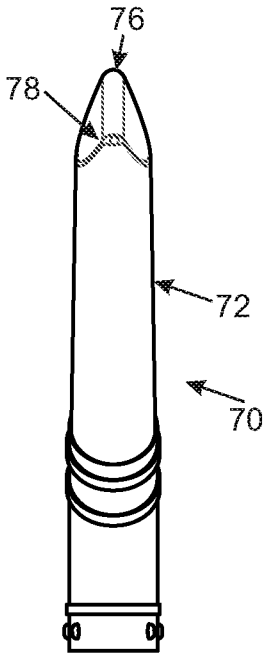


Fig. 9c

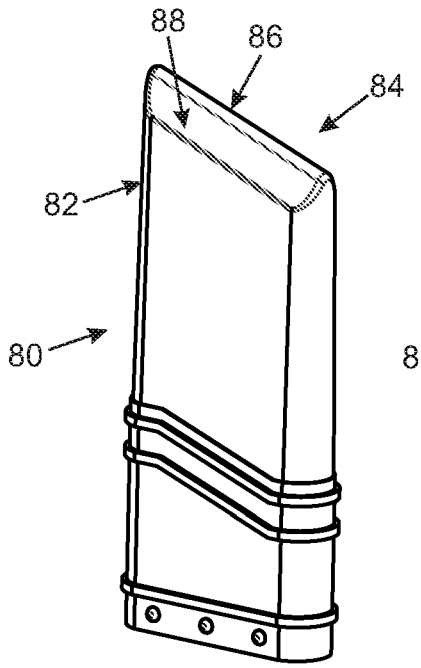


Fig. 10a

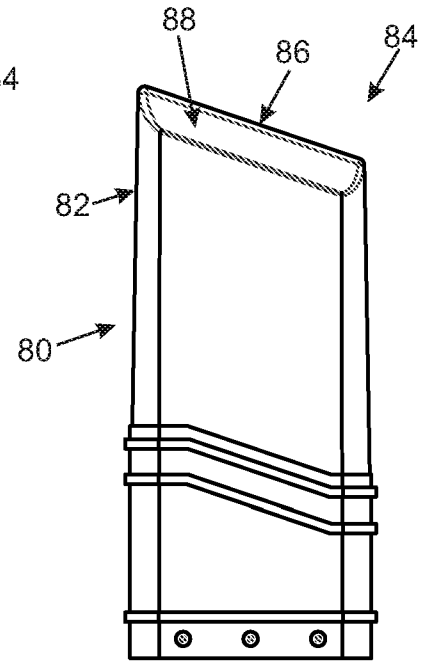


Fig. 10b

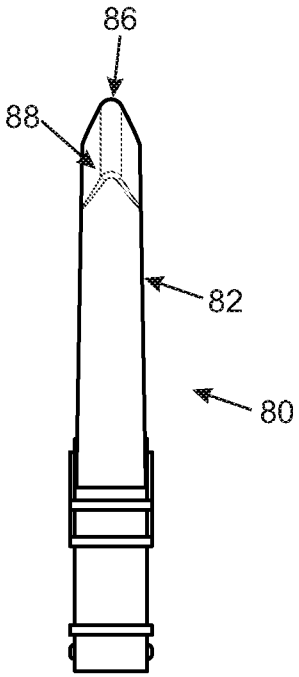


Fig. 10c

Fig. 11

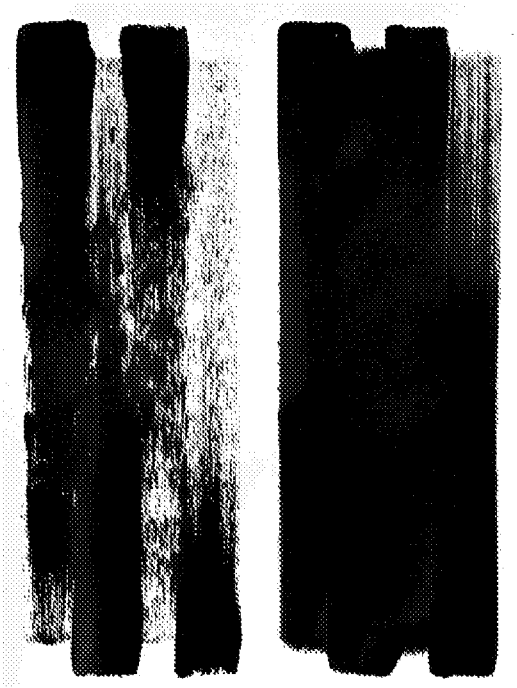

Fig. 12

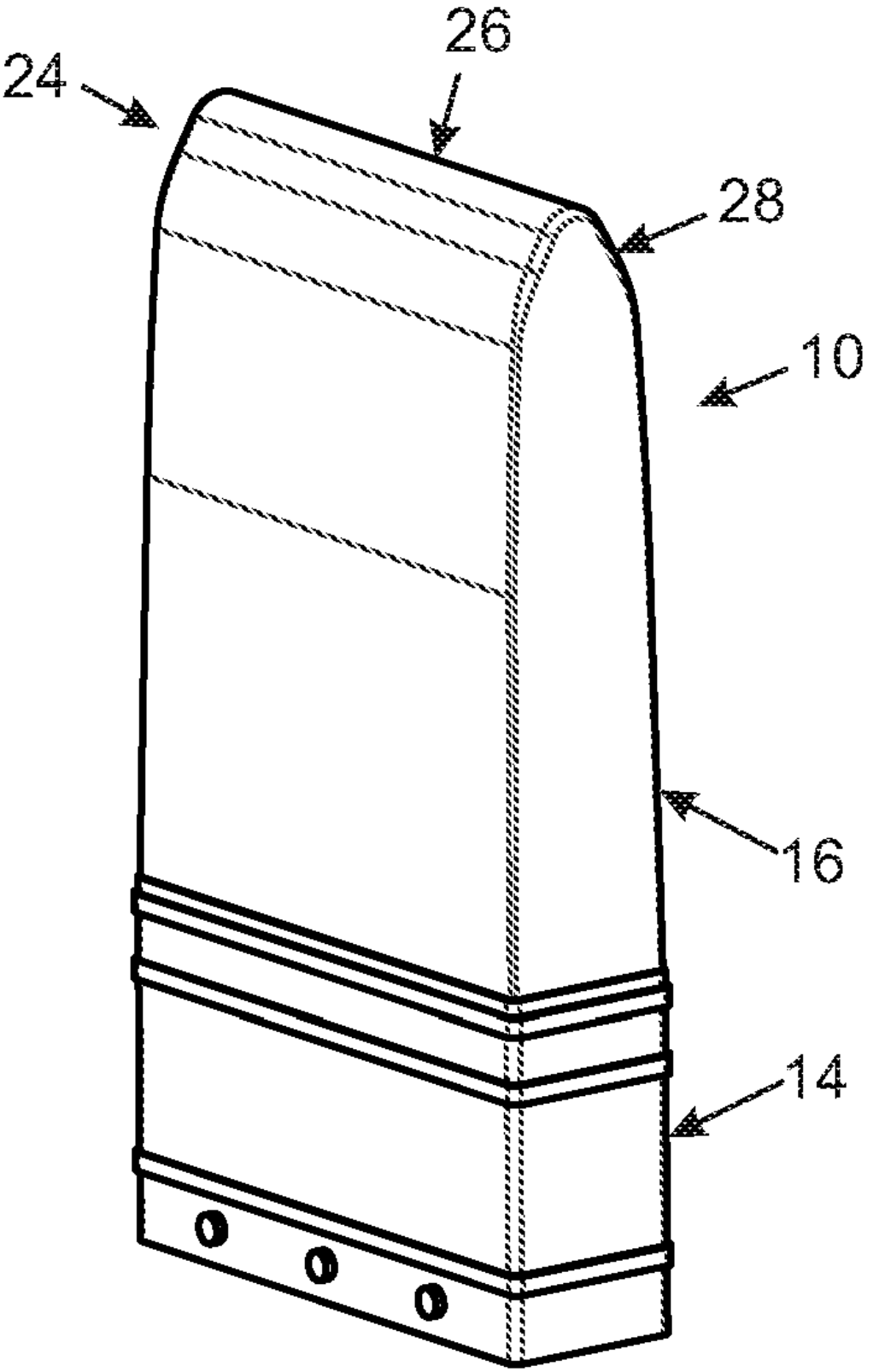


Fig. 2