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(54) Title: AUTOMATIC EMITTER POINT CLEANERS

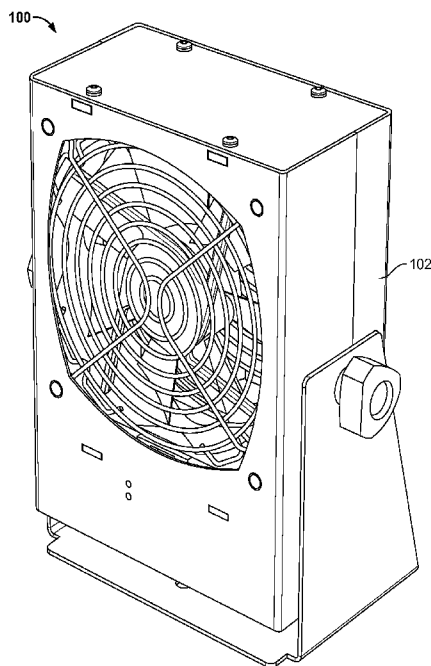


FIG. 1

(57) Abstract: Automatic emitter point cleaners are disclosed. An automatic emitter point cleaning system 204 includes: a fan 202 configured to direct a stream of air through an air path; a point emitter 304 configured to produce at least one of positive ions or negative ions within or proximate to the air path; a brush 404; a first gear 308 coupled to the brush and configured to move the brush into contact with the point emitter; a second gear 306 to engage the first gear; and a motor 206 to actuate the second gear such that the second gear actuates the first gear to move the brush past the point emitter.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
KM, ML, MR, NE, SN, TD, TG).

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## AUTOMATIC EMITTER POINT CLEANERS

### RELATED APPLICATIONS

[0001] This international application claims priority to U.S. Provisional Patent Application Serial No. 62/476,144, filed March 24, 2017, entitled “Automatic Emitter Point Cleaners,” and to U.S. Patent Application Serial No. 15/928,261, filed March 22, 2018, entitled “Automatic Emitter Point Cleaners.” The entireties of U.S. Provisional Patent Application Serial No. 62/476,144 and U.S. Patent Application Serial No. 15/489,321 are incorporated herein by reference.

### BACKGROUND

[0002] This disclosure relates generally to ionizers and, more particularly, to automatic emitter point cleaners.

[0003] Ionizing devices that function as static eliminators or neutralizers may produce both polarities of ions that combine with and neutralize oppositely charged surfaces. Such devices are useful for maintaining electrostatically neutral conditions usually associated with the manufacture of electronic devices, especially semiconductors. Because these ionizers use discharge electrodes that produce an electric field, they tend to accumulate foreign particles at their emitter points or edges. This particle accumulation can cause an excess emission of ions of one polarity or the other, i.e., ion imbalance, whereby the area at which both polarities of ions are directed tends to become charged rather than electrostatically neutral.

### SUMMARY

[0004] Automatic emitter point cleaners are disclosed, substantially as illustrated by and described in connection with at least one of the figures, as set forth more completely in the claims.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1 is a view of an example DC corona ionizer, in accordance with aspects of this disclosure.

[0006] FIG. 2 is a view of an interior of the example DC corona ionizer of FIG. 1.

[0007] FIG. 3 is a view of the example fan of the DC corona ionizer attached to an automatic emitter point cleaner, in accordance with aspects of this disclosure.

[0008] FIG. 4 is another view of the example fan and the automatic emitter point cleaner of FIG. 3.

[0009] FIG. 5 is another view of the example fan and the automatic emitter point cleaner of FIG. 3.

[0010] FIG. 6 is a view of example implementation of the automatic emitter point cleaner of FIGS. 3-5.

[0011] The figures are not necessarily to scale. Where appropriate, similar or identical reference numbers are used to refer to similar or identical components.

#### DETAILED DESCRIPTION

[0012] Conventional emitter point cleaning devices for ionizing blowers are connected to an axis of rotation of a fan, and the fan speed must be reduced from the speed during operation to enable emitter cleaning. As a result, conventional emitter point cleaning devices require a reduction in performance, or even disabling, of the ionizing blower to perform cleaning of the emitter points. A reduction in performance or disabling of the ionizing blower may provide a window in which charge buildup is more likely to damage sensitive devices.

[0013] Disclosed example systems enable emitter point cleaning for ionizing devices such that the ionizing device can continue to function (e.g., clean the air, neutralize charge, etc.) during cleaning. Disclosed example systems include a brush, a first ring coupled to the brush, a second ring to engage the first ring, and a motor to actuate the second ring such that the second ring actuates the first ring.

[0014] Disclosed example automatic emitter point cleaning systems include: a fan configured to direct a stream of air through an air path; a point emitter configured to produce at least one of positive ions or negative ions within or proximate to the air path; a brush; a first gear coupled to the brush and configured to move the brush into contact with the point emitter; a second gear to engage the first gear; and a motor to actuate the second gear such that the second gear actuates the first gear to move the brush past the point emitter.

[0015] Some example systems further include a plurality of point emitters, in which the first gear is configured to move the brush into contact ones of the plurality of point emitters. In some examples, the plurality of point emitters are arranged in a substantially circular or polygonal arrangement. In some examples, the plurality of point emitters are arranged around an inner circumference of the first gear. In some examples, wherein the substantially circular or polygonal arrangement is substantially coaxial with the fan.

**[0016]** Some example systems further include a position detector configured to determine when the brush is in a predetermined position. In some examples, the motor is bidirectional. Some example systems further include a housing configured to couple the first gear, the second gear, the motor, and the fan. In some examples, the point emitter is configured to generate bipolar ions. In some examples, the motor is configured to actuate the second gear based on at least one of a determination by processing circuitry or an external signal. In some examples, the motor is configured to actuate the second gear to clear the point emitter while the plurality of point emitters are generating the positive ions or the negative ions. In some example systems, the second gear and the motor are outside of the air path.

**[0017]** Disclosed example automatic emitter point cleaning systems include a fan configured to direct a stream of air through an air path; a plurality of point emitters arranged in a circular or polygonal arrangement and configured to produce at least one of positive ions or negative ions within or proximate to the air path; a brush configured to physically clean the plurality of point emitters; and a motor configured to cause the brush to clean the plurality of point emitters via a gearing system having one or more gears.

**[0018]** In some examples, the plurality of point emitters are arranged around an inner circumference of a first gear of the gearing system. In some examples, the substantially circular or polygonal arrangement is substantially coaxial with the fan. In some examples, the motor is configured to drive the gearing system to move the brush in either direction.

**[0019]** Some example systems further include a housing configured to couple the gearing system, the plurality of point emitters, the motor, and the fan. In some examples, the point emitter is configured to generate bipolar ions. In some examples, the gearing system comprises three or more gears. In some examples, the motor is configured to cause the brush to clean the plurality of point emitters while the plurality of point emitters are generating the positive ions or the negative ions.

**[0020]** FIG. 1 is a view of an example DC corona ionizer 100. The ionizer 100 includes a housing 102 that holds a fan configured to blow a stream of air through an air path. As described in more detail below, the ionizer 100 includes ion emitters that emit positive and/or negative ions, and the fan blows the stream of air over the ion emitters, which results in a neutralization of electric charge that may be present in the air stream.

**[0021]** While examples disclosed below are described with reference to a DC corona ionizer, aspects of this disclosure may additionally or alternatively be used with an AC corona ionizer and/or a combination AC/DC corona ionizer.

**[0022]** FIG. 2 is a view of an interior of the example DC corona ionizer 100 of FIG. 1. FIG. 2 illustrates the example fan 202 and an automatic emitter point cleaner 204. The automatic emitter point cleaner 204 includes a unidirectional or bidirectional DC motor 206. The DC motor 206 may receive a drive signal and/or DC current to actuate the automatic emitter point cleaner 204. The example fan 202 includes a housing 208 that may be used to mount the fan 202 to the housing 102 and/or to attach the automatic emitter point cleaner 204 to the fan 202.

**[0023]** The example DC motor 206 may be a brushless DC motor or any other type of AC or DC motor.

**[0024]** FIG. 3 is a view of the example fan 202 of the DC corona ionizer 100 attached to automatic emitter point cleaner 204. The example ionizer 100 includes an emitter frame 302 that holds ion emitters 304 in place around an inner circumference of the emitter frame 302, within the air path of the fan 202.

**[0025]** The example automatic emitter point cleaner 204 includes a pinion gear 306 and a spur gear 308. The spur gear 308 holds an emitter point brush. The pinion gear 306 is driven by the DC motor 206 of FIG. 2, and interfaces with the spur gear 308 to drive the spur gear 308. The example spur gear 308 and the emitter frame 302 are attached to the housing 208 of the fan 202 such that the spur gear 308 is substantially coaxial with the fan and holds the emitter point brush in a same plane as the ion emitters 304.

**[0026]** FIG. 4 is another view of the example fan 202 and the automatic emitter point cleaner 204 of FIG. 3. FIG. 4 shows the fan 202, the housing 208, the example emitter frame 302, the emitters 304, the pinion gear 306, and the spur gear 308. An emitter point brush 402 is visible in FIG. 4.

**[0027]** FIG. 5 is another view of the example fan 202 and the automatic emitter point cleaner 204 of FIG. 3. In the view of FIG. 4, the emitter point brush 402 is shown in a known default, or home, position. The automatic emitter point cleaner 204 may include a position detector to identify (e.g., generate a signal) when the emitter point brush 402 is in the default position. The example emitter frame 302 includes a detection window 502, through which a visual-type position detector (e.g., a laser detector) may identify when the emitter point brush 402 is proximate the detection window 502. Other position detectors include, for example, Hall effect sensors, switches, and/or any other type of proximity sensor and/or circuitry.

**[0028]** As illustrated in FIGS. 4 and 5, the spur gear 308 and the brush 402 may make complete and/or partial rotations around the inner circumference of the emitter frame 302 in one or both

directions 504, 506. For example, the motor 206 of FIG. 2 drives the pinion gear 306 in one or both directions, which in turn causes rotation of the spur gear 308 and movement of the brush 402 around the inner circumference of the emitter frame 302. The example ionizer 100 may continue to run the fan 202 and generate ions via the emitters 304 while the brush 402 moves and cleans the emitters 304.

**[0029]** FIG. 6 is a view of example implementation of the automatic emitter point cleaner 204 of FIGS. 3-5. The structure of the example pinion gear 306, the example spur gear 308, and the example emitter point brush 402 are illustrated in FIG. 6.

**[0030]** The example automatic emitter point cleaner 204 of FIGS. 2-6 is motor driven (i.e., not centrifugal as in conventional systems). As a result, the automatic emitter point cleaner 204 may be activated to perform cleaning independently of the fan 202. For example, the automatic emitter point cleaner 204 may be activated with an internal timer (e.g., in a microprocessor controlling the fan 202 and/or emission of ions from the emitters 304) and/or from an external signal via an I/O connector.

**[0031]** While the examples of FIGS. 2-6 illustrate a two-gear implementation, other examples include three or more gears and/or a single-gear implementation in which the gear holding the emitter point brush is driven directly by a motor.

**[0032]** The example automatic emitter point cleaner 204 can be actuated in a single direction (e.g., clockwise or counterclockwise) and/or can be operated in both clockwise and counterclockwise to clean the emitters 304 in both directions.

**[0033]** The example automatic emitter point cleaner 204 may clean with any combination of full rotations and/or partial rotations. For example, a processor controlling the motor 206 may execute application-specific cleaning procedures including full rotations and/or partial rotations to perform particular types of cleaning.

**[0034]** The example automatic emitter point cleaner 204 may include position sensing to monitor the location of the emitter point brush 404. For example, the automatic emitter point cleaner 204 may determine when the brush assembly is in a default position at a start and/or finish of the cleaning process. In other examples, a processor controlling the motor 206 may track a location of the emitter point brush 404 along the inner circumference of the emitter frame 302 using a sensor (e.g., a gyroscope, a travel sensor coupled to the pinion gear 306 or the spur gear 308) and/or by tracking the speed and direction of operation of the motor 206.

**[0035]** As utilized herein, “and/or” means any one or more of the items in the list joined by “and/or”. As an example, “x and/or y” means any element of the three-element set {(x), (y), (x, y)}.

In other words, “x and/or y” means “one or both of x and y”. As another example, “x, y, and/or z” means any element of the seven-element set {(x), (y), (z), (x, y), (x, z), (y, z), (x, y, z)}. In other words, “x, y and/or z” means “one or more of x, y and z”. As utilized herein, the term “exemplary” means serving as a non-limiting example, instance, or illustration. As utilized herein, the terms “e.g.,” and “for example” set off lists of one or more non-limiting examples, instances, or illustrations.

**[0036]** While the present method and/or system has been described with reference to certain implementations, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted without departing from the scope of the present method and/or system. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the present disclosure without departing from its scope. For example, blocks and/or components of disclosed examples may be combined, divided, re-arranged, and/or otherwise modified. Therefore, it is intended that the present method and/or system not be limited to the particular implementations disclosed, but that the present method and/or system will include all implementations falling within the scope of the appended claims, both literally and under the doctrine of equivalents.

## CLAIMS

What is claimed is:

1. An automatic emitter point cleaning system, comprising:
  - a fan configured to direct a stream of air through an air path;
  - a point emitter configured to produce at least one of positive ions or negative ions within or proximate to the air path;
  - a brush;
  - a first gear coupled to the brush and configured to move the brush into contact with the point emitter;
  - a second gear to engage the first gear; and
  - a motor to actuate the second gear such that the second gear actuates the first gear to move the brush past the point emitter.
2. The system as defined in claim 1, further comprising a plurality of point emitters, the first gear configured to move the brush into contact ones of the plurality of point emitters.
3. The system as defined in claim 2, wherein the plurality of point emitters are arranged in a substantially circular or polygonal arrangement.
4. The system as defined in claim 3, wherein the plurality of point emitters are arranged around an inner circumference of the first gear.
5. The system as defined in claim 3 wherein the substantially circular or polygonal arrangement is substantially coaxial with the fan.
6. The system as defined in claim 1, further comprising a position detector configured to determine when the brush is in a predetermined position.
7. The system as defined in claim 1, wherein the motor is bidirectional.
8. The system as defined in claim 1, further comprising a housing configured to couple the first gear, the second gear, the motor, and the fan.
9. The system as defined in claim 1, wherein the point emitter is configured to generate bipolar ions.
10. The system as defined in claim 1, wherein the motor is configured to actuate the second gear based on at least one of a determination by processing circuitry or an external signal.
11. The system as defined in claim 1, wherein the motor is configured to actuate the second gear to clear the point emitter while the plurality of point emitters are generating the positive ions or the negative ions.

12. The system as defined in claim 1, wherein the second gear and the motor are outside of the air path.

13. An automatic emitter point cleaning system, comprising:  
a fan configured to direct a stream of air through an air path;  
a plurality of point emitters arranged in a circular or polygonal arrangement and configured to produce at least one of positive ions or negative ions within or proximate to the air path;  
a brush configured to physically clean the plurality of point emitters; and  
a motor configured to cause the brush to clean the plurality of point emitters via a gearing system having one or more gears.

14. The system as defined in claim 13, wherein the plurality of point emitters are arranged around an inner circumference of a first gear of the gearing system.

15. The system as defined in claim 13, wherein the substantially circular or polygonal arrangement is substantially coaxial with the fan.

16. The system as defined in claim 13, wherein the motor is configured to drive the gearing system to move the brush in either direction.

17. The system as defined in claim 13, further comprising a housing configured to couple the gearing system, the plurality of point emitters, the motor, and the fan.

18. The system as defined in claim 13, wherein the point emitter is configured to generate bipolar ions.

19. The system as defined in claim 13, wherein the gearing system comprises three or more gears.

20. The system as defined in claim 13, wherein the motor is configured to cause the brush to clean the plurality of point emitters while the plurality of point emitters are generating the positive ions or the negative ions.

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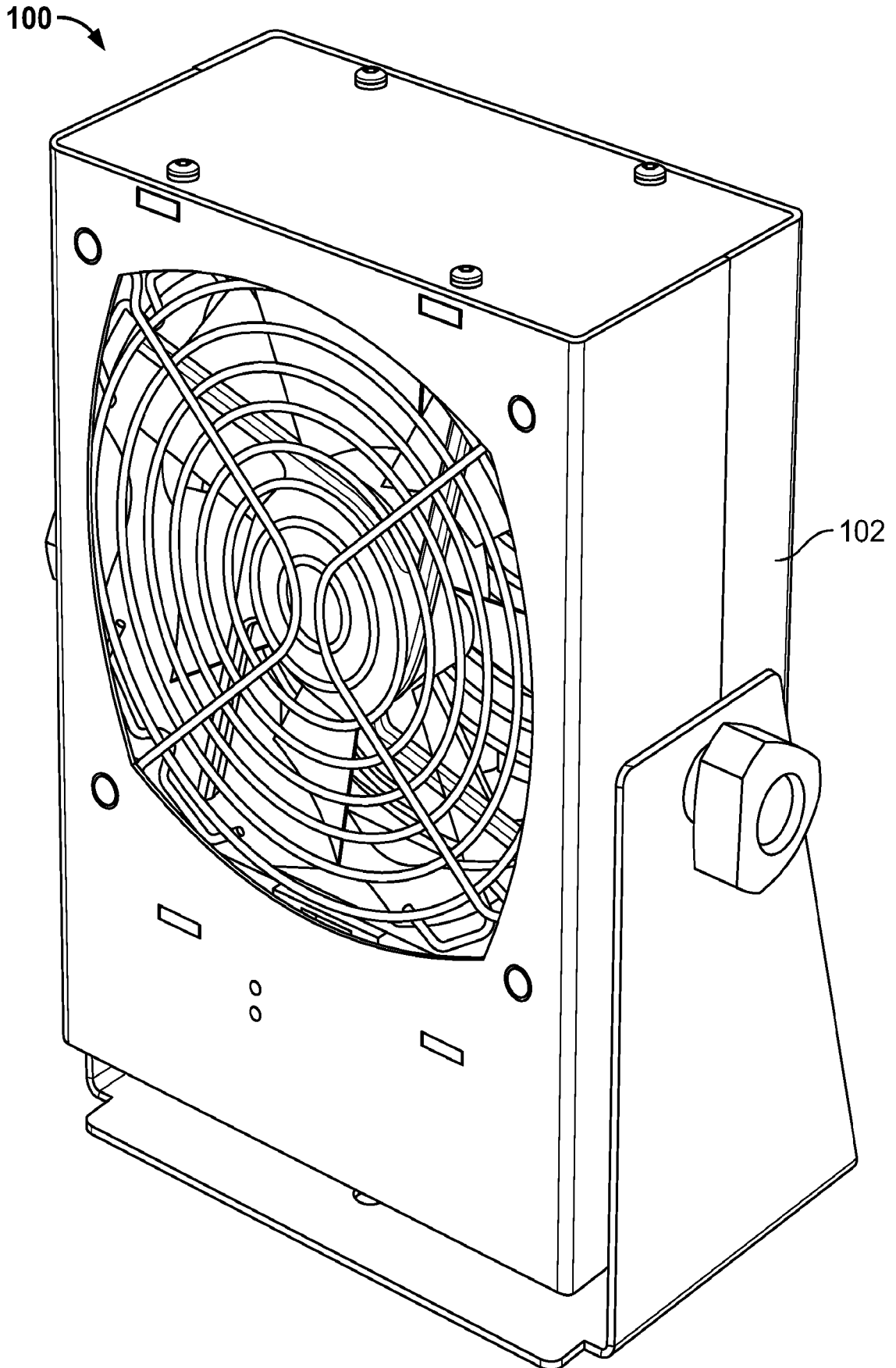


FIG. 1

2/6

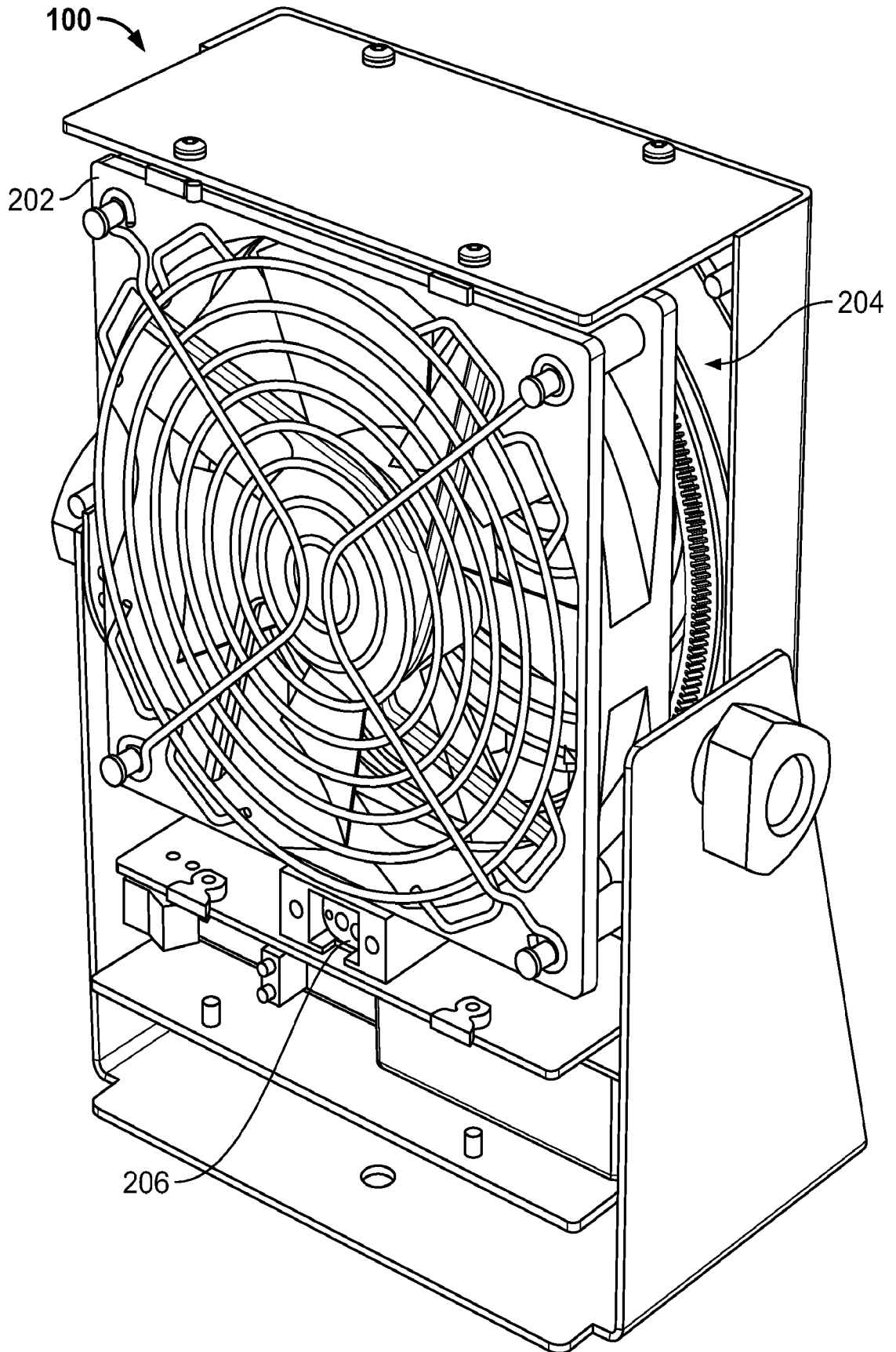


FIG. 2

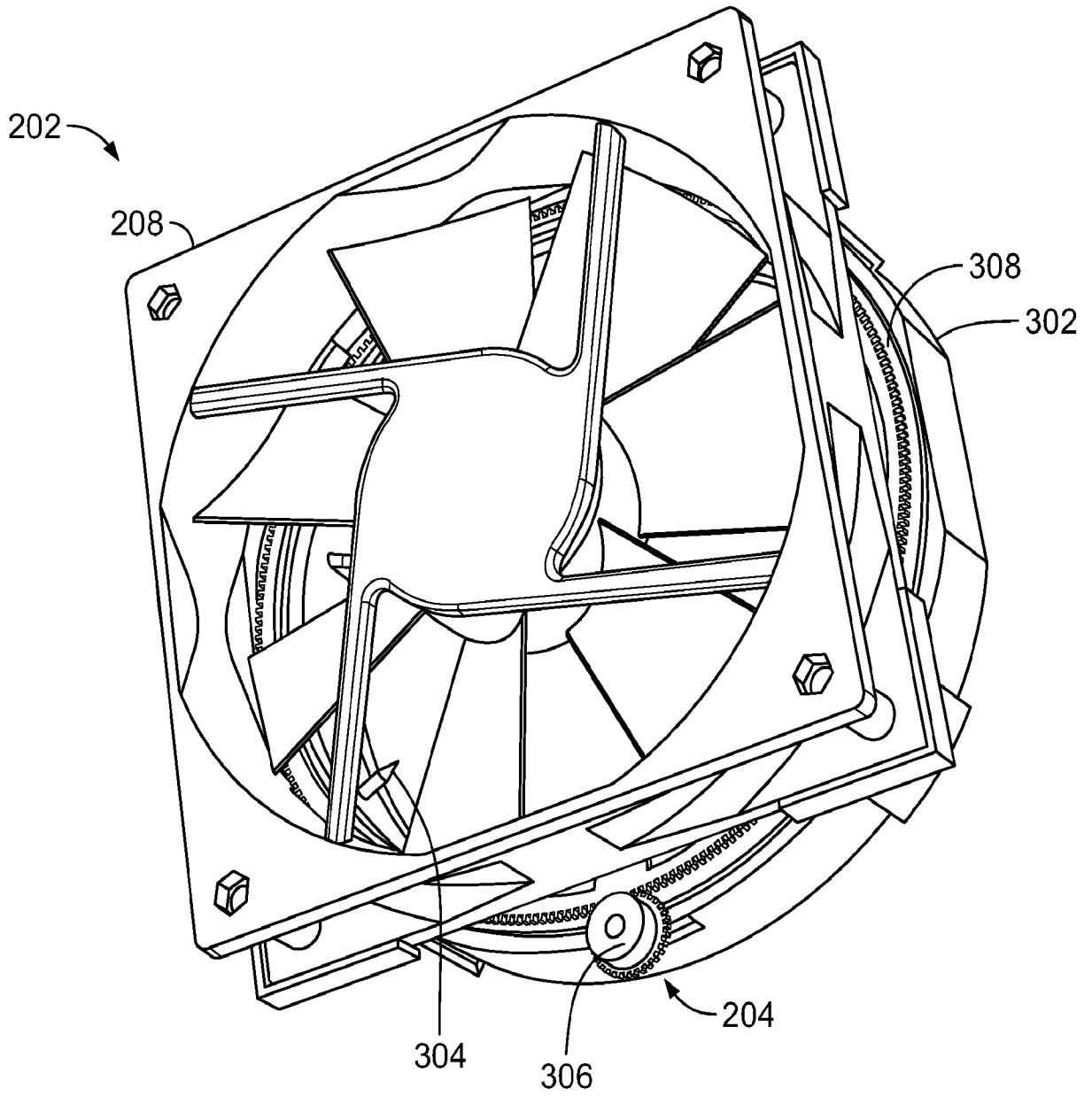


FIG. 3

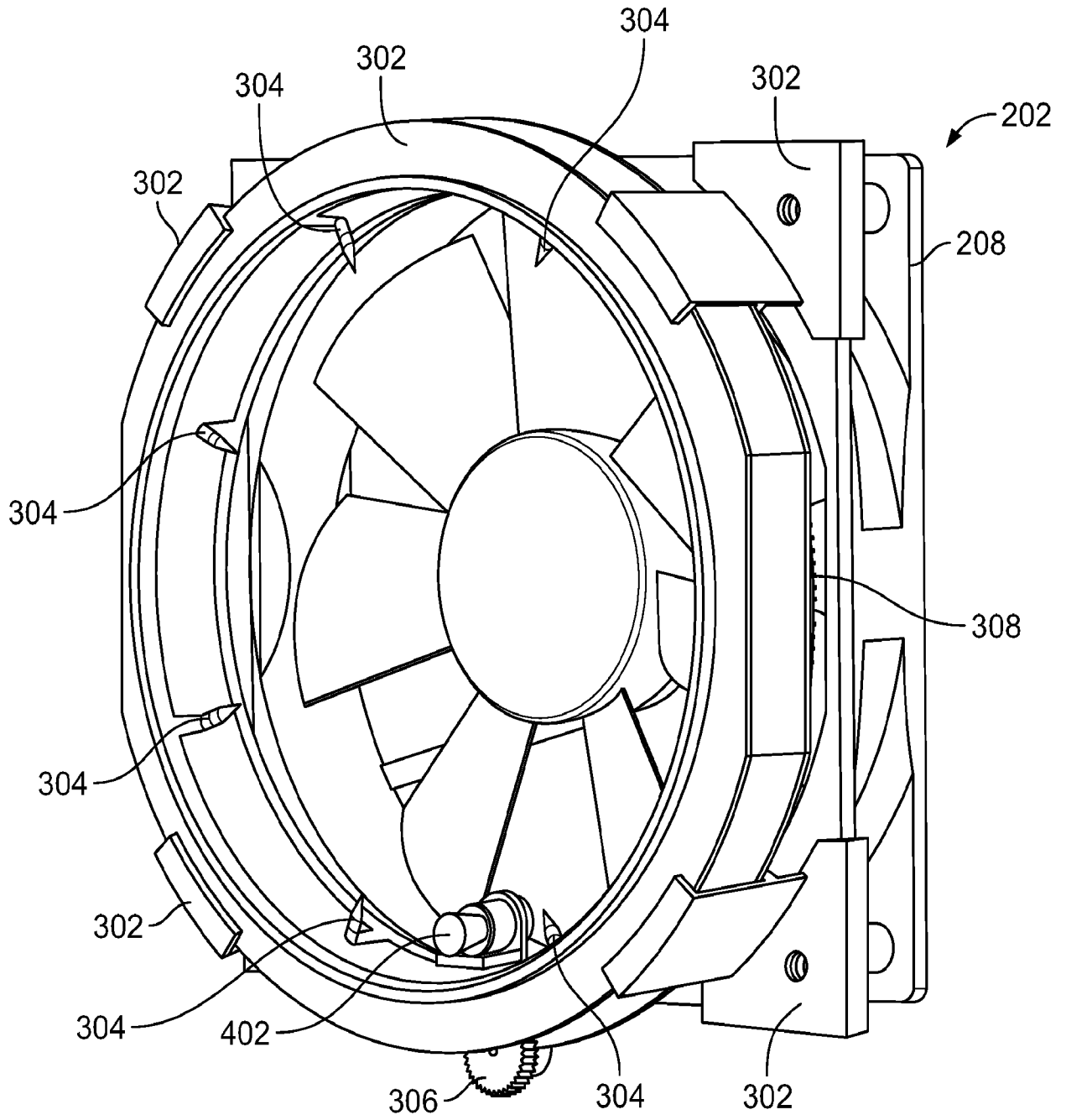


FIG. 4

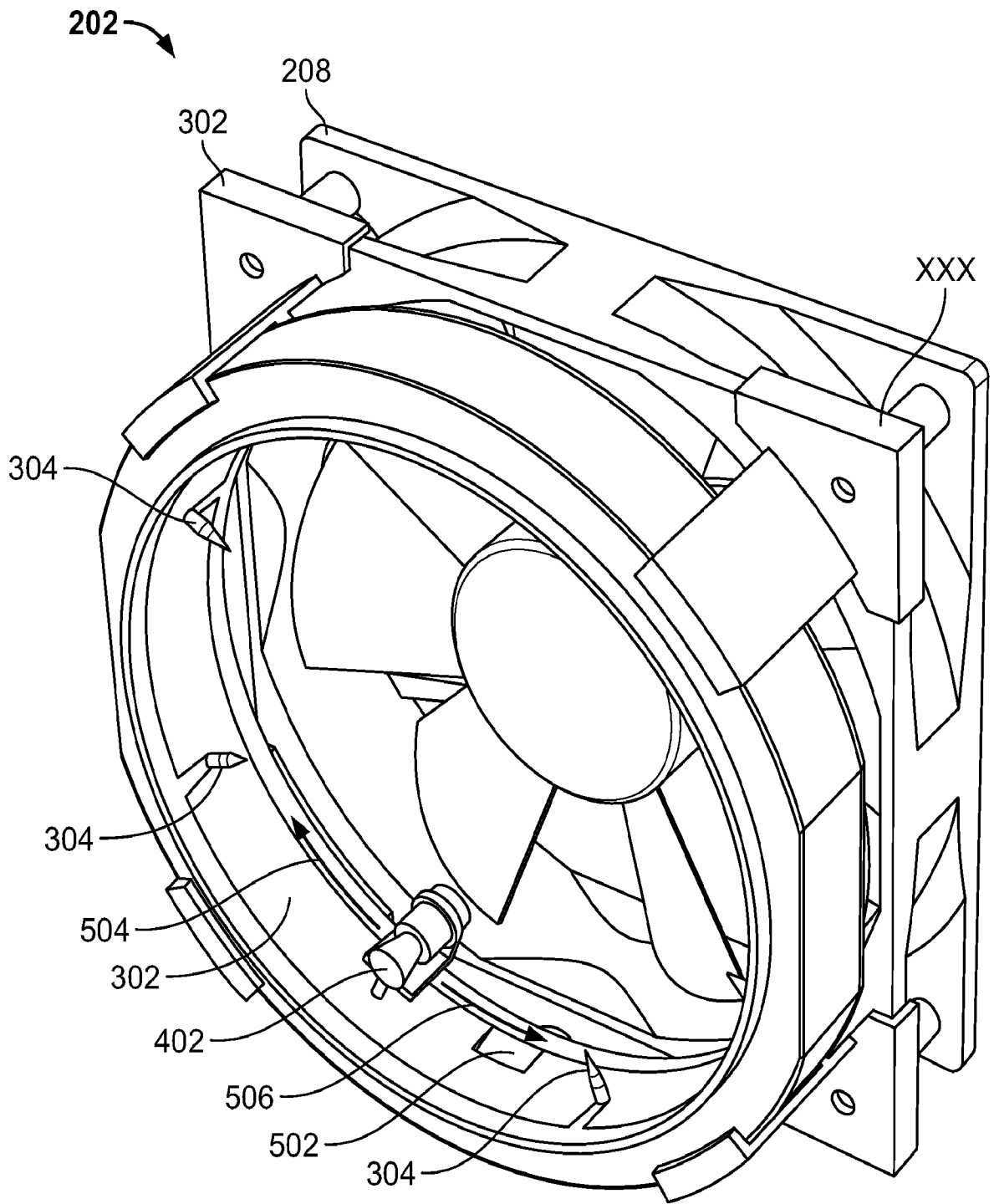


FIG. 5

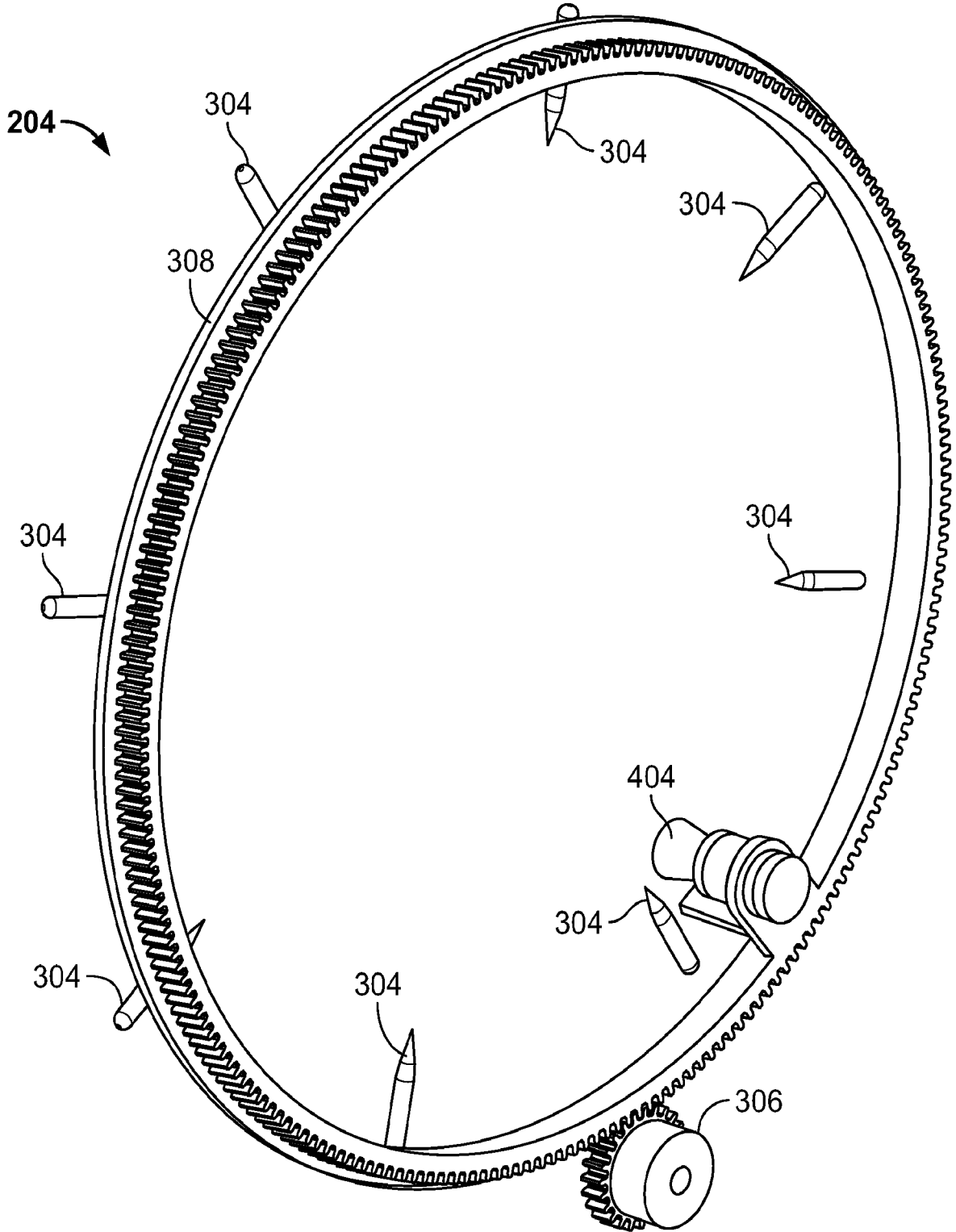


FIG. 6

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/US2018/023920

**A. CLASSIFICATION OF SUBJECT MATTER**  
 INV. H01T19/04 H01T23/00 H05F3/04 H05F3/06  
 ADD.  
 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)  
 H01T H05F

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 2015 0072063 A (DONG IL TECHNOLOGY LTD [KR]) 29 June 2015 (2015-06-29)	1-18,20
Y	abstract paragraph [0013] paragraphs [0021], [0027]; figures 4b, 5 figures 1-4a	19
Y	----- US 5 493 383 A (POZNIAKAS ROBERT S [US] ET AL) 20 February 1996 (1996-02-20)	19
A	figures 1,2 -----	13

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
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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

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Date of the actual completion of the international search  12 June 2018	Date of mailing of the international search report  20/06/2018
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2018/023920

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 20150072063	A	29-06-2015	NONE
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US 5493383	A	20-02-1996	NONE
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