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(54) Title: TWISTED COSMETIC BRUSH

(57) Abstract: A cosmetic brush that includes a plurality of polymer bristles that extend from a polymer core in a radial direction, wherein at least a portion of the core is twisted and bristles in the twisted portion are arranged in one or more columns disposed in one or more spiral paths that extend along at least a portion of the longitudinal axis of the core is presented. The polymer bristles have grooves and/or projections on their surfaces for holding cosmetic liquid for the cosmetic brush.

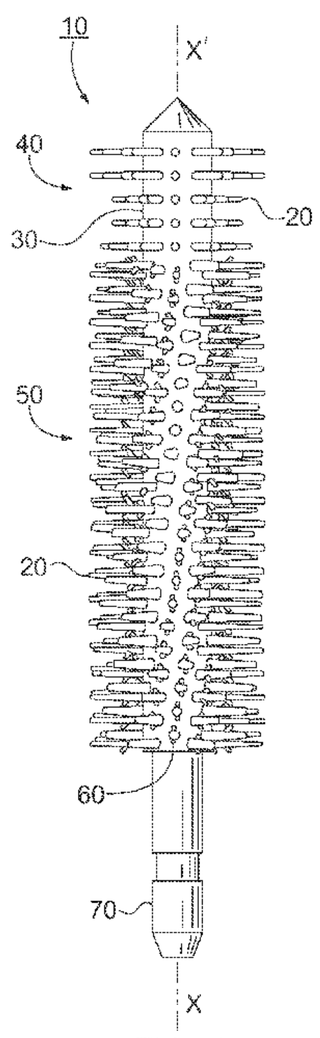

FIG. 1

WO 2021/087289 A1

TWISTED COSMETIC BRUSH

RELATED APPLICATION

This application claims priority to U.S. Provisional Application No. 62/929,213, "TWISTED COSMETIC BRUSH," filed November 1, 2019, which application is incorporated by reference herein in its entirety.

FIELD OF THE DISCLOSED SUBJECT MATTER

The present invention relates to a cosmetic brush. More specifically, the present invention relates to a cosmetic brush having at least a partial spiral or helical arrangement of bristles. Furthermore, the present invention relates to a cosmetic brush with bristles for improved volumizing effect.

BACKGROUND

Cosmetic brushes for applying a cosmetic composition to hair include, as examples, mascara brushes and hair coloring brushes. In general, there are three types of mascara brushes – volumizing, curling, and lengthening. Out of these, volumizing mascara brushes are the most in demand. Long bristles with large overall brush diameter and bristles oriented in random directions hold the most bulk which is needed to make the lashes look thick and voluminous. Traditional twisted nylon mascara brushes were previously the best choice for volumizing mascaras because of their randomness and no limitation on the brush diameter. However, the drawback of this brush is that the randomness in the brush is too random, which leads to a great deal of clumping of the bulk with clumps of bulk applied on the eyelashes. In order to solve the clumping issue, the

industry developed molded mascara brushes which have bristles aligned in a consistent manner so that the clumping is reduced. However, due to technical limitations, bristles had to be arranged in an orderly fashion leading to less volume effect. Therefore, a need exists for volumizing mascara brushes that also provide reduced clumping of mascara.

U.S. Patent No. 10,188,194 discloses a cosmetic brush that includes a plurality of polymer bristles that extend from a polymer core in a radial direction, where at least a portion of the core is twisted and bristles in the twisted portion are arranged in one or more columns disposed in one or more spiral paths that extend along at least a portion of the longitudinal axis of the core. The cross-sectional shape of the conventional molded bristles is circular and is tapered toward their ends.

However, while a cosmetic brush disclosed in U.S. Patent No. 10,188,194 solves the above problem, there is an urgent need for improvement of the cosmetic brush disclosed in U.S. Patent No. 10,188,194 for users who want to have better volumizing effect.

SUMMARY OF THE DISCLOSED SUBJECT MATTER

There is provided in accordance with various embodiments a cosmetic brush that includes a plurality of polymer bristles that extend from a polymer core in a radial direction, wherein at least a portion of the core is twisted and bristles in the twisted portion are arranged in one or more columns disposed in one or more spiral or helical paths that extend about at least a portion of the longitudinal axis of the core. In an embodiment, the configuration of the spiral or helical path is maintained without external means.

In at least one embodiment, the polymer bristles are integrally molded with the polymer core.

In at least one embodiment, each column on the core is disposed in a separate spiral or helical path that extends about at least a portion of the longitudinal axis of the core. In at least one embodiment, none of the column paths intersect.

In at least one embodiment, the cosmetic brush further includes one or more columns of bristles disposed in one or more straight paths that extend parallel to at least a portion of the longitudinal axis of the core. In at least one embodiment, none of the column paths intersect.

In at least one embodiment, the molded polymer core is twisted with a plurality of twist angles such that the plurality of polymer bristles have an organized randomness.

In at least one embodiment, an upper most bristle in the twisted portion is offset from a lower most bristle in the twisted portion by one of the plurality of twist angles, and the twist angles are angles between two bristles in different rows within the twisted portion.

In at least one embodiment, the polymer bristles have a plurality of grooves on their surfaces for holding cosmetic liquid for the cosmetic brush.

In at least one embodiment, the polymer bristles have cross-sectional shapes of any regular or irregular polygons.

In at least one embodiment, shapes and dimensions of an inner most portion of the bristles and an outermost portion of the bristles are different, the inner most portion of the bristles is a portion that is closest to the core, and the outer most portion of the bristles is a portion that is farthest to the core.

In at least one embodiment, the polymer bristles have a plurality of projections on their surfaces for holding the cosmetic liquid for the cosmetic brush.

In at least one embodiment, the polymer bristles further comprise a plurality of branches of any shapes and dimensions.

In at least one embodiment, the polymer bristles are formed with a regular and alternative arrangement of thick bristles and thin bristles throughout the core.

In at least one embodiment, the polymer bristles are formed with an irregular arrangement of thick bristles and thin bristles throughout the core.

In at least one embodiment, the polymer bristles have curvy or zigzag lines/shapes such that they have a shape like ramen noodles regardless of their thickness.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a cosmetic brush in accordance with an exemplary embodiment of the invention with at least a portion of the bristles having a 90 degree twist angle;

FIG. 2 is a perspective view of the cosmetic brush of FIG. 1;

FIG. 3 is a side view of a cosmetic brush in accordance with another exemplary embodiment of the invention with at least a portion of the bristles having a 180 degree twist angle;

FIG. 4 is a perspective view of the cosmetic brush of FIG. 3;

FIG. 5 is a side view of a cosmetic brush in accordance with another exemplary embodiment of the invention with at least a portion of the bristles having a 270 degree twist angle;

FIG. 6 is a perspective view of the cosmetic brush of FIG. 5; and

FIG. 7 is a perspective view of a cosmetic brush in accordance with another exemplary embodiment of the invention with at least a portion of the bristles having a 360 degree twist angle.

FIG. 8 shows various cross-sectional shapes of bristles of a cosmetic brush in accordance with an exemplary embodiment of the invention.

FIG. 9 shows bristles of a cosmetic brush in accordance with an exemplary embodiment of the invention, where shapes and dimensions of an inner most portion of the bristles and an outermost portion of the bristles are different.

FIG. 10 shows bristles of a cosmetic brush in accordance with an exemplary embodiment of the invention, which have a plurality of grooves on their surfaces for holding cosmetic liquid.

FIG. 11 shows bristles of a cosmetic brush in accordance with an exemplary embodiment of the invention, which have a plurality of projections on their surfaces for holding cosmetic liquid.

FIG. 12 shows bristles of a cosmetic brush in accordance with an exemplary embodiment of the invention are formed with a regular arrangement of thin bristles throughout the core.

FIG. 13 shows bristles of a cosmetic brush in accordance with an exemplary embodiment of the invention are formed with a regular arrangement of thick bristles throughout the core.

FIG. 14 shows bristles of a cosmetic brush in accordance with an exemplary embodiment of the invention are formed with a regular and alternative arrangement of thin and thick bristles throughout the core.

FIG. 15 shows bristles of a cosmetic brush in accordance with an exemplary embodiment of the invention are formed with an irregular arrangement of thin and thick bristles throughout the core.

DETAILED DESCRIPTION

The present disclosure provides polymer cosmetic brushes having randomized bristles. Cosmetic brushes according to the present disclosure provide an improved degree of volumization over standard thermoplastic brushes and also reduce clumping that is associated with traditional nylon and wire brushes.

As used in this document, the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise. Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art. As used in this document, the term "comprising" means "including, but not limited to."

As used herein, the term "cosmetic brush" includes, but is not limited to, mascara brushes and hair coloring brushes. Cosmetic brushes disclosed herein include a core member with at least one twist angle greater than zero degrees. In general, the twist angle is measured between two bristles in different rows, namely the bristles in the upper most and lower most rows within the twisted portion. In an untwisted arrangement, the twist angle between the two bristles is zero, i.e. the bristle column is substantially parallel to a longitudinal axis of the core. In a twisted arrangement, the twist angle between the same two bristles is greater than zero. In one embodiment, the twist angle is from about 1 degree to about 360 degrees. Any specific angle within this range is suitable (e.g., 2 degrees, 3 degrees, 4 degrees, 5 degrees, 10 degrees, 20 degrees, 30 degrees, 40 degrees,

etc.). It is further contemplated that the twist angle may be greater than 360 degrees. It is contemplated that the entire core possesses at least one twist angle, however, it is also possible that a portion of the core is twisted while another portion is not. It is further contemplated that the core may include more than one twist angle such that a portion of the bristles extend at a first twist angle and another portion of the bristles extend at a second, distinct twist angle.

The core member extends along a longitudinal axis XX' and may have any suitable cross-sectional shape. Exemplary shapes for the core member includes, but are not limited to, circular, oval, triangular, square, trapezoidal, hexagonal, and the like.

The bristles can also have any suitable cross-sectional shape (e.g. circular, oval, triangular, square, trapezoidal, hexagonal, etc.). That is, the bristles have cross-sectional shapes of any polygons (both regular polygons and irregular polygons). The bristles can also be round or flat. The bristles can also have a regular or an irregular shape. It is also possible that the shapes and dimensions of an inner most portion of the bristles (portion that is closest to the core with respect to the longitudinal axis of the core) and an outer most portion of the bristles (portion that is farthest from the core with respect to the longitudinal axis of the core) are different or the same. The bristles can also have a groove or grooves (an indent or indents) on any of their surfaces so that mascara (i.e., liquid) can be contained in the bristles, thereby increasing volumizing effect. Alternatively, the bristles can also have a projection or projections on any of their surfaces. Here, the groove (projection) or grooves (projections) on the surfaces of the bristles can have any suitable shape. It is also possible that the bristles have a branch or branches for having various overall shapes of the bristles. Here, the branch or branches include various types/shapes/sizes of the bristles. It is also possible that the bristles have various

thicknesses and that the bristles can be formed with various arrangement of the bristles of different thickness throughout the core. For example, the bristles can be formed with a regular and alternative arrangement of thick bristles and thin bristles throughout the core. Alternatively, the bristles can be formed with an irregular arrangement of thick bristles and thin bristles throughout the core. It is also possible that the bristles have curvy or zigzag lines (shapes) such that they have a shape similar to ramen noodles regardless of their thickness.

The cosmetic brushes are manufactured from a polymer material, which may include synthetic or semi-synthetic materials. Preferably, both the core and the bristles are manufactured from a thermoplastic material; however, the invention is not limited to such. One or both of the core and bristles may be manufactured from a different material. Additionally, the core and bristles are preferably manufactured from the same material; however, the may be manufactured from different materials from one another.

The cosmetic brushes according to the invention can be fabricated according to any suitable method. In one exemplary method, a thermoplastic brush is initially molded (e.g. via injection molding, extrusion, or the like) with the bristles formed integrally with the core in parallel, non-twisted columns. At least a portion of the molded core is then twisted via an application of force, heat, wind, chemicals, or a combination thereof, that results in a permanent deformation (e.g. twisting) of the core with the bristles in the twisted area extending in spiral or helical columns. For example, the molded core is twisted with a plurality of twist angles via an application of heat such that polymer bristles have an organized randomness. The upper most bristle in the twisted portion is offset from the lower most bristle in the twisted portion by one of twisted angles, where the twist angles are angles between two bristles in different rows within the twisted portion. Also, it is

possible that the molded core is twisted with twist angles throughout the entire twisted portion. Here, twisted angles could be distinct from each other.

Referring to FIGS. 1 and 2, a cosmetic brush **10** in accordance with an exemplary embodiment of the invention will be described. The brush **10** includes a plurality of polymer bristles **20** that extend from a polymer core **30** in a radial direction. In this embodiment, the core **30** includes a twisted portion **50** having a twist angle of approximately 90 degrees. Bristles **20** in the twisted portion **50** are arranged in multiple columns disposed in multiple spiral or helical paths **60** that extend about a portion of the longitudinal axis XX′ of the core **30**. None of the spiral/helical paths intersect. As illustrated in FIG. 2, the upper most bristle **20a** in the twisted portion **50** is offset from the lower most bristle **20b** in the twisted portion **50** by about 90 degrees.

In the illustrated embodiment, the core **30** also includes an untwisted portion **40** in which the core **30** is not twisted and the bristles **20** are disposed in multiple straight paths that extend generally parallel to the longitudinal axis XX′ of the core **30**. The opposite end of the core **30** may optionally include a stem **70**. The stem **70** facilitates connection of the cosmetic brush to a handle or the like (not shown).

The view presented in FIG. 1 provides a view of the bristles **20** as randomized in the twisted portion **50**. The view presented in FIG. 2 provides a view of the bristles **20** as disposed in multiple spiral or helical paths that extend about a portion of the longitudinal axis XX′ of the core **30**. As such, it can be said that the bristles **20** have an organized randomness.

Referring to FIGS. 3 and 4, a cosmetic brush **10'** in accordance with another exemplary embodiment of the invention will be described. The brush **10'** includes a plurality of polymer bristles **20** that extend from a polymer core **30'** in a radial direction.

In this embodiment, the core **30'** includes a twisted portion **50'** having a twist angle of approximately 180 degrees. Bristles **20** in the twisted portion **50'** are arranged in multiple columns disposed in multiple spiral or helical paths **60'** that extend about a portion of the longitudinal axis XX′ of the core **30'**. None of the spiral/helical paths intersect. As illustrated in FIG. 4, the upper most bristle **20a'** in the twisted portion **50'** is offset from the lower most bristle **20b'** in the twisted portion **50'** by about 180 degrees.

In the illustrated embodiment, the core **30'** also includes an untwisted portion **40** in which the core **30'** is not twisted and the bristles **20** are disposed in multiple straight paths that extend generally parallel to the longitudinal axis XX′ of the core **30'**. The opposite end of the core **30'** may optionally include a stem **70**. The stem **70** facilitates connection of the cosmetic brush to a handle or the like (not shown).

The view presented in FIG. 3 provides a view of the bristles **20** as randomized in the twisted portion **50'**. The view presented in FIG. 4 provides a view of the bristles **20** as disposed in multiple spiral or helical paths that extend about a portion of the longitudinal axis XX′ of the core **30'**. As such, it can be said that the bristles **20** have an organized randomness.

Referring to FIGS. 5 and 6, a cosmetic brush **10"** in accordance with another exemplary embodiment of the invention will be described. The brush **10"** includes a plurality of polymer bristles **20** that extend from a polymer core **30"** in a radial direction. In this embodiment, the core **30"** includes a twisted portion **50"** having a twist angle of approximately 270 degrees. Bristles **20** in the twisted portion **50"** are arranged in multiple columns disposed in multiple spiral or helical paths **60"** that extend about a portion of the longitudinal axis XX′ of the core **30"**. None of the spiral/helical paths intersect. As

illustrated in FIG. 6, the upper most bristle **20a"** in the twisted portion **50"** is offset from the lower most bristle **20b"** in the twisted portion **50"** by about 270 degrees.

In the illustrated embodiment, the core **30"** also includes an untwisted portion **40** in which the core **30"** is not twisted and the bristles **20** are disposed in multiple straight paths that extend generally parallel to the longitudinal axis XX′ of the core **30"**. The opposite end of the core **30"** may optionally include a stem **70**. The stem **70** facilitates connection of the cosmetic brush to a handle or the like (not shown).

The view presented in FIG. 5 provides a view of the bristles **20** as randomized in the twisted portion **50"**. The view presented in FIG. 6 provides a view of the bristles **20** as disposed in multiple spiral or helical paths that extend about a portion of the longitudinal axis XX′ of the core **30"**. As such, it can be said that the bristles **20** have an organized randomness.

Referring to FIG. 7, a cosmetic brush **10'"** in accordance with another exemplary embodiment of the invention will be described. The brush **10'"** includes a plurality of polymer bristles **20** that extend from a polymer core **30'"** in a radial direction. In this embodiment, the core **30'"** includes a twisted portion **50'"** having a twist angle of 360 degrees. Bristles **20** in the twisted portion **50'"** are arranged in multiple columns disposed in multiple spiral or helical paths **60'"** that extend about a portion of the longitudinal axis XX′ of the core **30'"**. None of the spiral/helical paths intersect. As illustrated in FIG. 7, the upper most bristle **20a'"** in the twisted portion **50'"** is offset from the lower most bristle **20b'"** in the twisted portion **50'"** by about 360 degrees.

In the illustrated embodiment, the core **30'"** also includes an untwisted portion **40** in which the core **30'"** is not twisted and the bristles **20** are disposed in multiple straight paths that extend generally parallel to the longitudinal axis XX′ of the core **30'"**. The

opposite end of the core **30'"** may optionally include a stem **70**. The stem **70** facilitates connection of the cosmetic brush to a handle or the like (not shown).

The view presented in FIG. 7 provides a view of the bristles **20** as disposed in multiple spiral or helical paths **60'"** that extend about a portion of the longitudinal axis XX′ of the core **30'"**. Again, the bristles **20** have an organized randomness.

FIG. 8 shows various cross-sectional shapes of bristles of a cosmetic brush in accordance with an exemplary embodiment of the invention.

Referring to FIG. 9, the view presented in FIG. 9 shows the bristles **20** of the cosmetic brush, where shapes and dimensions of an inner most portion of the bristles and an outermost portion of the bristles are different. Here, the inner most portion of the bristles **20** is a portion that is closest to the core **30** with respect to the longitudinal axis of the core, and the outer most portion of the bristles **20** is a portion that is farthest from the core **30** with respect to the longitudinal axis of the core.

Referring to FIG. 10, the view presented in FIG. 10 shows the bristles **20** of the cosmetic brush, which have a plurality of grooves **21** on their surfaces for holding cosmetic liquid. The plurality of grooves may be formed uniformly (i.e., evenly spaced among the plurality of grooves) or randomly throughout the surfaces of the bristles. Shapes and dimensions of the plurality of grooves are not limited as shown in FIG. 10.

Referring to FIG. 11, the view presented in FIG. 11 shows the bristles **20** of the cosmetic brush, which have a plurality of projections **22** on their surfaces for holding cosmetic liquid. The plurality of projections may be formed uniformly (i.e., evenly spaced among the plurality of grooves) or randomly throughout the surfaces of the bristles. Shapes and dimensions of the plurality of projections are not limited as shown in FIG. 11.

Referring to FIG. 12, the view presented in FIG. 12 shows that the bristles of the cosmetic brush are formed with a regular arrangement (i.e., evenly spaced) of thin bristles ("second type of bristles") throughout the core.

Referring to FIG. 13, the view presented in FIG. 13 shows that the bristles of the cosmetic brush are formed with a regular arrangement (i.e., evenly spaced) of thick bristles ("first type of bristles") throughout the core. Here, the first type of bristles is thicker than the second type of bristles.

Referring to FIG. 14, the view presented in FIG. 14 shows that the bristles of the cosmetic brush are formed with a regular and alternative arrangement of thick ("first type of bristles") and thin bristles ("second type of bristles") throughout the core.

Referring to FIG. 15, the view presented in FIG. 15 shows that the bristles of the cosmetic brush are formed with an irregular arrangement (without specific predetermined arrangements) of thick ("first type of bristles") and thin bristles ("second type of bristles") throughout the core.

While this invention has been described with an emphasis upon preferred embodiments, it will be obvious to those of ordinary skill in the art that variations in the preferred compositions and methods can be used and that it is intended that the invention can be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications encompassed within the spirit and scope of the invention as defined by the claims that follow.

CLAIMS

What is claimed is:

1. A cosmetic brush comprising:

a polymer core extending along a longitudinal axis and defining a first portion thereof extending between a first end of the first portion and a second end of the first portion;

a plurality of polymer bristles extending from the polymer core in a radial direction, wherein at least the first end of the first portion of the core is twisted about the longitudinal axis relative to the second end of the first portion of the core to define a twisted portion and wherein bristles in the twisted portion are arranged in one or more columns disposed in one or more spiral or helical paths about at least a portion of the longitudinal axis of the core, the plurality of polymer bristles integrally molded with the polymer core,

wherein the molded polymer core is twisted with a plurality of twist angles such that the plurality of polymer bristles have an organized randomness,

wherein an upper most bristle in the twisted portion is offset from a lower most bristle in the twisted portion by one of the plurality of twist angles,

wherein the twist angles are angles between two bristles in different rows within the twisted portion, and

wherein the bristles have a plurality of grooves on their surfaces for holding cosmetic liquid for the cosmetic brush.

2. The cosmetic brush according to claim 1, wherein the bristles have cross-sectional shapes of any regular or irregular polygons.

3. The cosmetic brush according to claim 1, wherein shapes and dimensions of an inner most portion of the bristles and an outermost portion of the bristles are different, and

wherein the inner most portion of the bristles is a portion that is closest to the core, and the outer most portion of the bristles is a portion that is farthest to the core with respect to the longitudinal axis of the core.

4. The cosmetic brush according to claim 1, wherein the bristles have a plurality of projections on their surfaces for holding the cosmetic liquid for the cosmetic brush.

5. The cosmetic brush according to claim 1, wherein the bristles further comprise a plurality of branches of any shapes and dimensions.

6. The cosmetic brush according to claim 1, wherein the bristles are formed with a regular and alternative arrangement of a first type of bristles and a second type of bristles throughout the core, wherein

the first type of bristles is thicker than the second type of bristles.

7. The cosmetic brush according to claim 1, wherein the bristles are formed with an irregular arrangement of a first type of bristles and a second type of bristles throughout the core, wherein

the first type of bristles is thicker than the second type of bristles.

8. The cosmetic brush according to claim 1, wherein the bristles have curvy or zigzag lines/shapes such that they have a shape like ramen noodles regardless of their thickness.

9. The cosmetic brush according to claim 1, wherein the plurality of grooves are formed uniformly on surfaces of the bristles.

10. The cosmetic brush according to claim 1, wherein the plurality of grooves are formed randomly on surfaces of the bristles.

11. The cosmetic brush according to claim 4, wherein the plurality of projections are formed uniformly on surfaces of the bristles.

12. The cosmetic brush according to claim 4, wherein the plurality of projections are formed randomly on surfaces of the bristles.

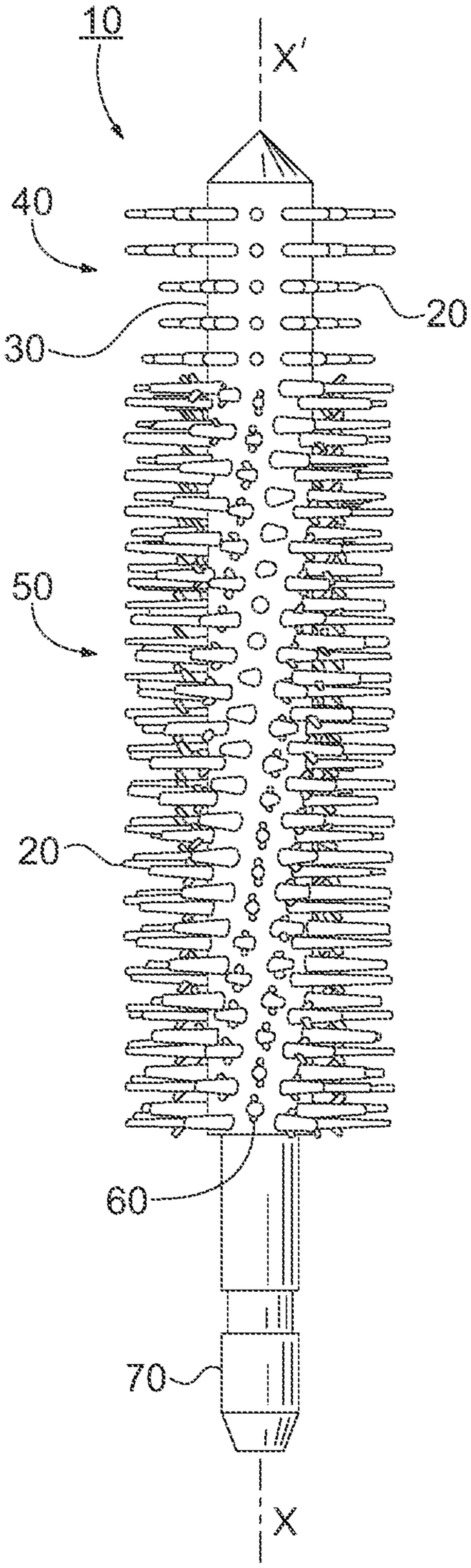

FIG. 1

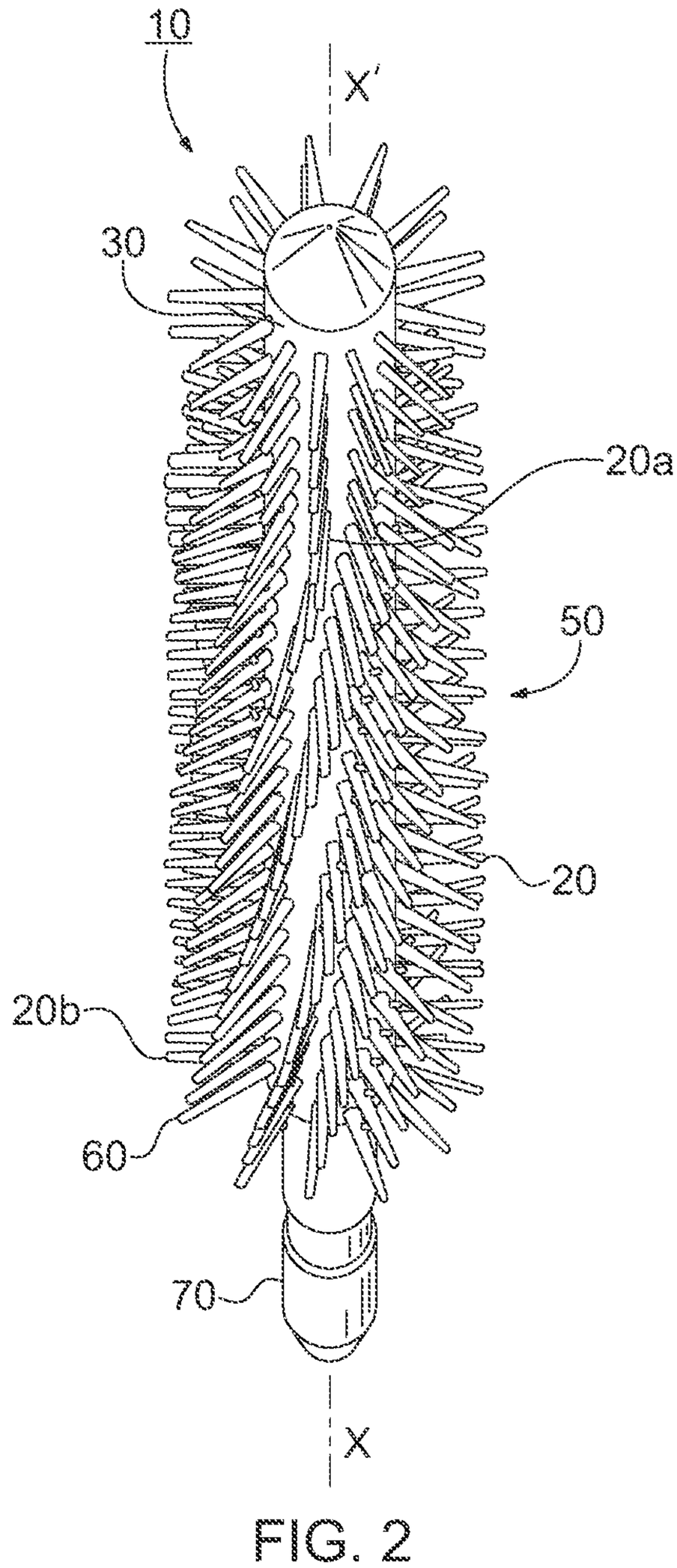

FIG. 2

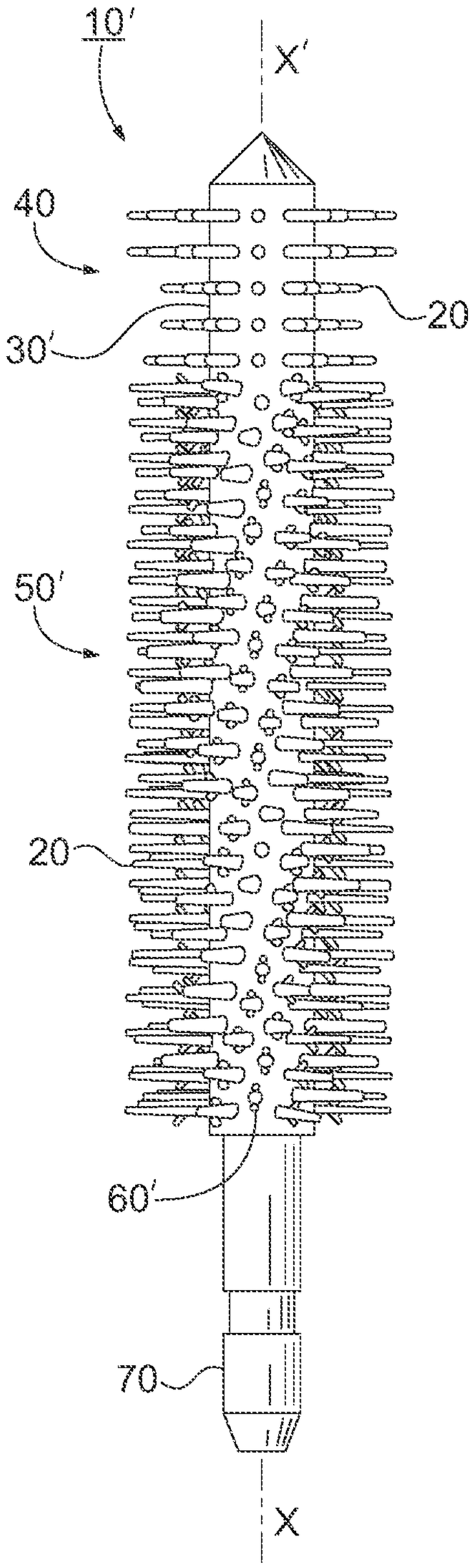

FIG. 3

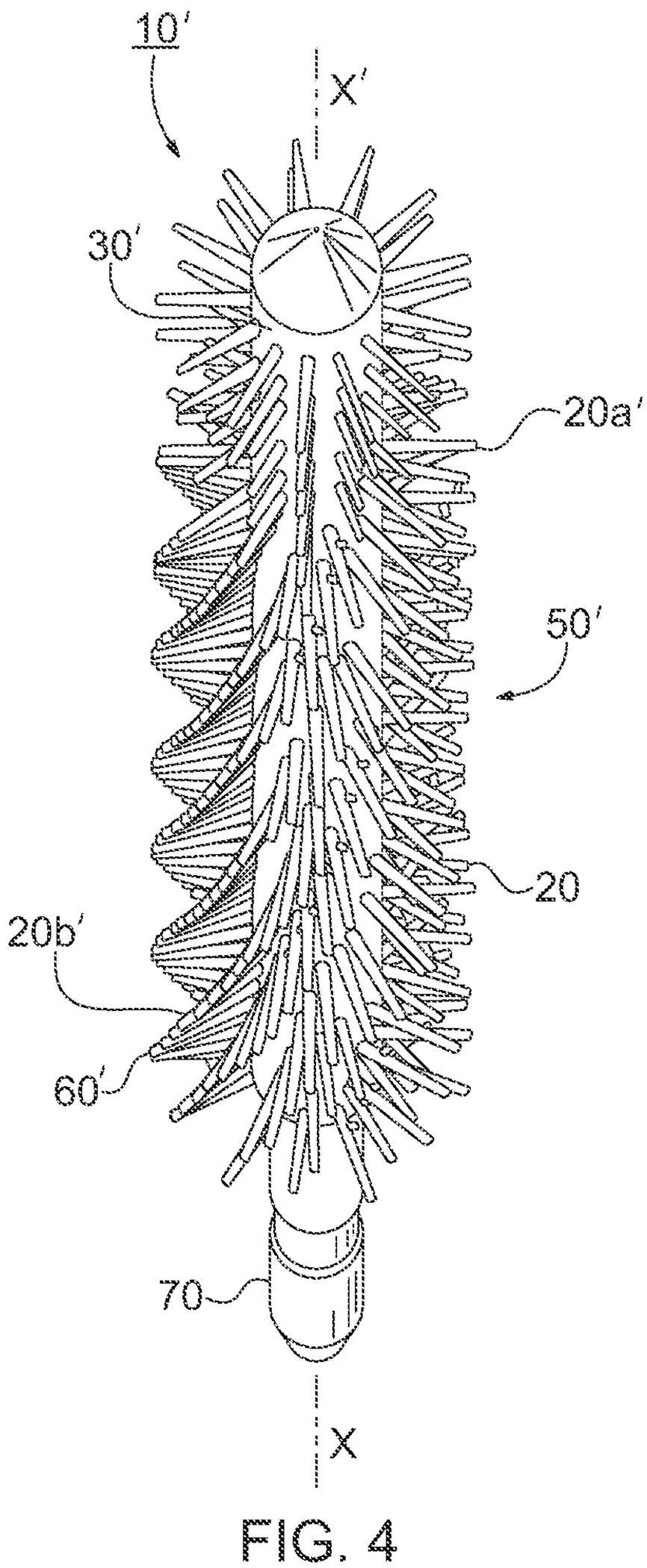

FIG. 4

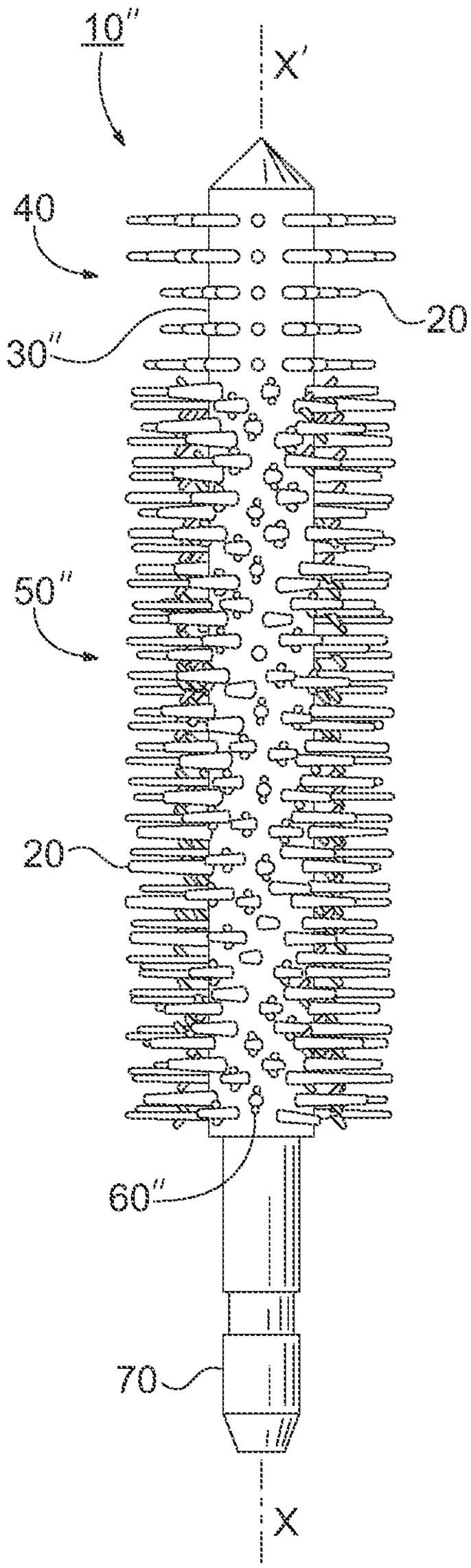

FIG. 5

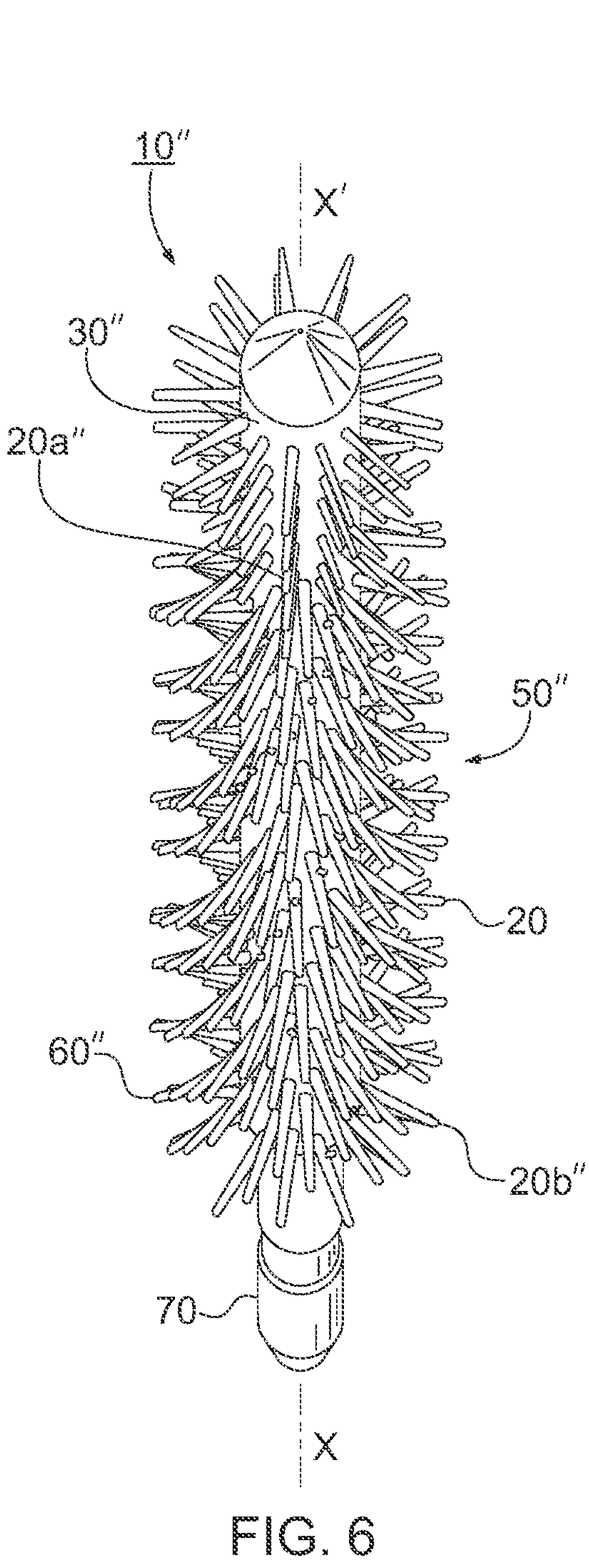

FIG. 6

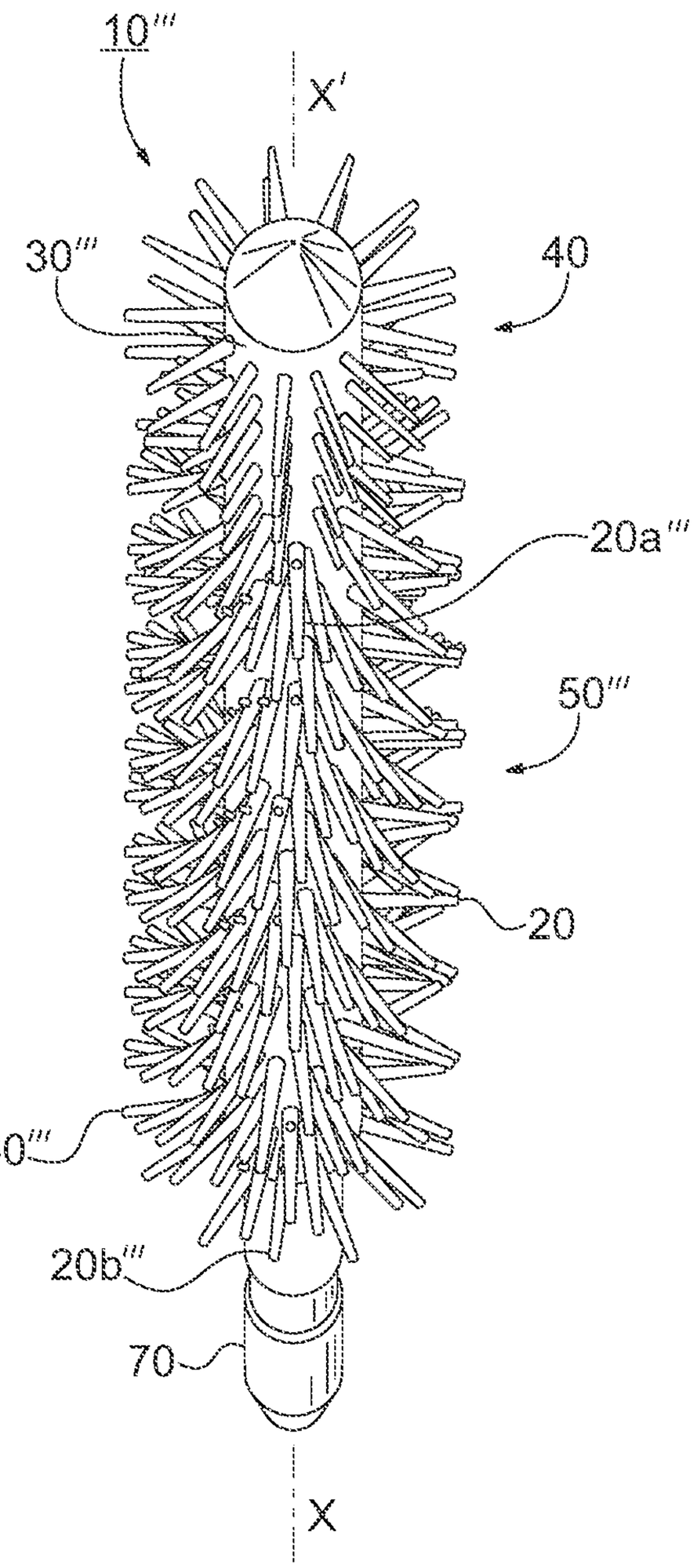

FIG. 7

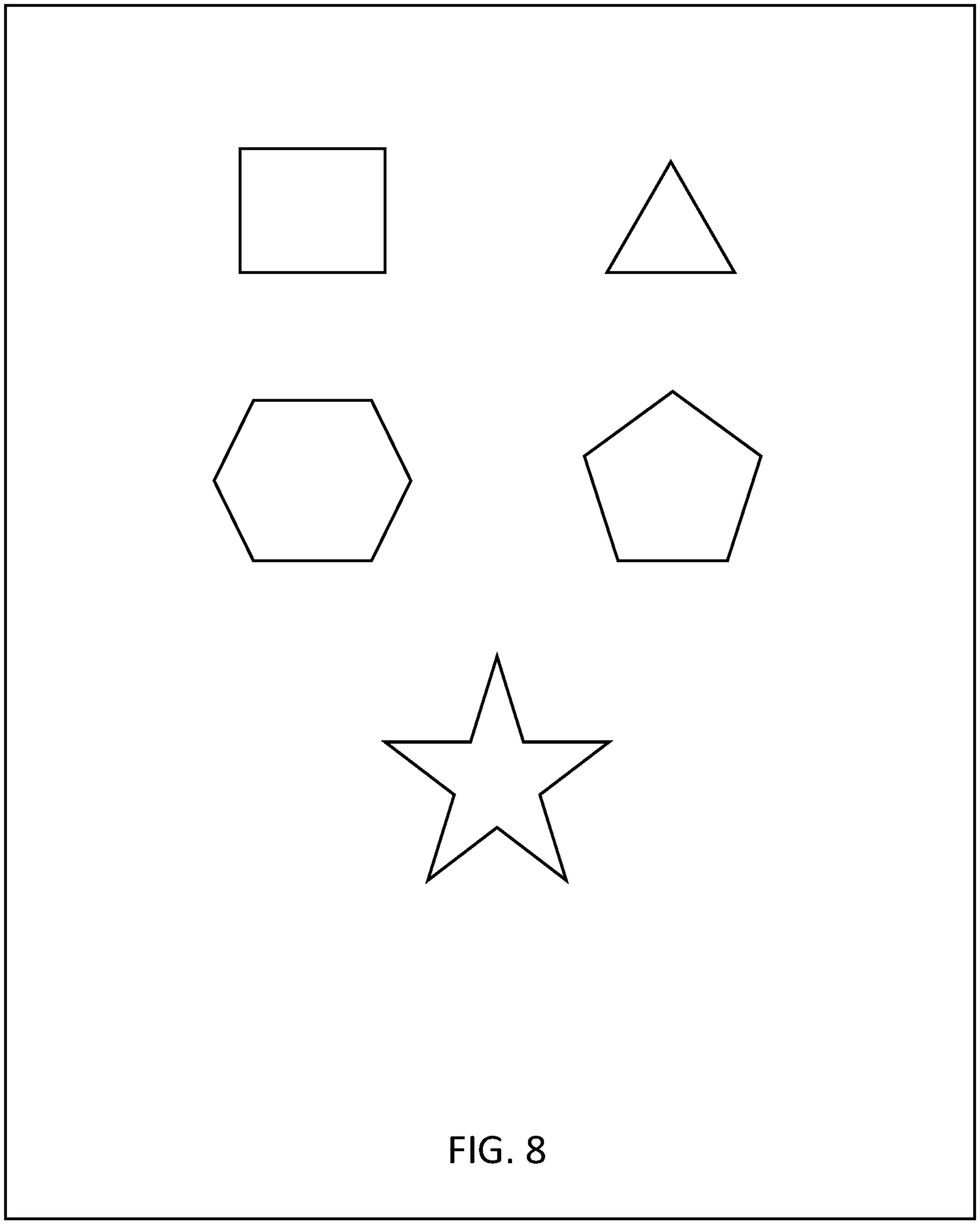

FIG. 8

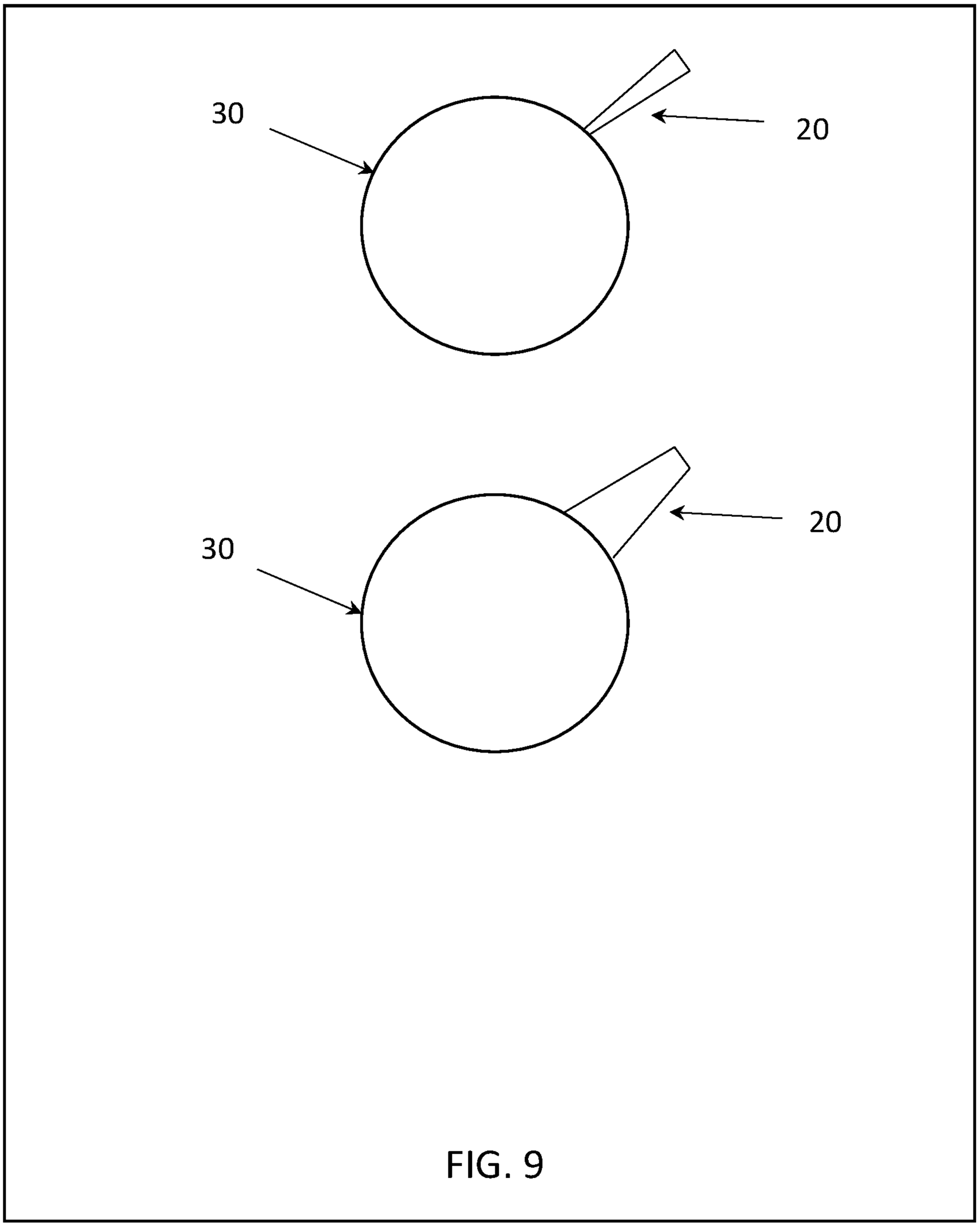

FIG. 9

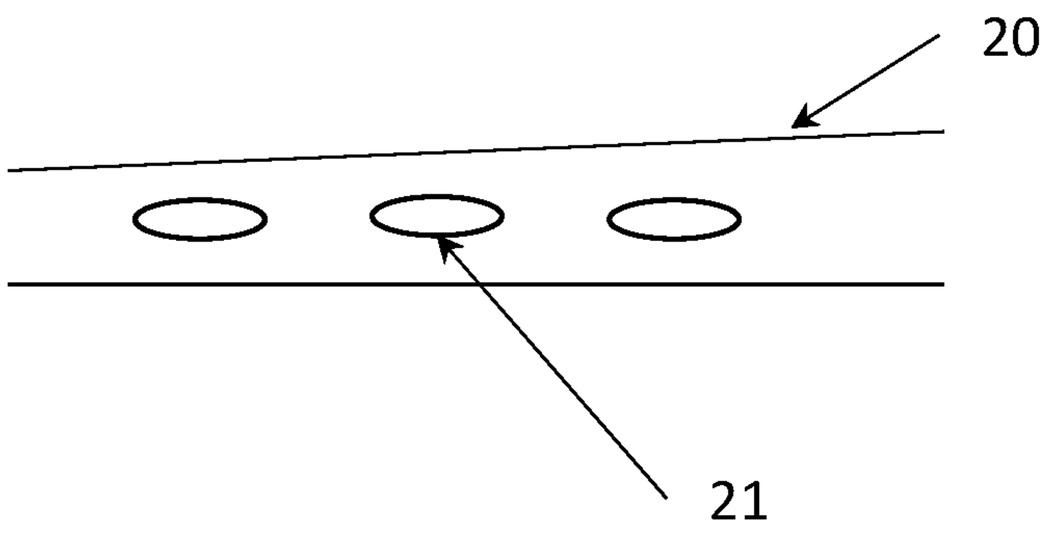

FIG. 10

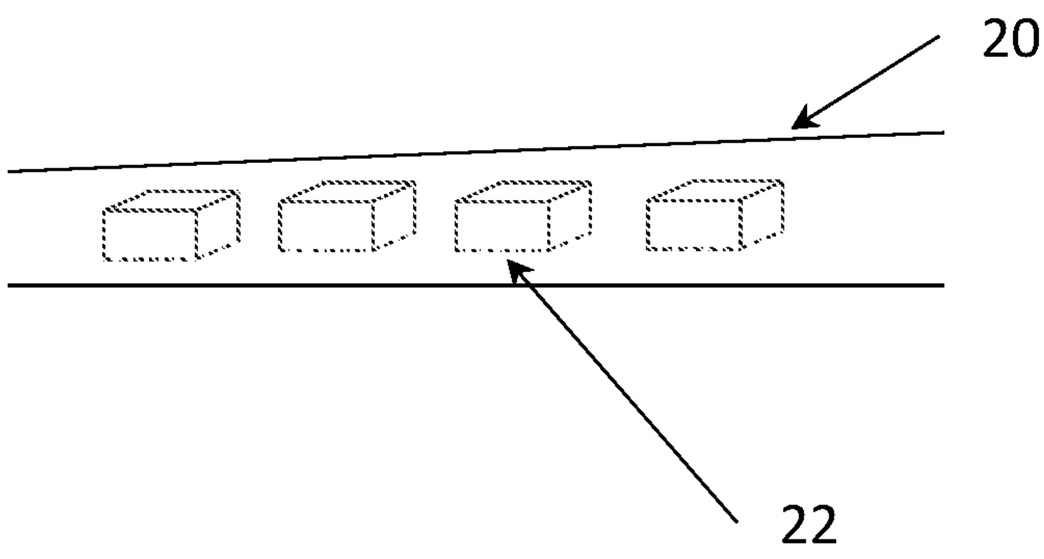

FIG. 11

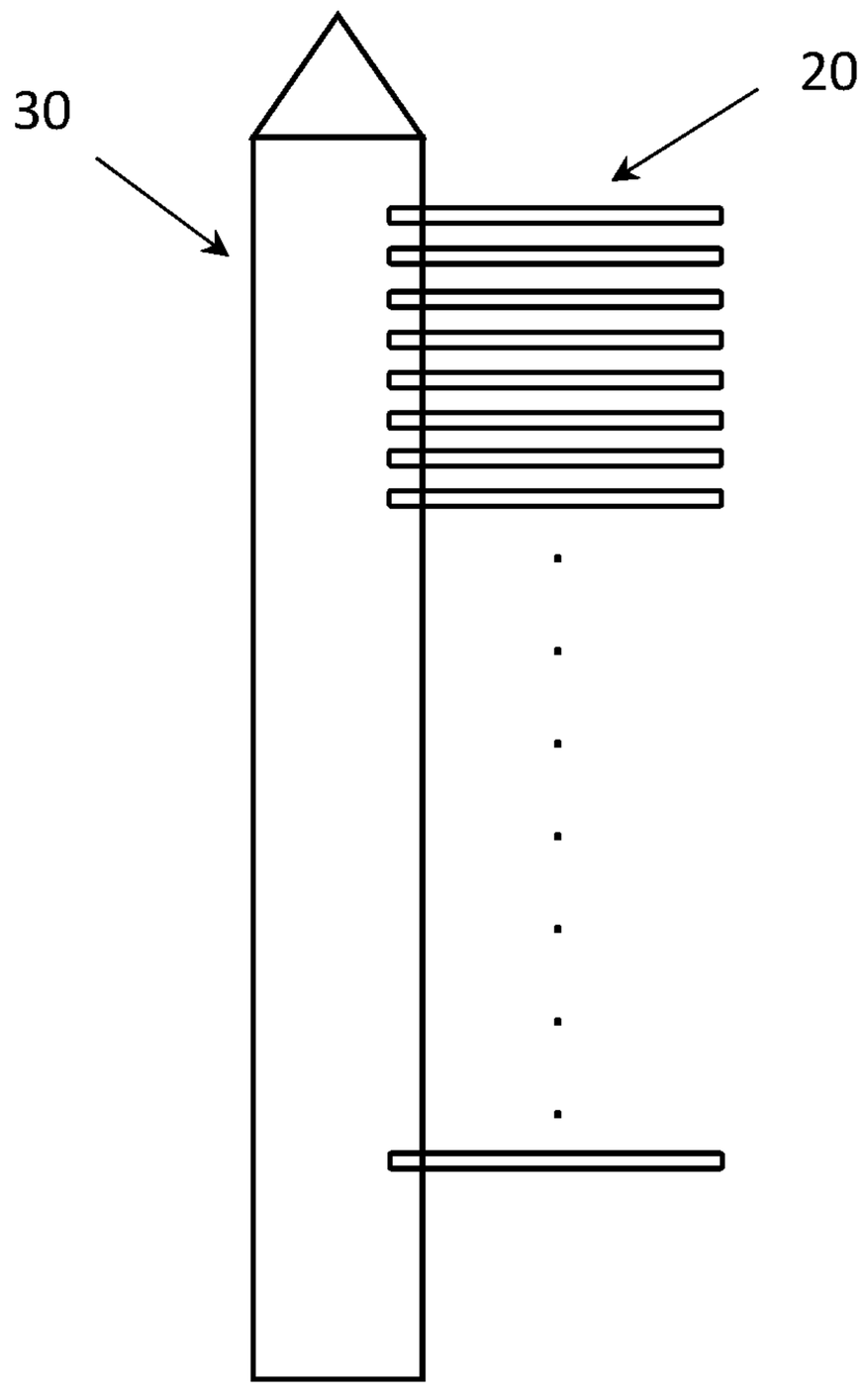

FIG. 12

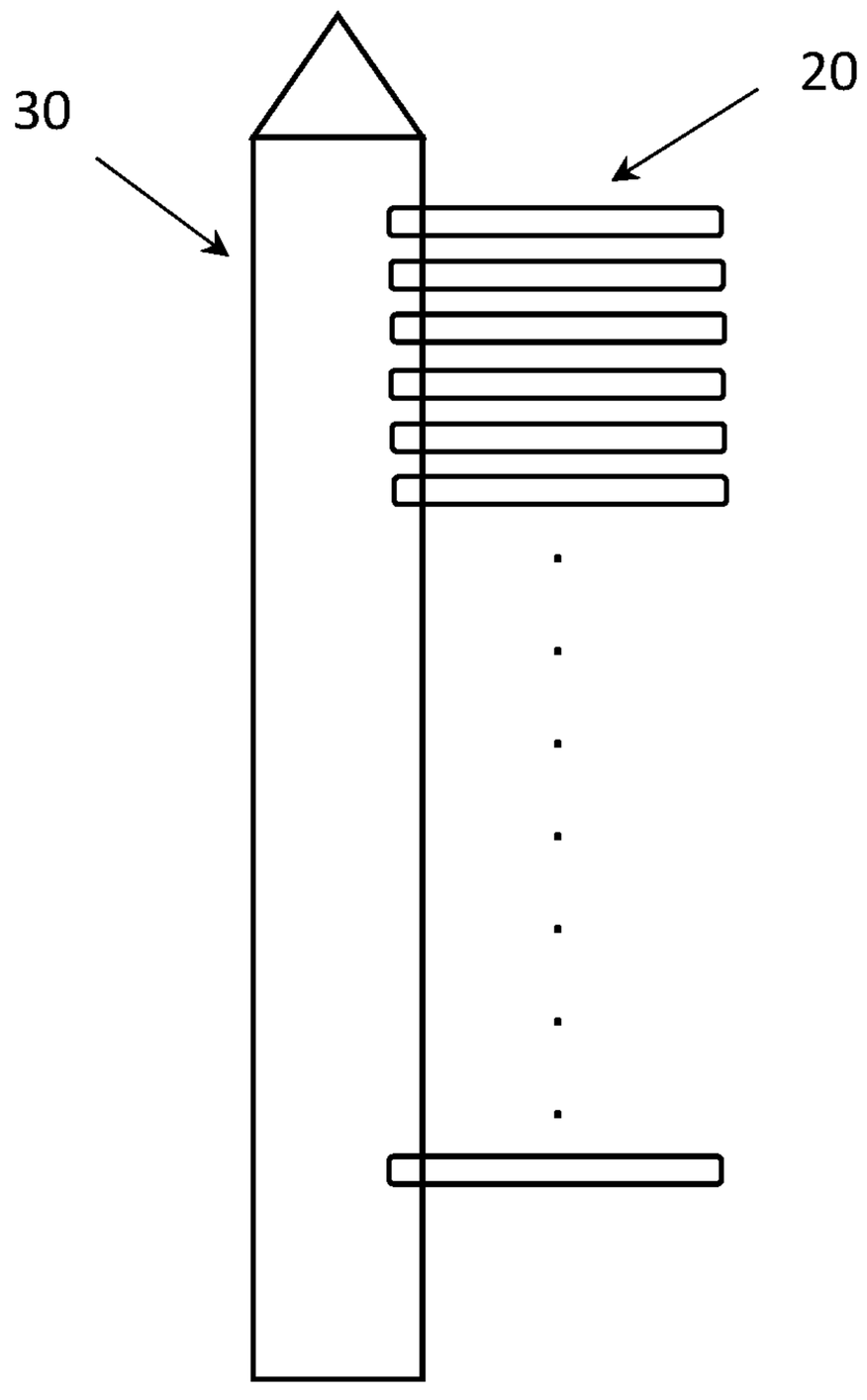

FIG. 13

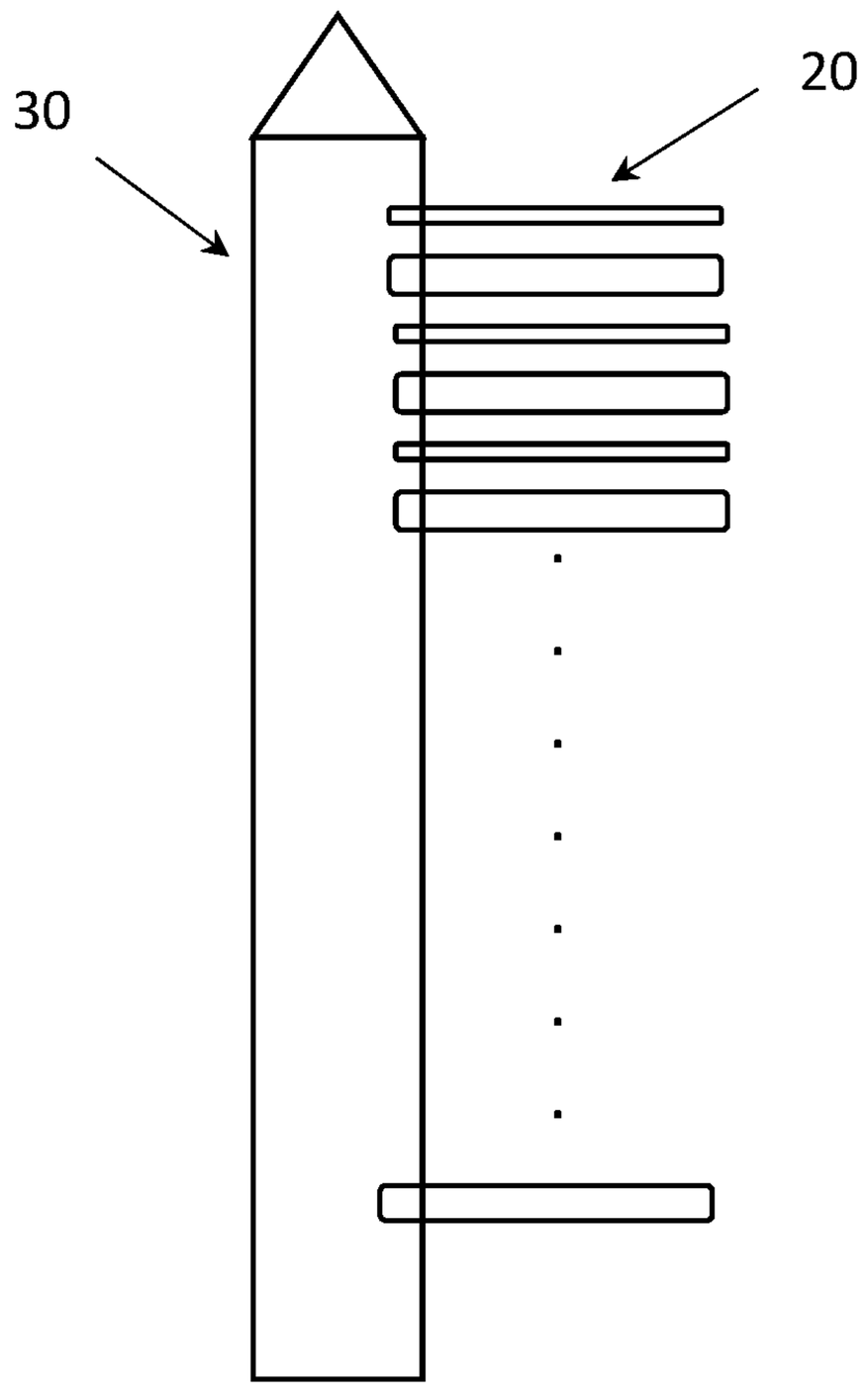

FIG. 14

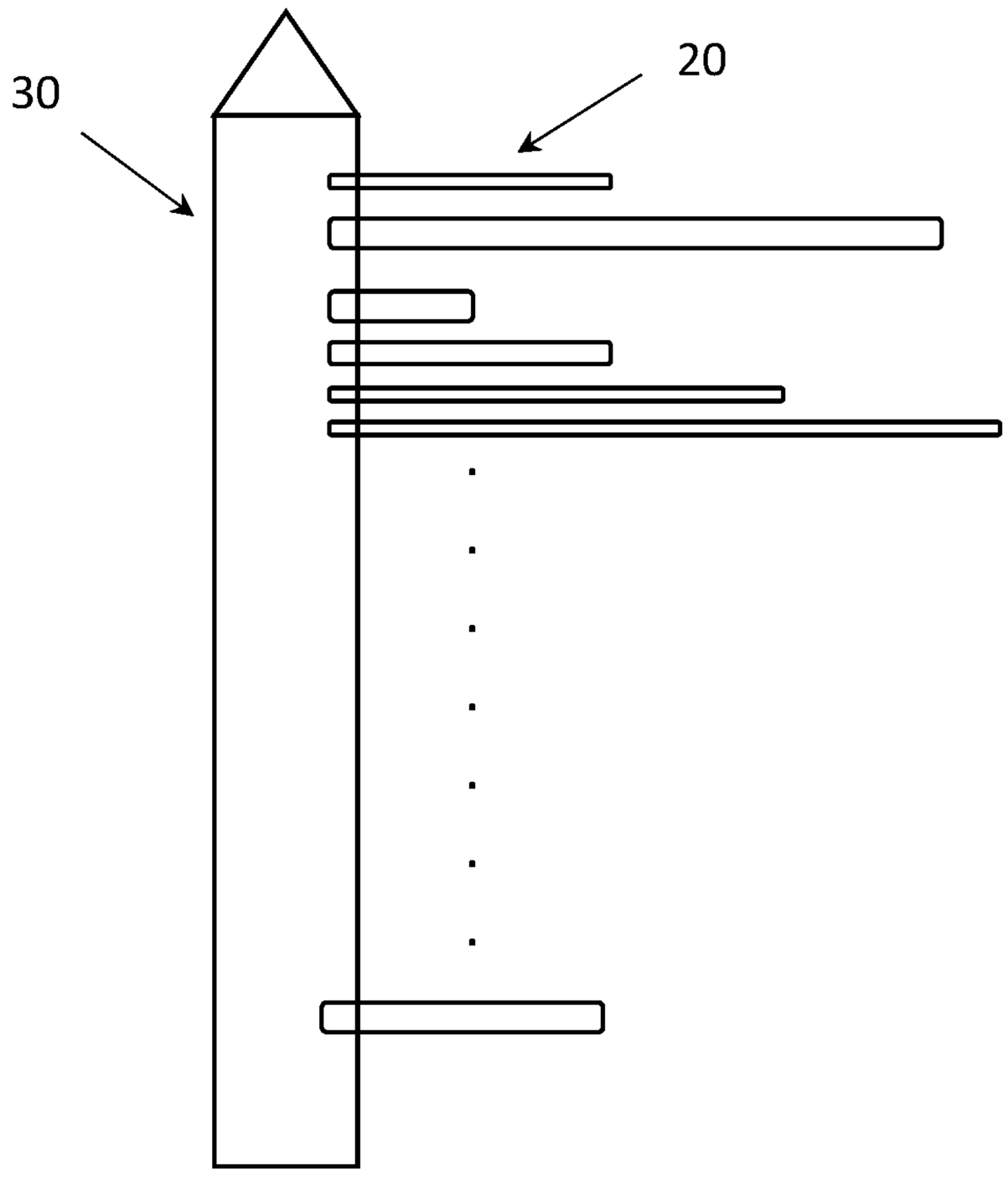

FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2020/058255

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A45D 40/26; A45D 34/04; A46B 9/02 (2020.01)
CPC - A45D 40/262; A46B 3/16; A46B 9/021; A46B 9/06; A46B 2200/1053 (2020.08)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
see Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
see Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
see Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 10,188,194 B2 (AA R&D LLC) 29 January 2019 (29.01.2019) entire document	1-12
Y	US 2017/0215566 A1 (SINWA CORPORATION) 03 August 2017 (03.08.2017) entire document	1-12
A	US 2019/0307236 A1 (SOCIETE INDUSTRIELLE DE MATIERES PLASTIQUES) 10 October 2019 (10.10.2019) entire document	1-12
A	US 2018/0213923 A1 (ELC MANAGEMENT LLC) 02 August 2018 (02.08.2018) entire document	1-12
A	US 2009/0276973 A1 (BOUIX et al) 12 November 2009 (12.11.2009) entire document	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 December 2020	25 JAN 2021
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver Telephone No. PCT Helpdesk: 571-272-4300