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Remarks:
This application was filed on 18.09.2024 as a divisional application to the application mentioned under INID code 62.

(54) AUTOMATIC SWIMMING POOL CLEANERS AND COMPONENTS THEREOF

(57) An electrolyte composition for a lithium ion battery. The composition including: (a) 5-35wt% of lithium salt (b) 2-10wt% of additive; and (c) 55-93wt% solvent; wherein the lithium salt comprises; (ai) a salt selected from lithium 2-trifluoromethyl-4,5-dicyanoimidazolide, lithium difluoro(oxalato)borate, lithium bis(oxalato) borate and lithium tetrafluroborate; (aii) and optionally, a co-salt selected from lithium bis(trifluoromethanesulfonyl)imide and/or lithium bis(fluorosulfonyl)imide; wherein the molar ratio of the salt to co-salt is between 100:0 and 5:95; with the proviso that the composition does not comprise lithium bis(fluorosulfonyl)imide alongside lithium difluoro(oxalato)borate or lithium tetrafluroborate; and wherein the additive comprises vinylene carbonate and optionally, fluoroeth

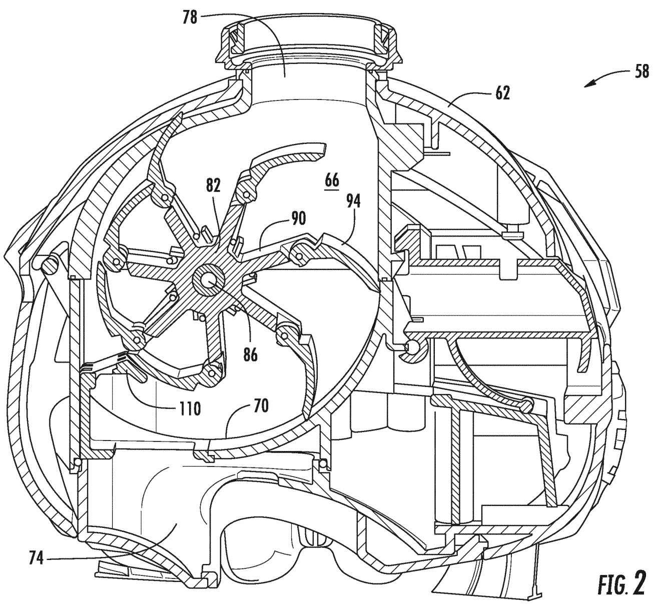

FIG. 2

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Description

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Application No. 62/837,017, filed on April 22, 2019, and titled "Automatic Swimming Pool Cleaners and Components Thereof".

FIELD OF THE INVENTION

[0002] This invention relates to automatic swimming pool cleaners.

BACKGROUND

[0003] Commonly-owned U.S. Patent No. 9,611,668 to van der Meijden, et al. describes components and aspects of certain automatic pool cleaners (APCs). Various embodiments of these APCs may include one or more bladed scrubbers configured to rotate about shafts oriented generally perpendicularly to a surface to be cleaned. Rotation of the scrubbers may produce downforce biasing a cleaner toward the to-be-cleaned surface. It also may create vortex action tending to induce debris-laden water to flow toward an inlet of the cleaner for filtering. Blades of the APCs may be "semi-rigid" as described in the van der Meijden patent so as to accommodate passage of large debris into the inlet with minimal or no blockage.

[0004] Disclosed in the van der Meijden patent is that exemplary APCs may utilize a fluid-powered motor of the type detailed in commonly-owned U.S. Patent Application Publication No. 2010/0119358 of van der Meijden, et al. The motor may include rotating blades or paddles configured to interact with water flowing therethrough. As disclosed in the van der Meijden application, the paddles may have distal edges which are "locally flexible to facilitate passage of debris".

[0005] Referenced in the van der Meijden application is U.S. Patent No. 6,292,970 to Rief, et al. APCs of the Rief patent include a turbine housing defining a waterflow chamber in which a rotor is positioned. Also included are a series of vanes pivotally connected to the rotor. Water interacting with the vanes rotates the rotor in one direction (clockwise as illustrated in the Rief patent), with the vanes pivoting when encountering "debris of substantial size" to allow the debris to pass through the housing for collection.

SUMMARY

[0006] Automatic swimming pool cleaners (APCs) are detailed herein. The APCs according to the invention are defined by the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The specification makes reference to the following appended figures, in which use of like reference numerals in different figures is intended to illustrate like or analogous components.

FIG. 1 is a perspective view of an exemplary automatic swimming pool cleaners (APC) of the present invention, shown with the cover in the open position.

FIG. 2 is a cut-away side view of components of the APC of FIG. 1.

FIG. 3A is a top perspective view of portions of the APC of FIG. 1, shown with the cover removed for clarity and with the upper portion in the open position.

FIG. 3B is a perspective view of the core of the APC of FIG. 1.

FIG. 3C is another top perspective view of portions of the APC of FIG. 1, shown with the cover removed for clarity and with the upper portion in the open position.

FIG. 3D is a perspective view of the upper portion of the APC of FIG. 1.

FIG. 3E is a cut-away view illustrating how the core is retained within the APC of FIG. 1 while the cover is in the closed position.

FIG. 3F is a perspective view of portions of the APC of FIG. 1, shown with the cover removed for clarity, the upper portion in the open position and the core partially removed.

FIGS. 4A-4C are partial, side views illustrating a seal of the APC of FIG. 1 in various positions.

FIG. 5A is a perspective front view of a vane of the APC of FIG. 1.

FIG. 5B is a perspective side view of the vane of FIG. 5A.

FIG. 5C is a side view of the vane of FIG. 5A.

FIG. 5D is a partial, cut-away view of the vanes of FIG. 5A assembled in the APC of FIG. 1.

FIG. 5E is a perspective, partial view of a vane of FIG. 5A assembled in the APC of FIG. 1.

FIG. 6A is a perspective view of a pin of the APC of FIG. 1.

FIGS. 6B-6F are perspective, partial views of the pin of FIG. 6A assembled in the APC of FIG. 1.

FIGS. 7A-7J conceptually detail various features of the vane of FIG. 5A.

FIG. 8 is a perspective view of another exemplary APC of the present invention, shown with the cover in the closed position.

FIG. 9 is a side view of the APC of FIG. 8, shown with the cover in the closed position.

FIG. 10 is a perspective of the APC of FIG. 8, shown with the cover in the open position.

FIG. 11 is a perspective of the APC of FIG. 8, shown with the cover in the open position and with the core removed.

FIG. 12 is a cross-sectional view of components of the APC of FIG. 8.

FIG. 13 is a perspective view of the core of the APC of FIG. 8.

FIG. 14A is a perspective view of a pin of the APC of FIG. 8.

FIGS. 14B is a partial, cross-sectional view of the core of FIG. 13 assembled with the APC of FIG. 8.

FIG. 15 is a side perspective view of a portion of the track of the APC of FIG. 8.

FIG. 16 is a top perspective view of a portion of the track of the APC of FIG. 8.

DETAILED DESCRIPTION

[0008] Avoiding clogging of APCs by large debris remains a considerable challenge to designers of these devices. Thus, although both the van der Meijden and Rief patents identify solutions to this challenge, developing additional solutions may be advantageous. The present examples seek to accomplish this in multiple innovative manners. The examples also include facilitating unclogging of APCs should clogging nevertheless occur.

[0009] FIG. 1 illustrates an exemplary APC 10 incorporating aspects of the inventions. Cleaner 10 may be similar to APCs shown or described in the van der Meijden patent, although such similarity is not necessary. Cleaner 10 may include at least body 14 and motive assembly 18, with motive assembly 18 comprising (closed-loop) track 22 having external and internal surfaces 26 and 30, respectively. Motive assembly 18 also may include pulley or drive wheel 34 and undriven wheels 38 and 42. A motive assembly 18 typically will be present at each of the left and right sides of cleaner 10.

[0010] As depicted, body 14 includes chamber 46 (see FIG. 3A) accessible at least via opening 50. Additionally illustrated in FIG. 1 is cover 54. Cover 54 preferably abuts opening 50 during operation of cleaner 10, closing access to chamber 46 from above. By contrast, FIG. 1 shows cover 54 having been moved relative to opening 50 so as to expose chamber 46 from above. In this position, cover 54 allows access to chamber 46 and to fluid-powered motor 58 positioned at least partially therein.

[0011] Cover 54 may attach to body 14 in any appropriate manner. FIG. 1, for example, illustrates cover 54 connecting to body 14 using a pin or hinges so that the cover 54 may pivot to and from the open position shown in FIG. 1. When cover 54 pivots to the closed position abutting opening 50, a latch, snaps, or any other suitable fasteners may be used to retain the cover 54 in that position during operation of APC 10. Preferably (although not necessarily), a user may simply push a button to unfasten cover 54 from body 14 and thus allow cover 54 to pivot under manual or mechanical force. Persons skilled in the art will recognize that other methods of causing movement of cover 54 manually, without using tools, may be employed instead.

[0012] At least some versions of cleaner 10 will connect, via at least one hose, to an inlet of a pump of a water-circulation system of a swimming pool. These versions are known as "suction-side" cleaners because of their connection to a pump inlet. When the system is operating, the pump evacuates cleaner 10, drawing debris-laden water from the pool through an inlet of body 14 into the hose for eventual travel to a filter to separate and remove debris from the water. Alternatively, versions of cleaner 10 may be "pressure-side" cleaners, connecting directly or indirectly to an outlet of such a pump. In these APCs, pressurized water exiting the pump is used, employing the Venturi principle, to create a low-pressure area configured to draw debris-laden water into the inlet of body 14.

[0013] In either event, water drawn into body 14 additionally may operate fluid-powered motor 58. In this respect, motor 58 may constitute a turbine resembling that of the Rief patent. As shown in FIG. 2, motor 58 may include housing 62 defining interior vacuum chamber 66 and having interior chamber wall 70, inlet port 74, and outlet port 78. Rotor 82 may be mounted within housing 62 on shaft 86 and configured to rotate about an axis coincident with the shaft 86. Inlet port 74 preferably is near the inlet of body 14 so that water entering that inlet may pass generally unobstructed to the inlet port 74. Similarly, outlet port 78 preferably is, or is near, an outlet of cleaner 10 to which a hose may be connected directly or indirectly.

[0014] Extending radially from an outer circumference of rotor 82 are spokes 90. Seven such spokes 90 are illustrated as so extending in FIG. 2, with spokes 90 being spaced uniformly along the outer circumference. More or fewer spokes 90 may be employed, however, and their spacing need not necessarily be uniform. Pivotally attached to each spoke 90 is a vane 94, with vanes 94 beneficially pivoting about axes parallel to that about which rotor 82 rotates. Collectively, at least rotor 82, shaft 86, spokes 90, and vanes 94 may be considered to constitute core 98 of motor 58. In some embodiments, gears 100 (see FIG. 3B) additionally may be part of core 98. Gears 100 may, directly or indirectly, help drive the drive wheels 34.

[0015] Housing 62 may be formed of more than one part. FIG. 1 illustrates upper portion 102 of an exemplary housing 62 being attached to, or otherwise configured to move with, cover 54, while lower portion 106 (see FIG. 3F) remains positioned within chamber 46 of body 14. In this manner, the simple act of opening cover 54 exposes core 98. This result is particularly useful when debris has impeded or obstructed operation of motor 58, as exposing core 98 may facilitate removal of that debris.

[0016] Equally as significant, core 98 may be configured within chamber 46 so that it is manually removable as a unit for cleaning, maintenance, repair, replacement, troubleshooting, or otherwise. Hence, merely by opening cover 54, core 98 is both exposed and available for removal from cleaner 10. Especially valuable is that no tool is required for any of these actions--manual manipulation of the components is sufficient.

[0017] FIGS. 3A-F illustrate and describe additional features of motor 58 and its interaction with, e.g., body 14. FIGS. 3A and C-F depict upper portion 102, which may form an upper fluid boundary during normal operation of cleaner 10. When cover 54 is latched, upper portion 102 also holds motor 58 in position within lower portion 106, which may form a lower fluid boundary during operation of the APC 10.

[0018] FIGS. 2 and 4A-C depict seal 110 which may be present within interior vacuum chamber 66 of motor 58. The existence of seal 110 helps bias water flow from inlet port 74 toward the right side of vacuum chamber 66 (as shown in FIG. 2) and promotes efficiency of engine operation. Generally, therefore, debris-laden water flows, and rotor 82 rotates, generally counterclockwise in FIG. 2.

[0019] Unlike conventional rigid seals, seal 110 is flexible in nature. In particular, seal 110 may flex downward in FIG. 2 if necessary to allow passage of debris. Thus, seal 110 aids motor 58 in avoiding seizures by allowing debris to re-circulate within vacuum chamber 66.

[0020] FIG. 4A shows a vane 94 in a normal sealed position against seal 110. Water pressure across the vane 94 helps retain this sealed relationship, and housing 62 may include rigid retention features 114 (see FIG. 4B) preventing seal 110 from extending upward in FIG. 2 beyond a particular point. By contrast, seal 110 may flex downward to accommodate extension of vane 94 (see FIG. 4B) as well as to allow passage of debris (see FIG. 4C). After debris passes, seal 110 may return to its normal position, as shown in FIG. 4A.

[0021] FIGS. 5A-E depict structural features of a vane 94. Vane 94 may include a proximal portion 116 into which an elongated hole 118 is formed so as to receive a connector such as pin 222 (see FIG. 6A). In this manner, vane 94 may connect to a corresponding spoke 90. Vane 94 also may include a distal portion 126 having an edge 130 as well as side edges 131 and 132. By tapering edges 131 and 132, the likelihood that debris will be trapped between a vane 94 and interior chamber wall 70 may be reduced without increasing leakage between the vane 94 and the wall 70.

[0022] Shown in FIG. 5D is that edge 130 may comprise leading portion 134 and lagging portion 138. Preferably, leading portion 134 is configured so as to be perpendicular to the direction of motion of its vane 94, while lagging portion 138 has an angled surface. The perpendicular nature of leading portion 134 facilitates its moving debris while not channeling the debris toward any gap between components. The angled surface of lagging portion 138, by contrast, aids debris located between components to move out of any such gap.

[0023] FIGS. 6A-F illustrate pin 222. As especially visible in FIG. 6A, pin 222 may comprise a generally-straight first section 226 and a generally-curved second section 230. First section 226 is sized and shaped so as to be received by hole 118 of a vane 94 and forms an axis about which vane 94 can pivot. Second section 230 bears against surface protrusion 234 of rotor 82 (see, e.g., FIGS. 6C and 6F), being retained in that position by rise 236 of rotor 82. Thus, to attach a vane 94, one may insert first section 226 into hole 118, deform second section 230 so that it may pass over rise 236, and then allow second section 230 to relax so that it bears against surface protrusion 234.

[0024] No adhesive hence need be used to retain pin 222 in appropriate position. Likewise, no other component of cleaner 10 need be deformed to allow placement of the pin 222. Accordingly, in use, pin 222 may function as a pivot axis for a corresponding vane 94 while restricting any translation of the vane 94. Moreover, the attachment process is reversible if necessary at least in part by re-deforming pin 222 and passing it back over rise 236.

[0025] FIGS. 7A-J conceptually detail additional features of vanes 94. Whenever an APC includes gaps (around hinges between components, for example), debris may settle in or be forced into the gaps and potentially impede proper exercise of hinges or other moveable components. Historically, gaps sizes have been fixed prior to manufacturing production components: if made too large, more debris may settle in them; if made smaller, increased fabrication precision, leading to increased manufacturing costs, may occur.

[0026] Accordingly, the present invention seeks to provide dynamic gap sizing that may both increase and decrease during operation of cleaner 10. FIGS. 7A-J illustrate this concept, with FIG. 7A showing vane 94 in a sealed position with respect to spoke 90. FIGS. 7B-C illustrate vane 94 separating slightly from spoke 90, allowing release of accumulated debris. FIGS. 7D-E depict vane 94 returning to its sealed position relative to spoke 90. Similar functionality is illustrated in FIGS. 7F-I. FIG. 7J, finally, illustrates core 98 with vanes 94 in various positions.

[0027] FIG. 8 illustrates another exemplary APC 1000 incorporating aspects of the inventions. Cleaner 1000 may be similar to APC 10 shown in the previous figures, although such similarity is not necessary. Cleaner 1000 may include at least body 1014 and motive assembly 1018, with motive assembly 1018 comprising (closed-loop) track 1022 having external and internal surfaces 1026 and 1030, respectively. Motive assembly 1018 also may include pulley or drive wheel 1034 and undriven wheels 1038 and 1042.

[0028] Drive wheel 1034 may include an oversized outer flange 1036 that helps retain track 1022 in position and prevent it from slipping laterally off the motive assembly 1018. More specifically, outer flange 1036 may be configured so it extends beyond external surface 1026 of track 1022 to serve as a stop against which track 1022 can abut, restricting lateral movement of track 1022. A motive assembly 1018 typically will be present at each of the left and right sides of cleaner 1000.

[0029] As shown in FIG. 15, track 1022 includes tread 1023 on external surface 1026 and teeth 1028 on internal surface 1030. The pattern of tread 1023 is such that tread 1023 is in-line with each tooth 1028. In this way, an axis 1037 of each tooth 1028 intersects at least a portion of tread 1023. This tooth 1028 to tread 1023 alignment leaves thin sections 1024 (corresponding to gaps between the teeth 1028 and gaps between the tread 1023), allowing track 1022 to remain flexible. Moreover, as shown in FIG. 16, track 1022 includes bridges 1032 that link the tread 1023. These bridges 1032 help prevent track 1022 from stretching. Moreover, the vertical position of each bridge 1032 alternates between each tread 1023, such that adjacent bridges 1032 are vertically offset from one another. Offsetting bridges 1032 further helps track 1022 remain flexible.

[0030] As depicted, for example in FIG. 10, body 1014 includes chamber 1046 accessible at least via opening 1050. Additionally illustrated in FIGS. 8-10 is cover 1054. Cover 1054 preferably abuts opening 1050 during operation of cleaner 1000, closing access to chamber 1046 from above. By contrast, FIG. 10 shows cover 1054 having been moved relative to opening 1050 into an open position so as to expose chamber 1046 from above. In this position, cover 1054 allows access to chamber 1046 and to fluid-powered motor 1058 positioned at least partially therein.

[0031] As with cover 54, cover 1054 may attach to body 1014 in any appropriate manner, including those described with respect to the cleaner 10 of FIG. 1. Cleaner 1000 also includes a handle 1060, which can help facilitate carrying and manually moving cleaner 1000. Cleaner 1000 further includes scrub brushes 1044 for scrubbing the bottom of the swimming pool or other liquid-containing body. Any number of scrub brushes 1044 may be included and they make take any suitable form.

[0032] Like cleaner 10, cleaner 1000 may be configured as a suction-side cleaner or a pressure-side cleaner. In either case, water drawn into body 1014 additionally may operate fluid-powered motor 1058. As shown in FIG. 12, motor 1058 may include housing 1062 defining interior vacuum chamber 1066 and having interior chamber wall 1070, inlet port 1074, and outlet port 1078. Rotor 1082 may be mounted within housing 1062 on shaft 1086 and configured to rotate about an axis coincident with the shaft 1086. Inlet port 1074 preferably is near the inlet of body 1014 so that water entering that inlet may pass generally unobstructed to the inlet port 1074. Similarly, outlet port 1078 preferably is, or is near, an outlet of cleaner 1000 to which a hose may be connected directly or indirectly.

[0033] Extending radially from an outer circumference of rotor 1082 are spokes 1090. Seven such spokes 1090 are illustrated as so extending in FIG. 12, with spokes 1090 being spaced uniformly along the outer circumference. More or fewer spokes 1090 may be employed, however, and their spacing need not necessarily be uniform. Pivotally attached to each spoke 90 is a vane 1094, with vanes 1094 pivoting about axes parallel to that about which rotor 1082 rotates. Collectively, at least rotor 1082, shaft 1086, spokes 1090, and vanes 1094 may be considered to constitute core 1098 (see FIGS. 11 and 13) of motor 1058. In some embodiments, gears 1100 (see FIG. 13) additionally may be part of core 1098. Gears 1100 may, directly or indirectly, help drive the drive wheels 1034.

[0034] Like housing 62, housing 1062 may be formed of more than one part if desired, although it need not be. Also like core 98, core 1098 may be configured within chamber 1046 so that it is manually removable as a unit, as shown in FIG. 11, for cleaning, maintenance, repair, replacement, troubleshooting, or otherwise. Hence, merely by opening cover 1054, core 1098 can be removed without obstruction from cleaner 1000 without requiring use of a tool, as shown in FIG. 11.

[0035] As shown in FIG. 13, some or all of vanes 1094 of core 1098 may include a domed portion 1102 so a face of vane 1094 is convex. In some cases, domed portion 1102 extends from a distal end to a proximal end of each vane 1094 to substantially cover face of vane 1094. As the motor 1058 turns (for example, in a counterclockwise direction relative to FIG. 12), debris that does not exit through outlet port 1078 may nest in cavity 1104 (see FIG. 12) created between housing 1062 and domed portion 1102 of vane 1094. This cavity 1104 allows the debris to circulate through the motor 1058 again without causing the motor 1058 to stall. As shown in FIG. 12, cleaner 1000 may not have a seal such as seal 110 described with respect to cleaner 10.

[0036] FIG. 14A illustrates pin 1222, which may comprise generally-straight first section 1226 and generally-straight second section 1230 separated by angle 1232. First section 1226 is sized and shaped so as to be received by a hole (such as hole 118 of vane 94) within vane 1094 and form an axis about which vane 1094 can pivot. Pin 1222 is trapped from lateral movement, as shown in the cross-sectional view of core 1098 in FIG. 14B, by the mating parts around it. No adhesive hence need be used to retain pin 1222 in appropriate position. Likewise, no other component of cleaner 1000 need be deformed to allow placement of the pin 1222. Accordingly, in use pin 1222 may function as a pivot axis for a corresponding vane 1094 while restricting any translation of the vane 1094.

[0037] References to "pools" and "swimming pools" herein may also refer to spas or other water containing vessels used for recreation or therapy and for which cleaning is needed or desired.

[0038] The foregoing is provided for purposes of illustrating, explaining, and describing embodiments of the present invention. Modifications and adaptations to these embodiments, including combinations of various features, will be apparent to those skilled in the art and may be made without departing from the scope or spirit of the invention. For avoidance of doubt, any combination of features not physically impossible or expressly identified as non-combinable herein may be within the scope of the invention.

[0039] The following embodiments (Embodiments 1 to 23) are parts of this description relating to the invention.

[0040] Embodiment 1. A fluid-powered motor for an automatic swimming pool cleaner, the fluid-powered motor comprising:

a core including a rotor;
at least one spoke extending from the rotor; and
a vane moveably attached to the at least one spoke.

[0041] Embodiment 2. The fluid-powered motor as recited in embodiment 1, further comprising a seal, wherein the seal is (i) configured to move from a sealed position in a first direction to create space for passage of debris between the seal and the vane and (ii) prevented from moving from the sealed position in a second direction opposite the first direction.

[0042] Embodiment 3. The fluid-powered motor as recited in embodiment 1, wherein the vane comprises at least one side portion with a tapered edge.

[0043] Embodiment 4. The fluid-powered motor as recited in embodiment 1, wherein a proximal portion of the vane is connected to the at least one spoke and wherein the vane comprises a distal portion, the distal portion comprising:

a leading portion perpendicular to a direction of motion of the vane; and
a lagging portion having an angled surface.

[0044] Embodiment 5. The fluid-powered motor as recited in embodiment 1, further comprising a pin connecting the vane to the at least one spoke, wherein the vane is rotatable about an axis of the pin.

[0045] Embodiment 6. The fluid-powered motor as recited in embodiment 5, wherein the pin comprises a generally straight first section and a generally-curved second section.

[0046] Embodiment 7. The fluid-powered motor as recited in embodiment 1, wherein the vane comprises a domed portion.

[0047] Embodiment 8. The fluid-powered motor as recited in embodiment 7, wherein the domed portion extends across a face of the vane from a distal end to a proximal end of the face.

[0048] Embodiment 9. The fluid-powered motor as recited in embodiment 1, wherein the vane is connected to the at least one spoke in a manner permitting a gap to form between the vane and the at least one spoke at first times during operation and for the vane and the at least one spoke to seal against each other at second times during operation.

[0049] Embodiment 10. The fluid-powered motor as recited in embodiment 1, wherein the core is removable from a body of the automatic swimming pool cleaner as a module without using any tool.

[0050] Embodiment 11. An automatic swimming pool cleaner comprising a motive assembly, the motive assembly comprising a drive wheel and a track, the track comprising an external surface and an internal surface, wherein:

the external surface of the track comprises tread,
the internal surface of the track comprises teeth, and
an axis of each tooth of the teeth intersects at least a portion of the tread.

[0051] Embodiment 12. The automatic swimming pool cleaner as recited in embodiment 11, wherein gaps between the tread vertically align with gaps between the teeth to create flexible sections of the track.

[0052] Embodiment 13. The automatic swimming pool cleaner as recited in embodiment 11, wherein the external surface of the track further comprises a plurality of bridges that connect the tread and extend along gaps between the tread, wherein adjacent bridges of the plurality of bridges are vertically offset from one another.

[0053] Embodiment 14. The automatic swimming pool cleaner as recited in embodiment 11, wherein the drive wheel of the motive assembly comprises a flange that extends beyond the external surface of the track to serve as a stop that restricts lateral movement of the track beyond the flange.

[0054] Embodiment 15. An automatic swimming pool cleaner comprising:

a body; and
a fluid-powered motor comprising:

a core including a rotor;
a plurality of spokes extending from the rotor;

and
a plurality of vanes, wherein each of the plurality of vanes is rotatably attached to one of the plurality of spokes,
wherein the core is removable from the body as a module without using any tool.

[0055] Embodiment 16. The automatic swimming pool cleaner as recited in embodiment 15, further comprising a pin connecting each of the plurality of vanes to one of the plurality of spokes, wherein each of the plurality of vanes is rotatable about an axis of the pin.

[0056] Embodiment 17. The automatic swimming pool cleaner as recited in embodiment 15, wherein at least one of the vanes of the plurality of vanes comprises a domed portion and, during operation of the fluid-powered motor, a cavity is formed between a housing of the fluid-powered motor and the domed portion.

[0057] Embodiment 18. The automatic swimming pool cleaner as recited in embodiment 17, wherein the domed portion extends across a face of the at least one vane from a distal end to a proximal end of the face.

[0058] Embodiment 19. The automatic swimming pool cleaner as recited in embodiment 15, further comprising a motive assembly comprising a drive wheel and a track, the track comprising an external surface and an internal surface, wherein:

the external surface of the track comprises tread;
the internal surface of the track comprises teeth; and
an axis of each tooth of the teeth intersects at least a portion of the tread.

[0059] Embodiment 20. The automatic swimming pool cleaner as recited in embodiment 15, further comprising a motive assembly comprising a drive wheel and a track, the track comprising an external surface and an internal surface, wherein:

the external surface of the track comprises tread;
the internal surface of the track comprises teeth; and
gaps between the tread vertically align with gaps between the teeth to create flexible sections of the track.

[0060] Embodiment 21. The automatic swimming pool cleaner as recited in embodiment 15, further comprising a motive assembly comprising a drive wheel and a track, the track comprising an external surface and an internal surface, wherein:
the external surface of the track comprises tread and a plurality of bridges that connect the tread, wherein adjacent bridges of the plurality of bridges are vertically offset from one another.

[0061] Embodiment 22. The automatic swimming pool cleaner as recited in embodiment 15, further comprising a motive assembly comprising a drive wheel and a track, wherein the drive wheel comprises a flange that extends beyond an external surface of the track to serve as a stop that restricts lateral movement of the track beyond the flange.

[0062] Embodiment 23. An automatic swimming pool cleaner comprising a motive assembly, wherein the motive assembly comprises a track and a drive wheel, the drive wheel comprising a flange that extends beyond an external surface of the track to serve as a stop that restricts lateral movement of the track beyond the flange.

Claims

1. An automatic swimming pool cleaner comprising:

   a body; and
   a fluid-powered motor comprising:

      a core including a rotor;
      a plurality of spokes extending from the rotor; and
      a plurality of vanes, wherein each of the plurality of vanes is rotatably attached to one of the plurality of spokes,
      wherein the core is removable from the body as a module without using any tool.

2. The automatic swimming pool cleaner of claim 1, further comprising a pin connecting each of the plurality of vanes to one of the plurality of spokes, wherein each of the plurality of vanes is rotatable about an axis of the pin.

3. The automatic swimming pool cleaner of claim 1, wherein at least one of the vanes of the plurality of vanes comprises a domed portion and, during operation of the fluid-powered motor, a cavity is formed between a housing of the fluid-powered motor and the domed portion.

4. The automatic swimming pool cleaner of claim 3, wherein the domed portion extends across a face of the at least one vane from a distal end to a proximal end of the face.

5. The automatic swimming pool cleaner of claim 1, further comprising a motive assembly comprising a drive wheel and a track, the track comprising an external surface and an internal surface, wherein:

   the external surface of the track comprises tread;
   the internal surface of the track comprises teeth; and
   an axis of each tooth of the teeth intersects at least a portion of the tread.

6. The automatic swimming pool cleaner of claim 1,

further comprising a motive assembly comprising a drive wheel and a track, the track comprising an external surface and an internal surface, wherein:

the external surface of the track comprises tread;
the internal surface of the track comprises teeth; and
gaps between the tread vertically align with gaps between the teeth to create flexible sections of the track.

7. The automatic swimming pool cleaner of claim 1, further comprising a motive assembly comprising a drive wheel and a track, the track comprising an external surface and an internal surface, wherein:
the external surface of the track comprises tread and a plurality of bridges that connect the tread, wherein adjacent bridges of the plurality of bridges are vertically offset from one another.

8. The automatic swimming pool cleaner of claim 1, further comprising a motive assembly comprising a drive wheel and a track, wherein the drive wheel comprises a flange that extends beyond an external surface of the track to serve as a stop that restricts lateral movement of the track beyond the flange.

9. An automatic swimming pool cleaner comprising a motive assembly, wherein the motive assembly comprises a track and a drive wheel, the drive wheel comprising a flange that extends beyond an external surface of the track to serve as a stop that restricts lateral movement of the track beyond the flange.

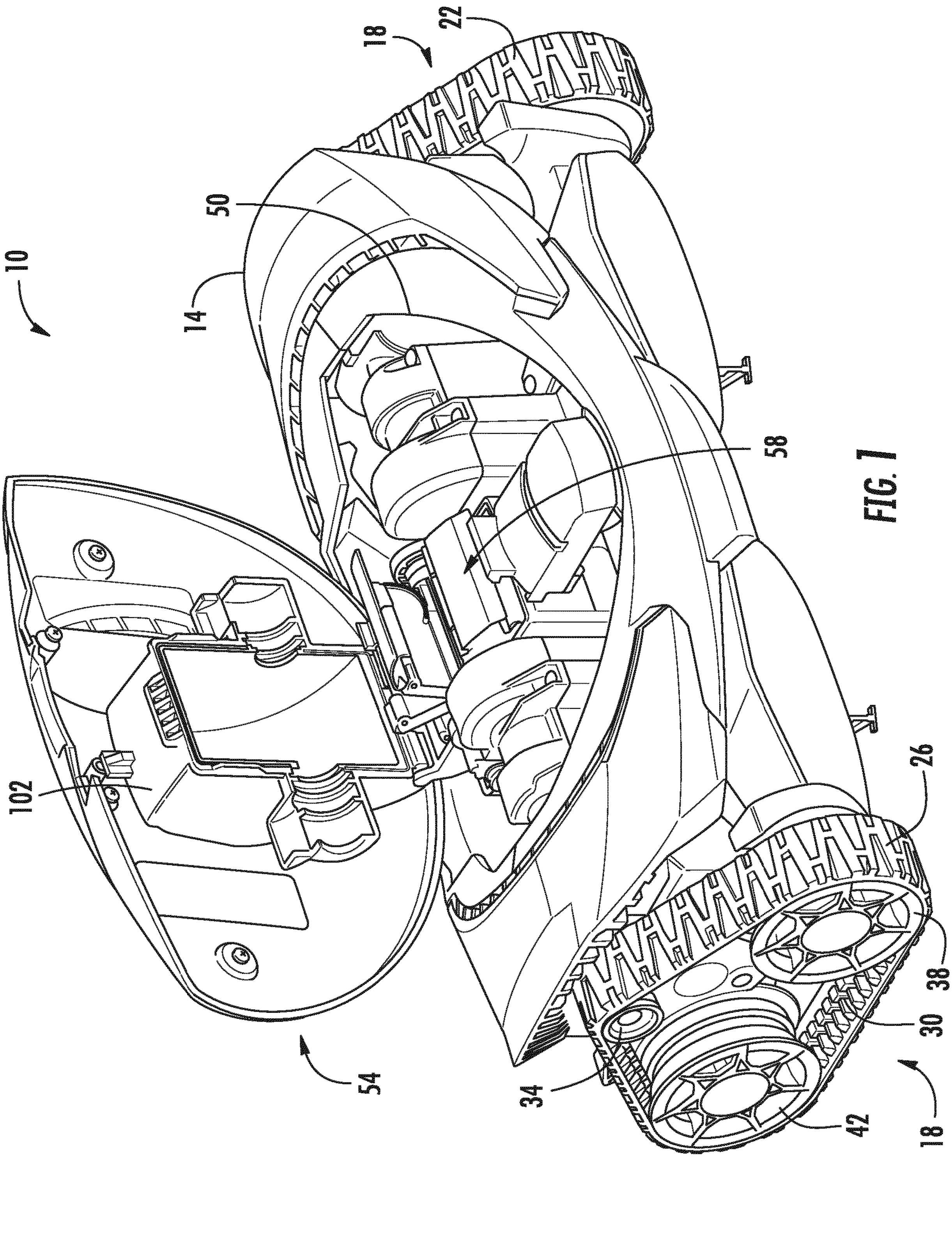


FIG. 1

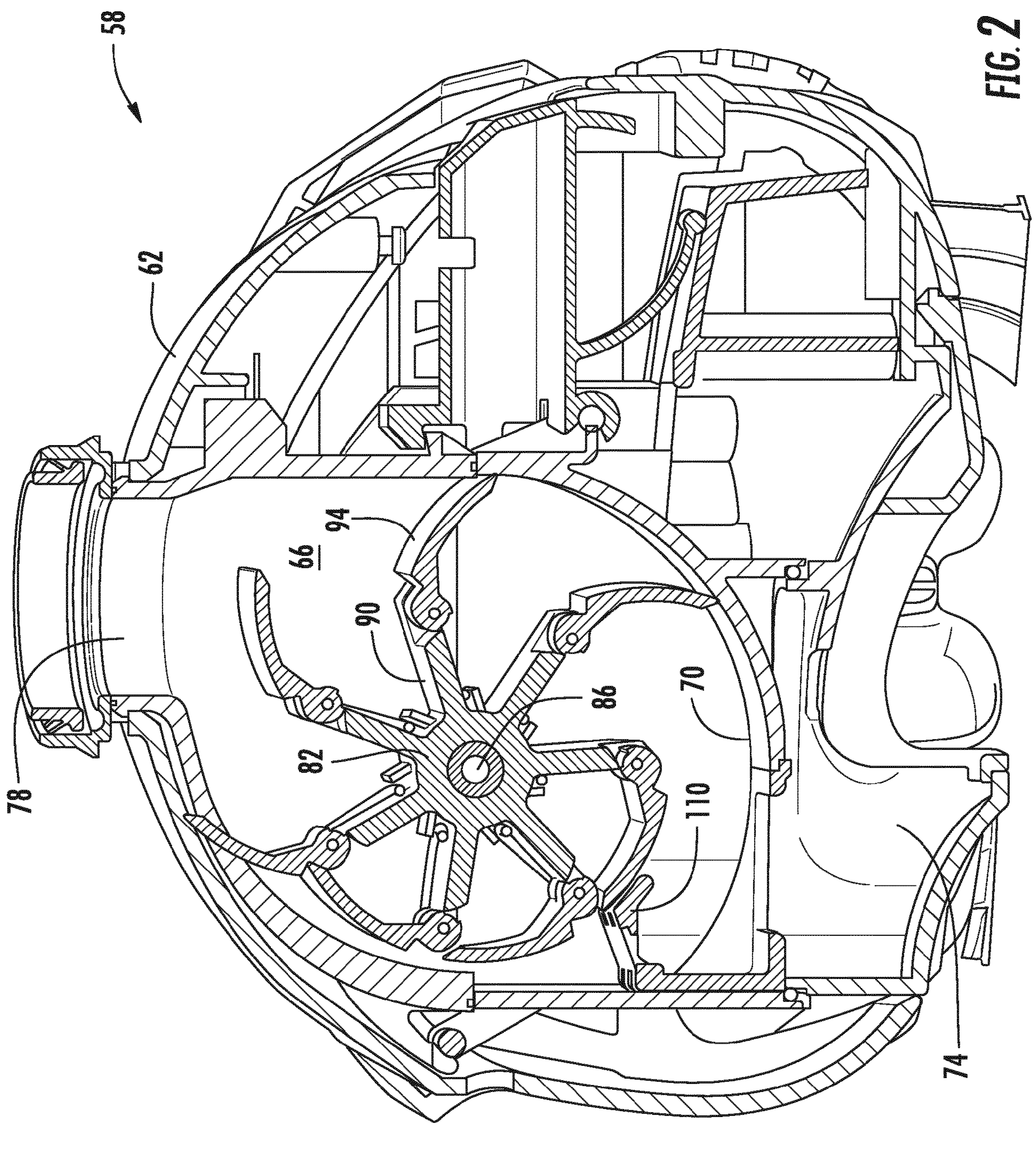


FIG. 2

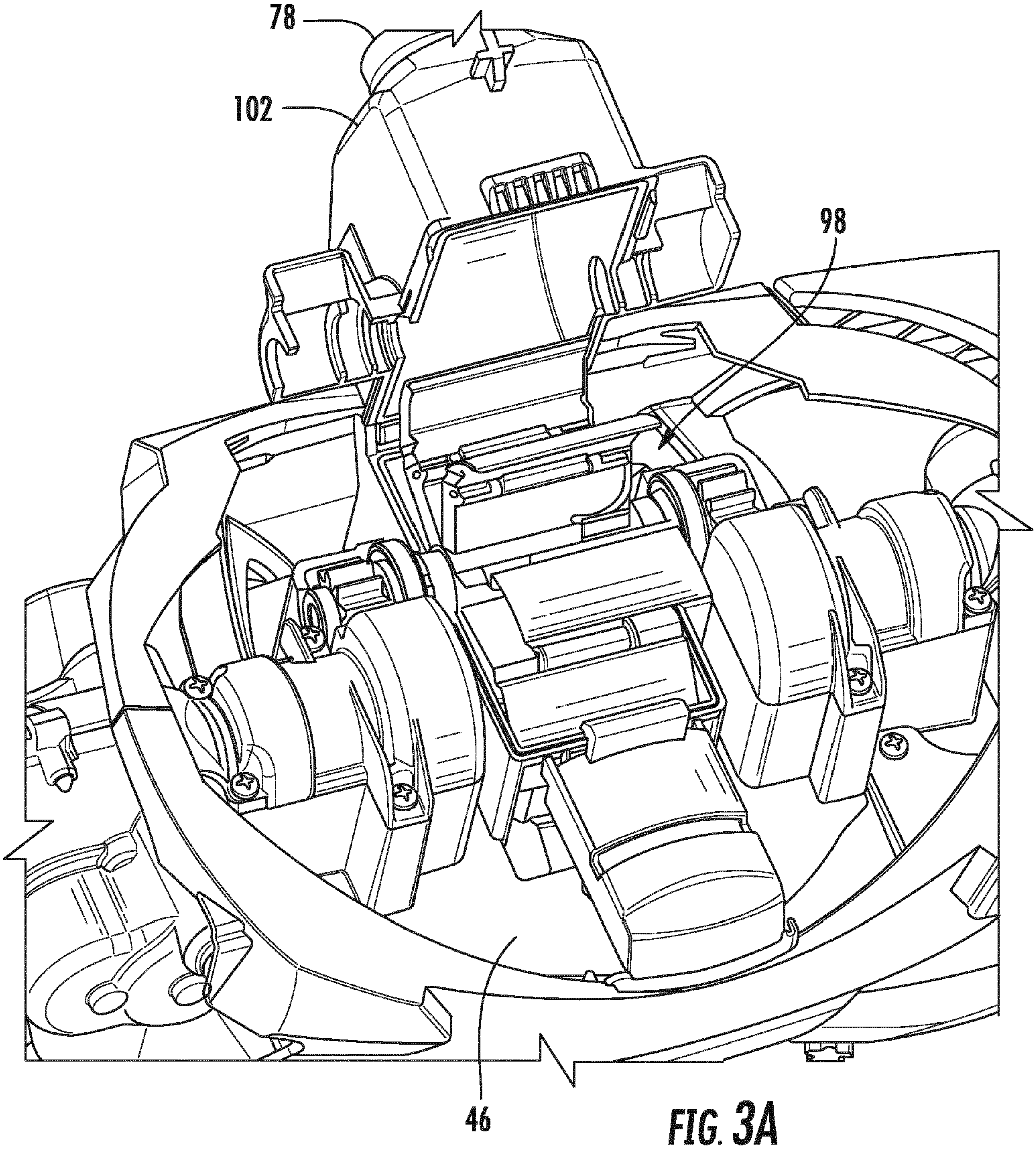


FIG. 3A

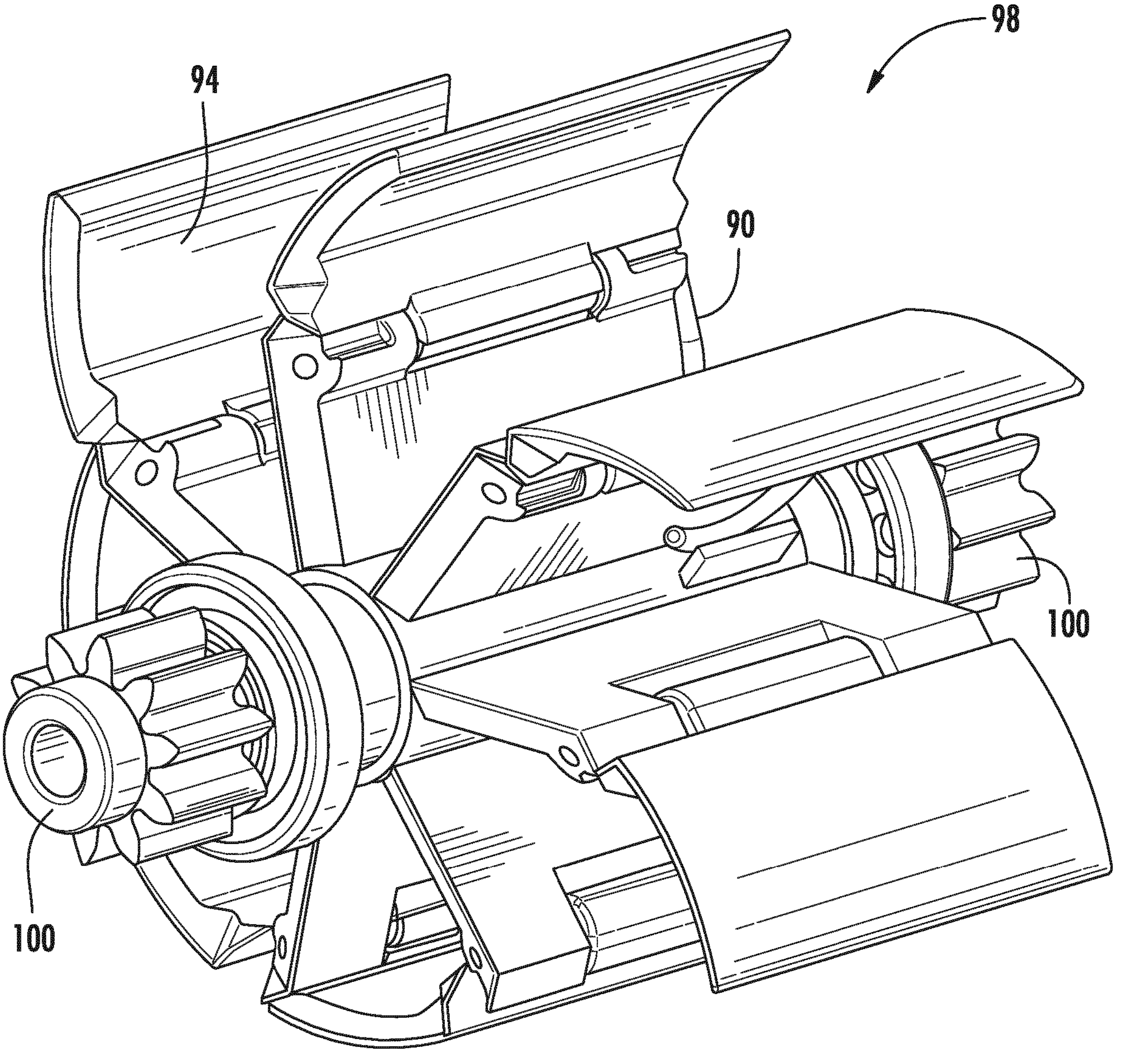


FIG. 3B

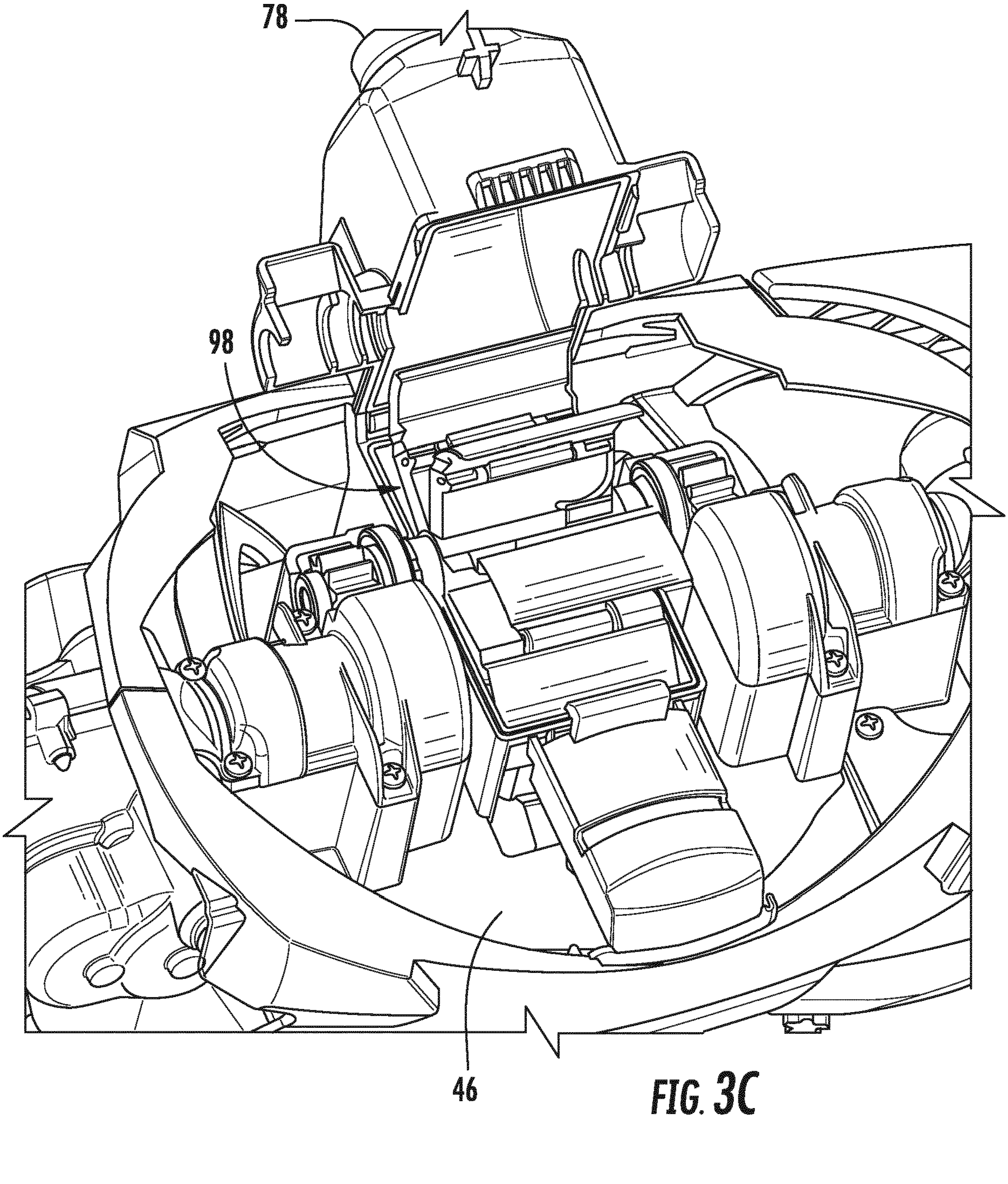


FIG. 3C

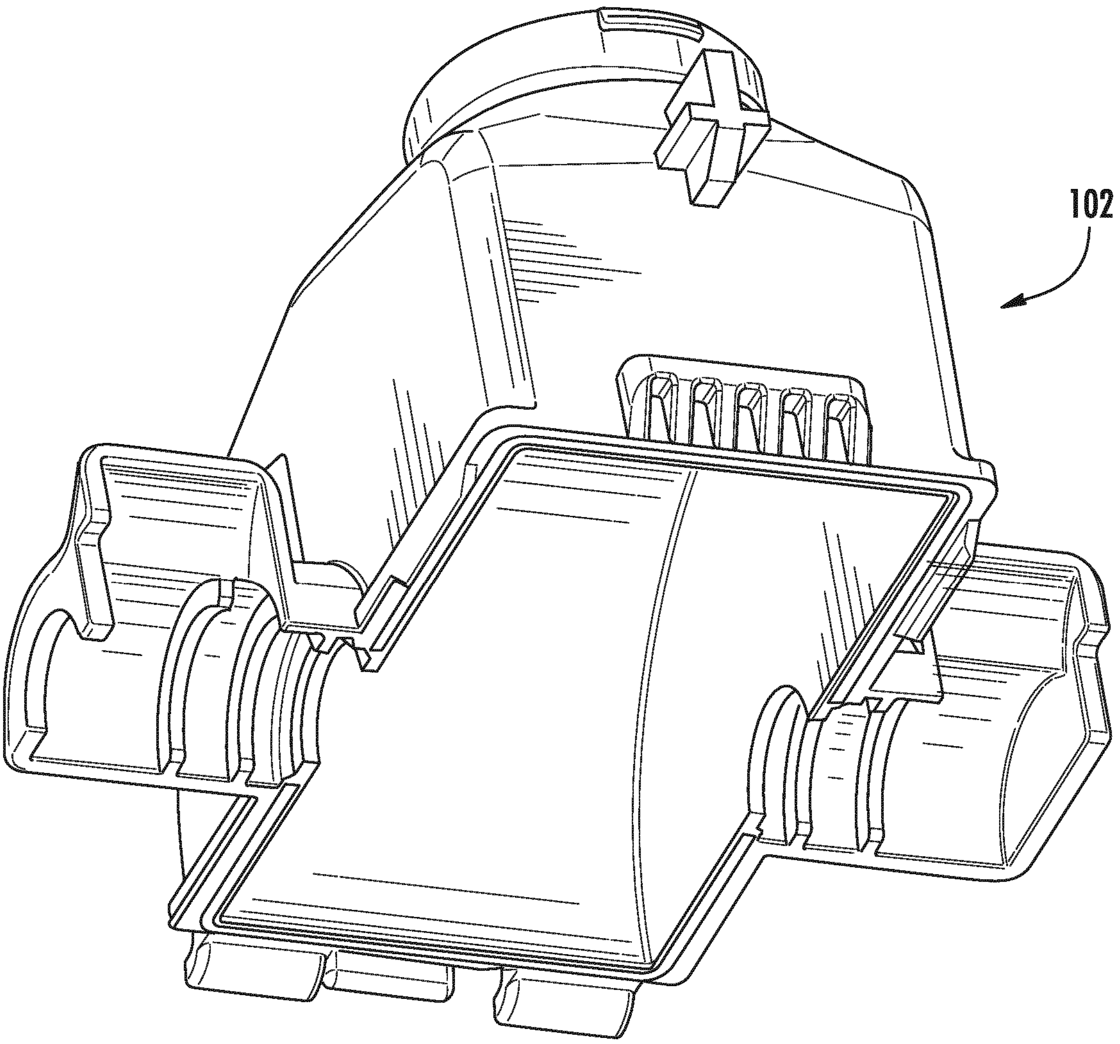


FIG. 3D

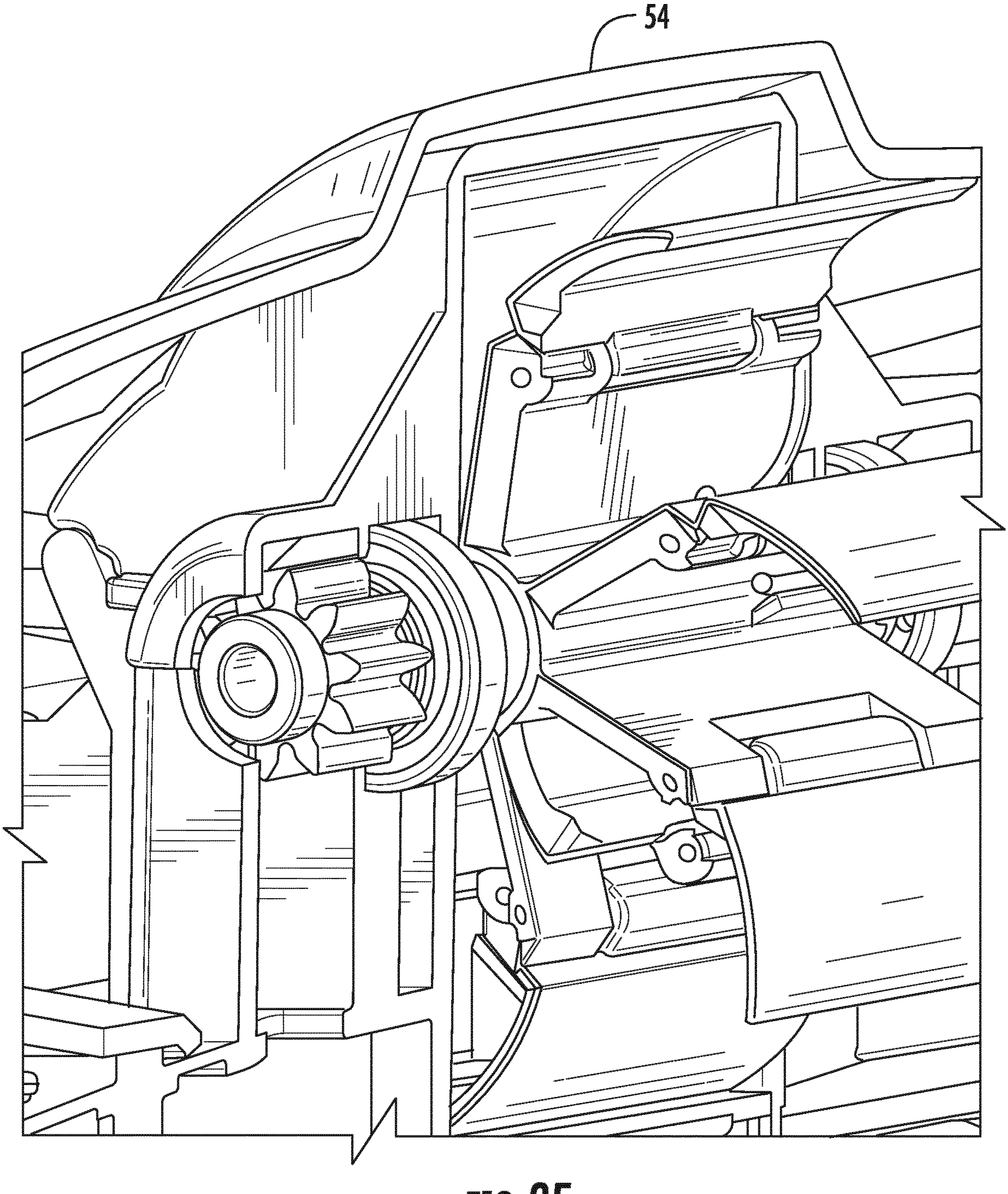


FIG. 3E

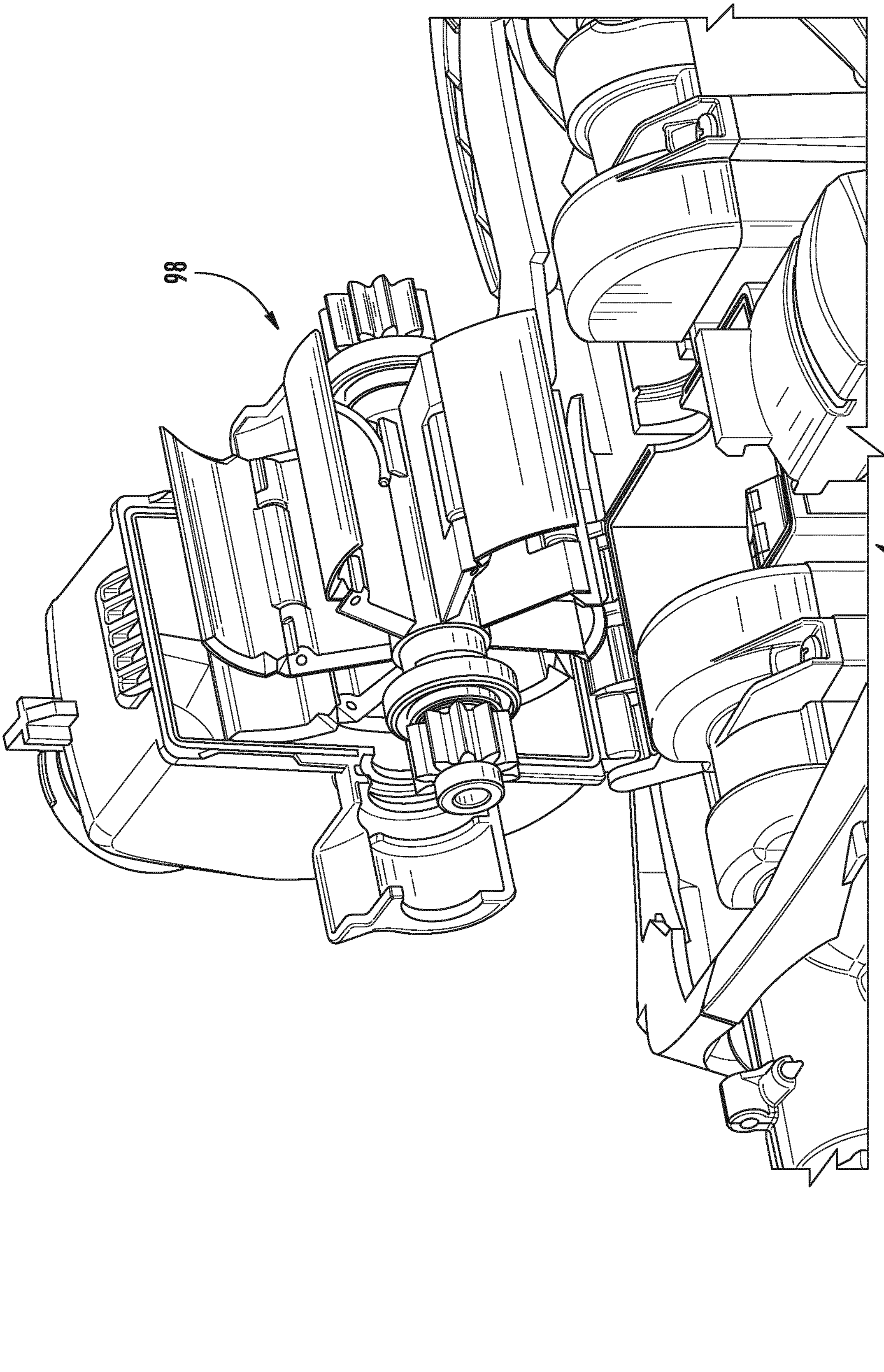


FIG. 3F

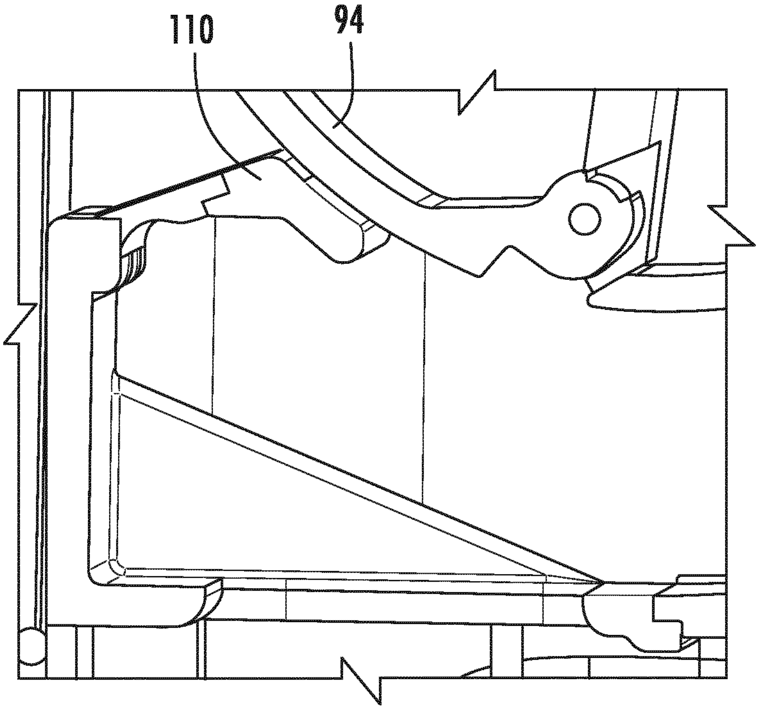


FIG. 4A

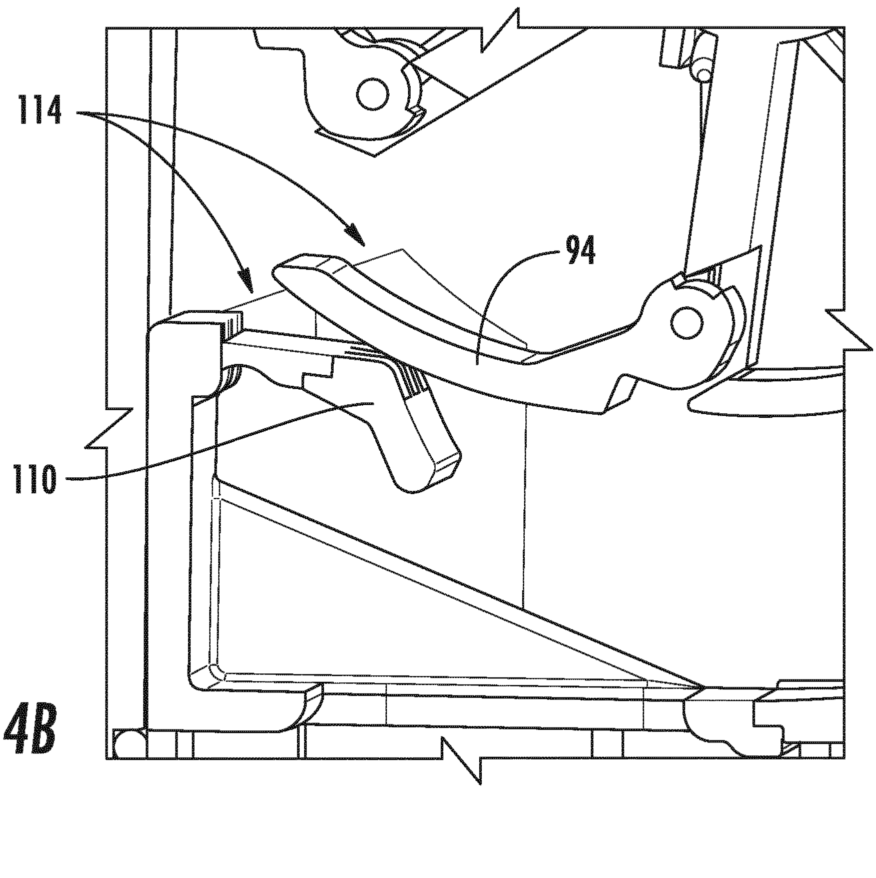


FIG. 4B

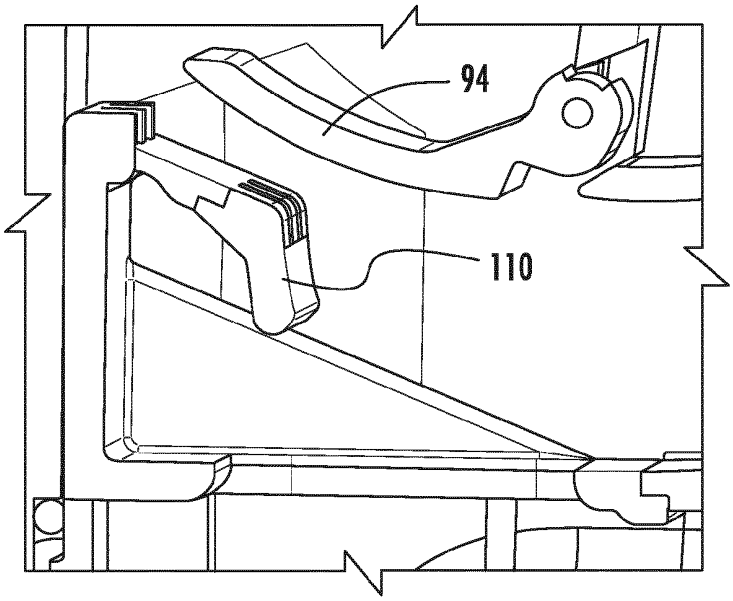


FIG. 4C

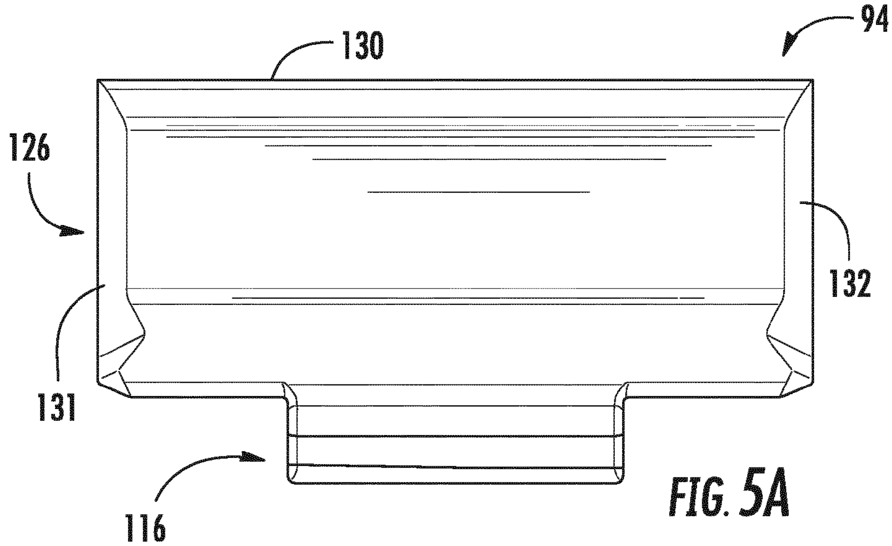


FIG. 5A

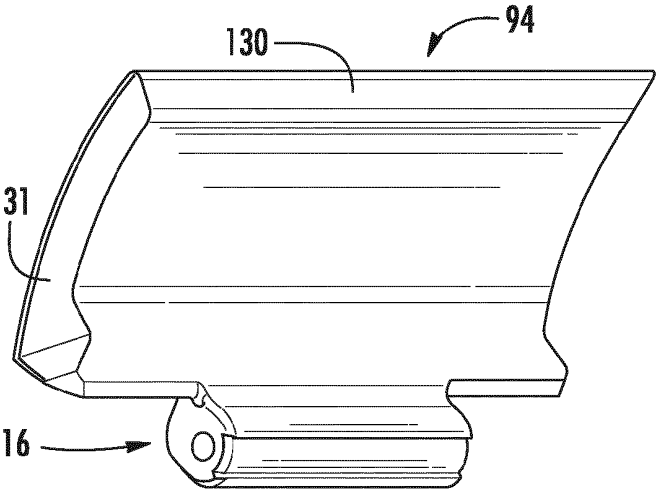


FIG. 5B

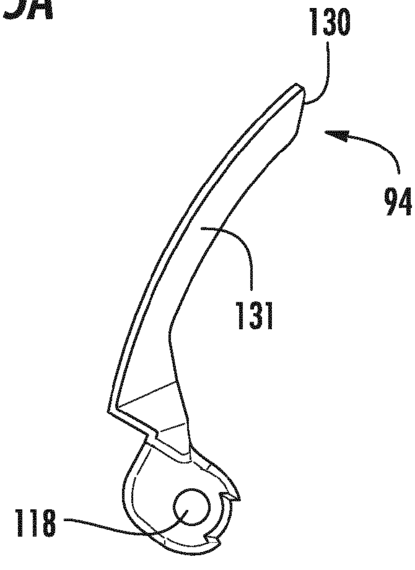


FIG. 5C

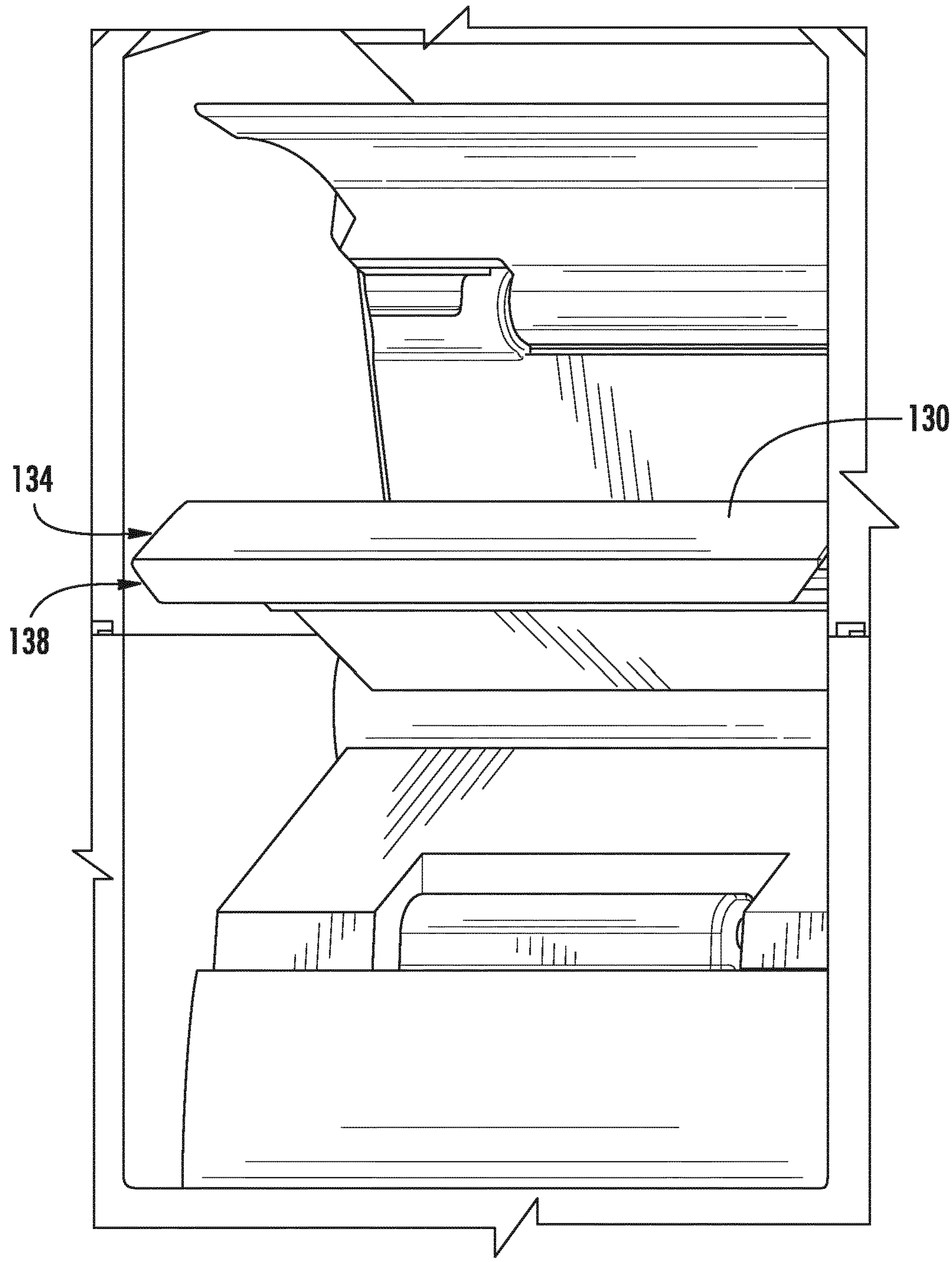


FIG. 5D

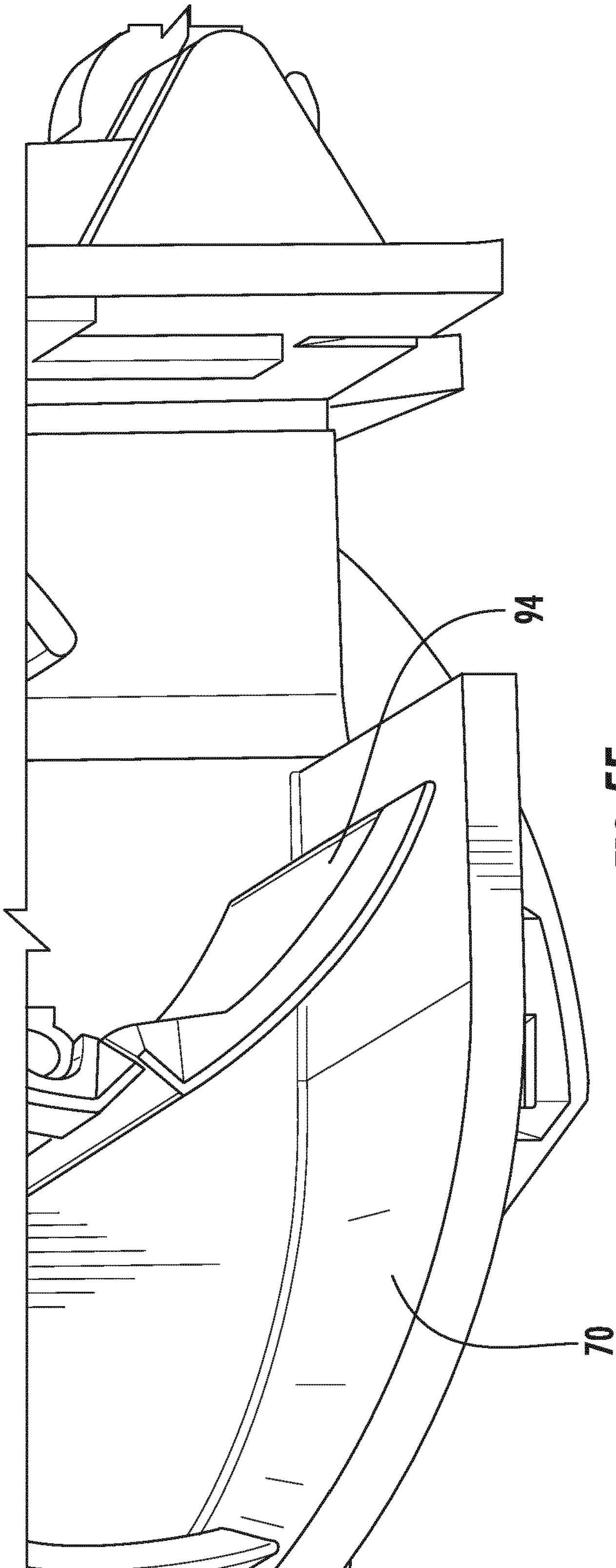


FIG. 5E

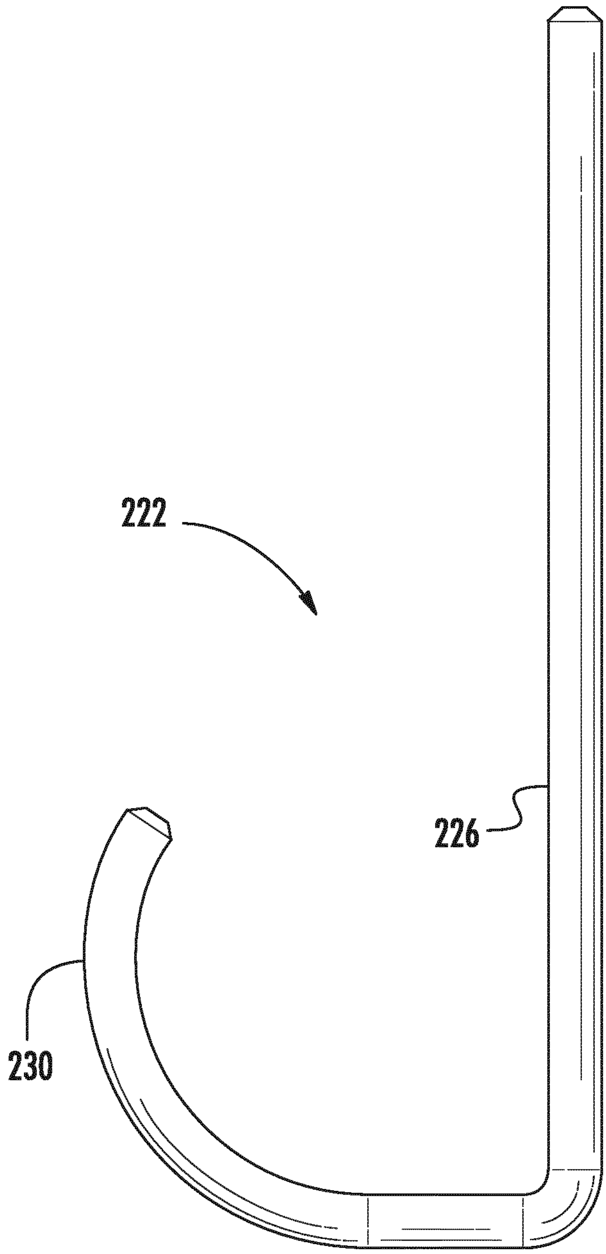


FIG. 6A

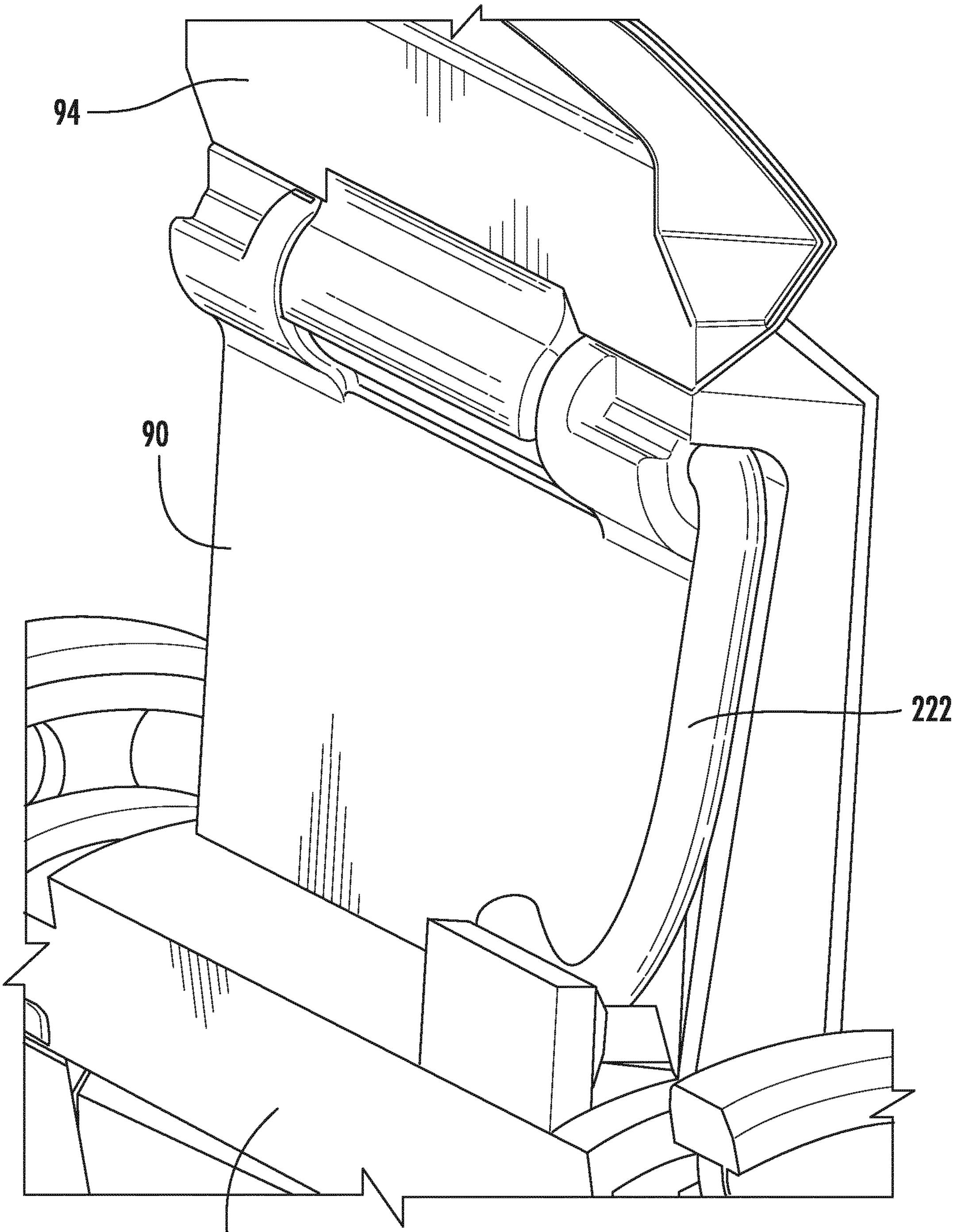


FIG. 6B

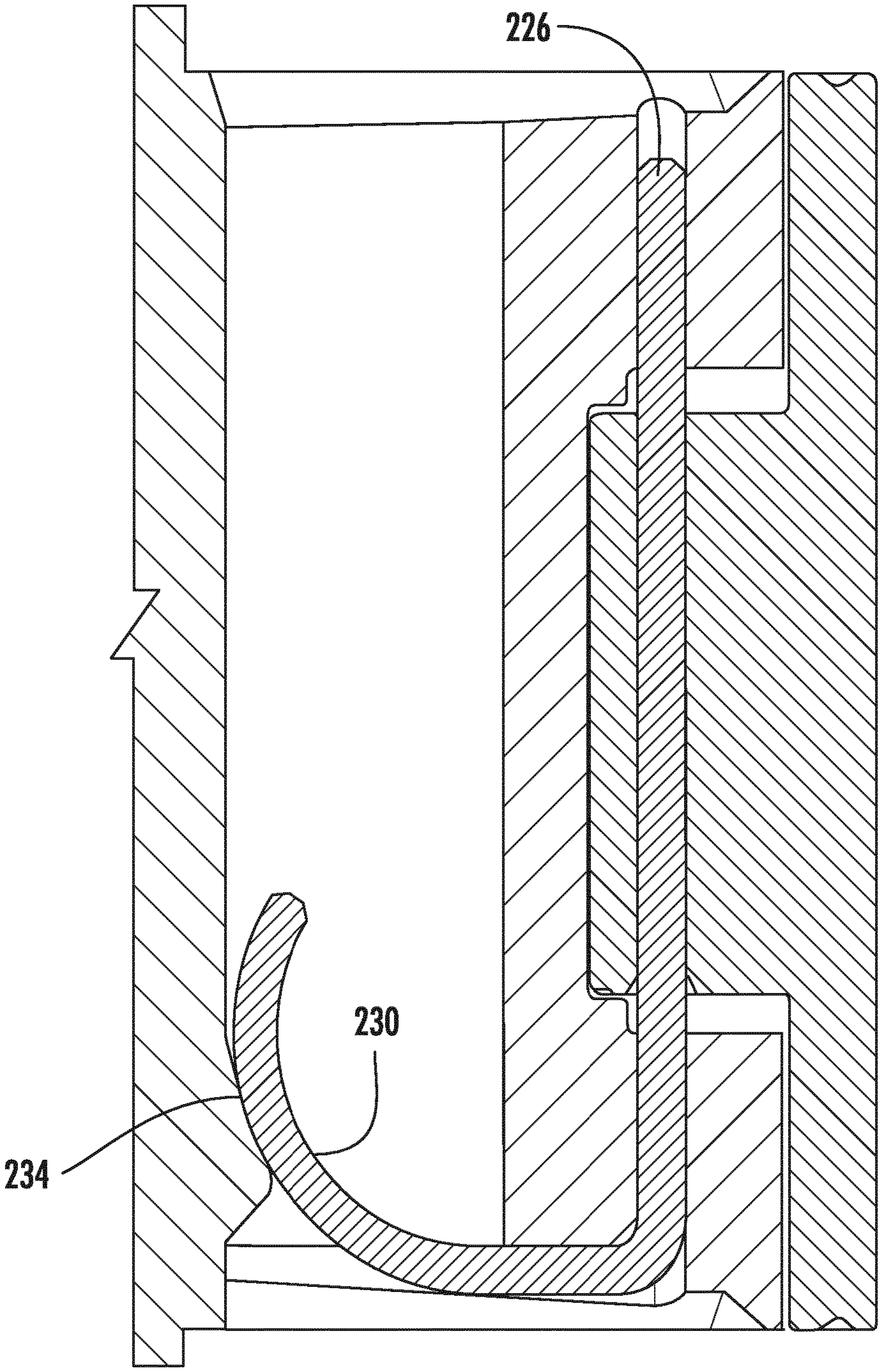


FIG. 6C

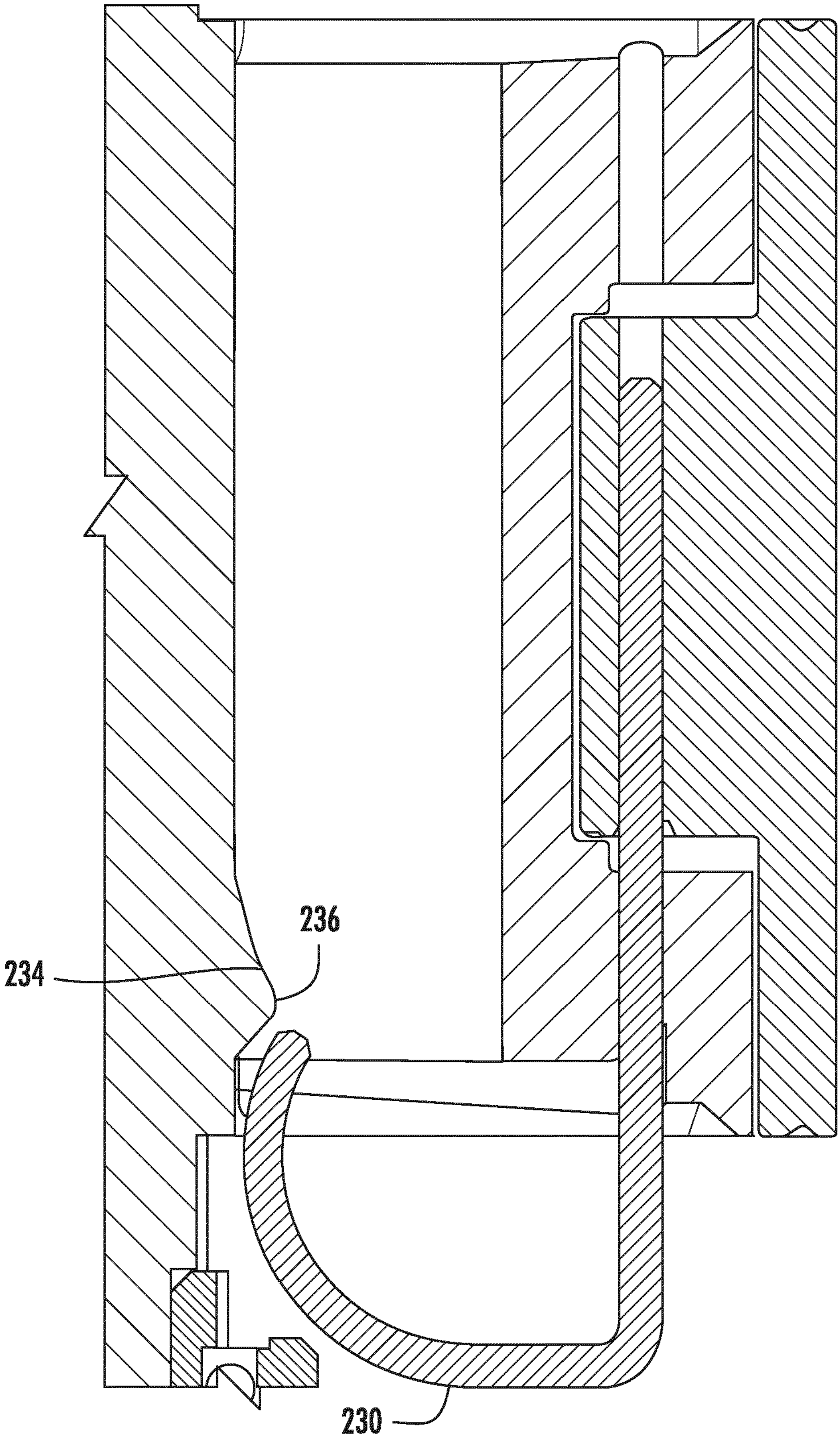


FIG. 6D

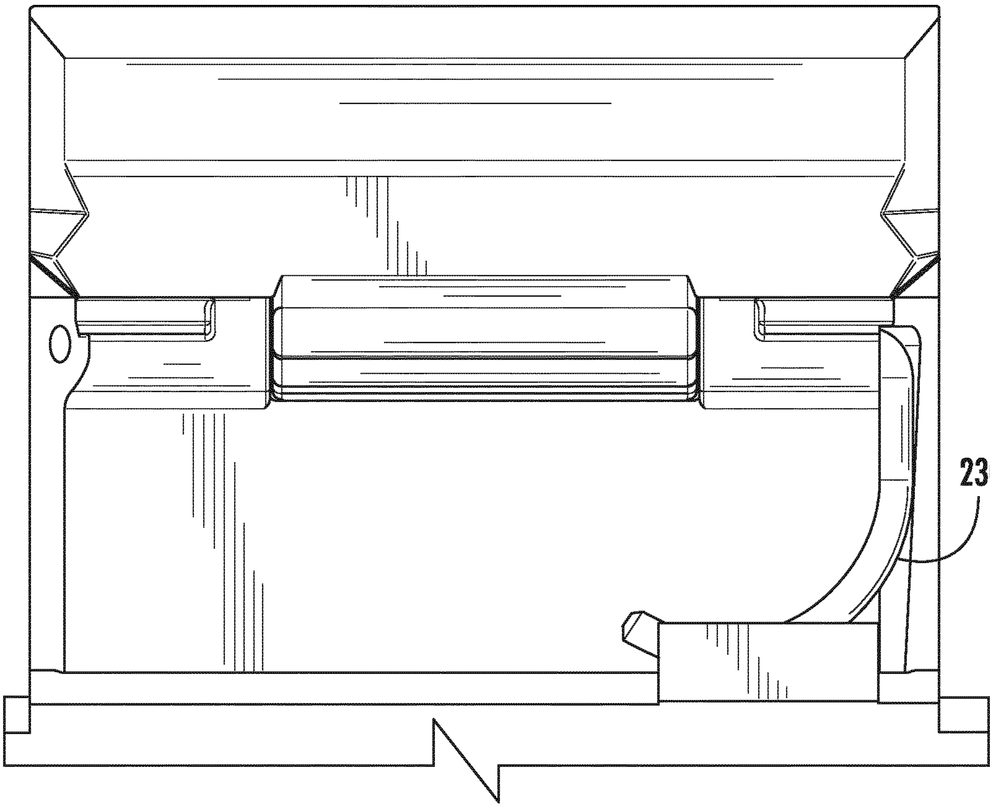


FIG. 6E

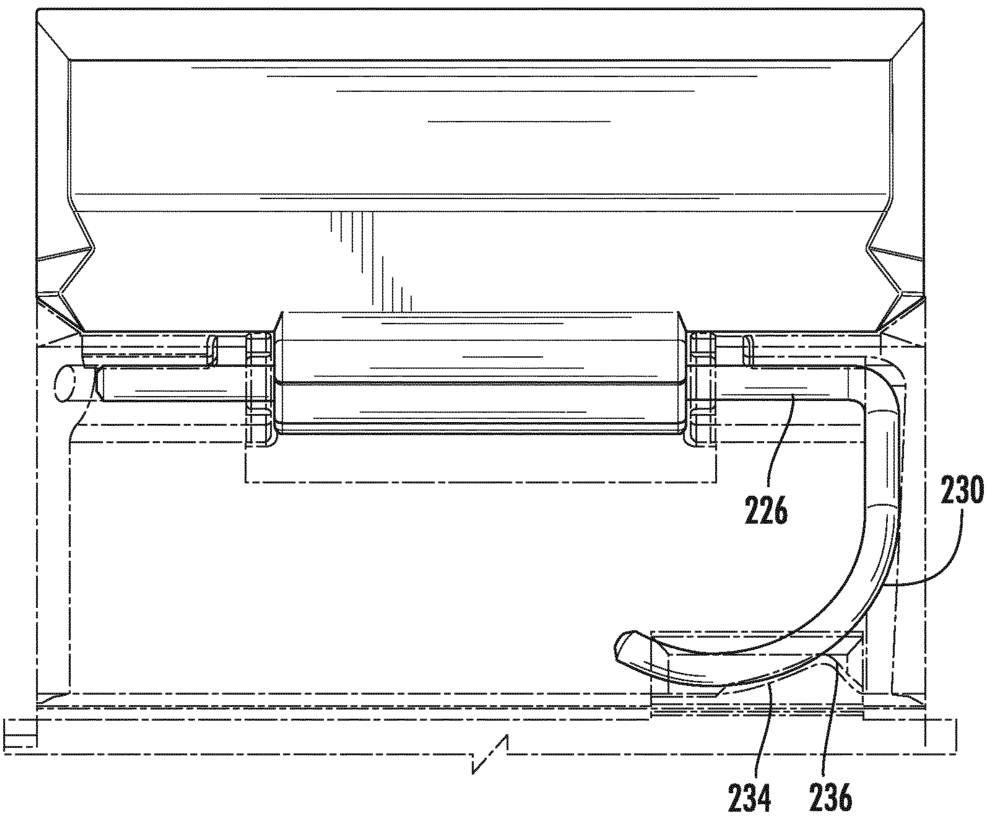


FIG. 6F

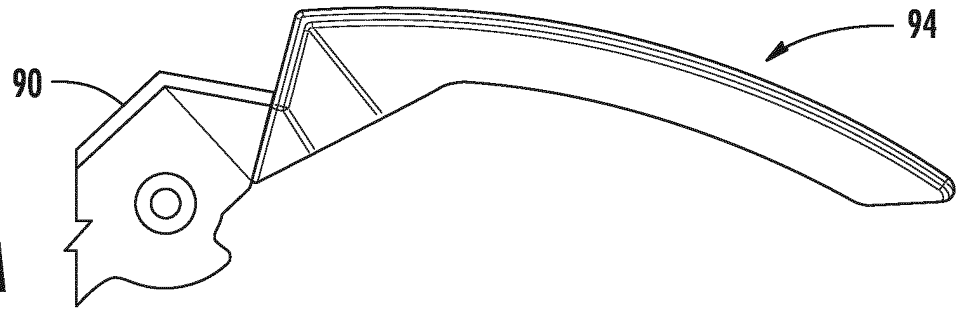


FIG. 7A

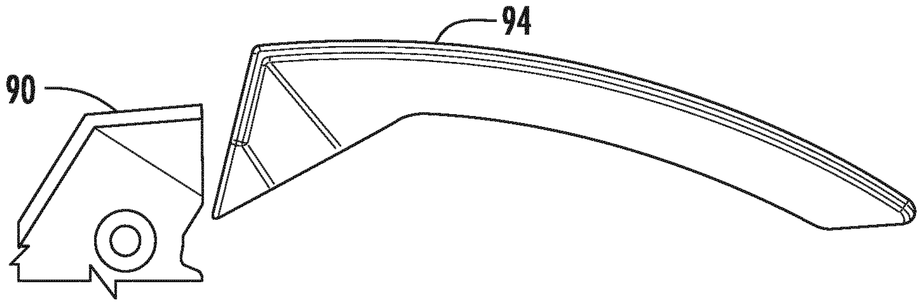


FIG. 7B

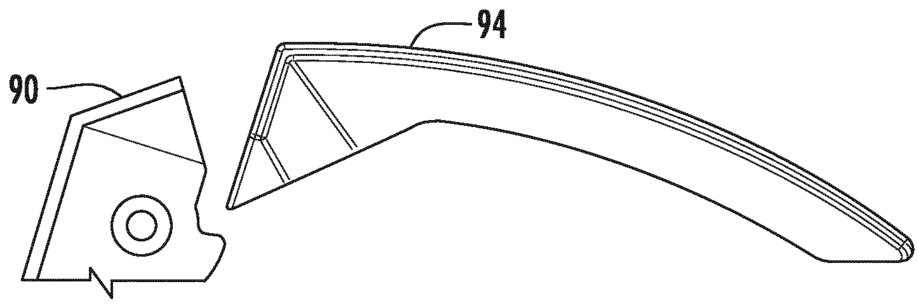


FIG. 7C

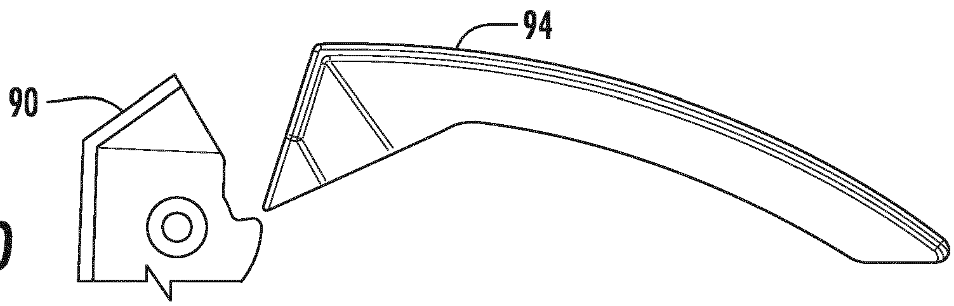


FIG. 7D

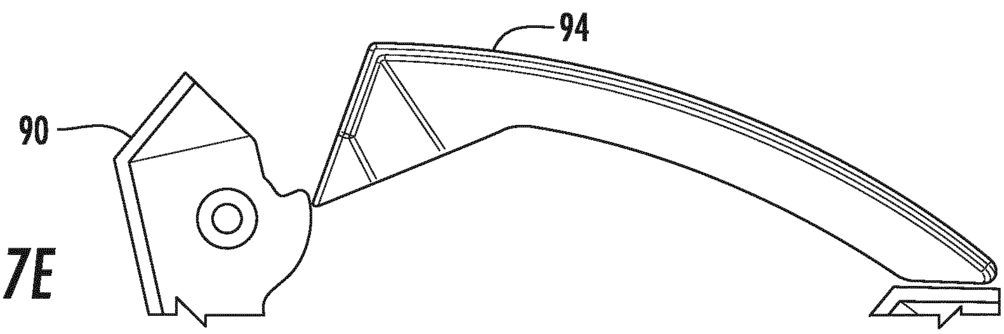


FIG. 7E

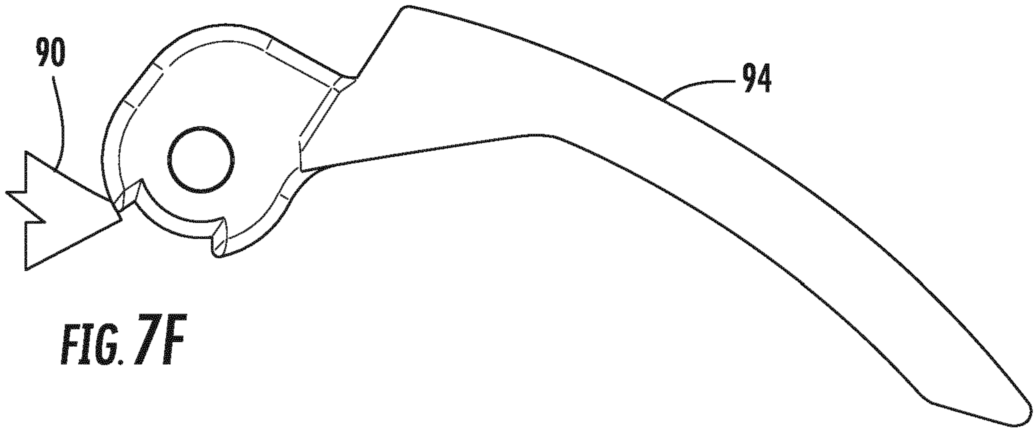


FIG. 7F

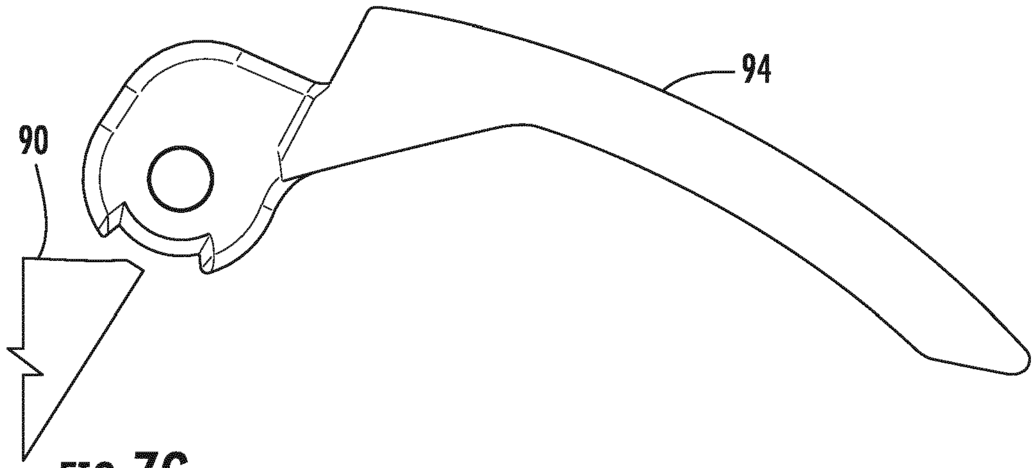


FIG. 7G

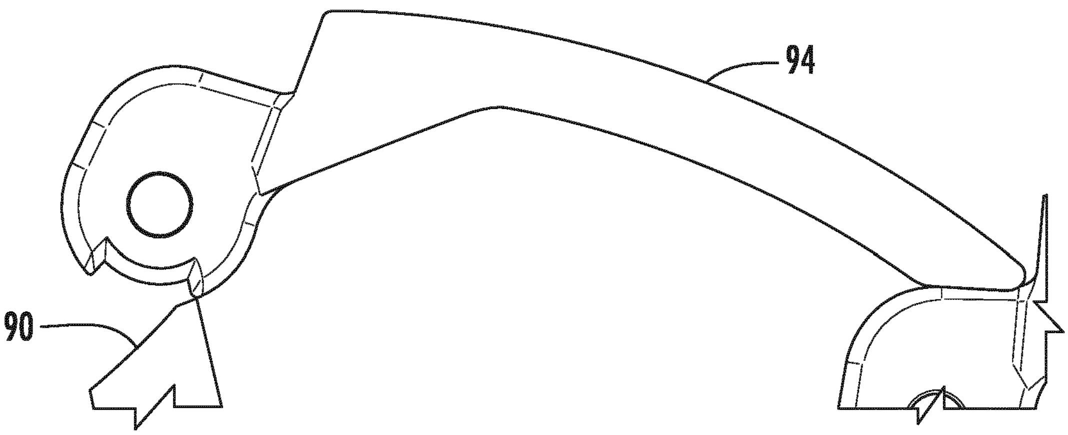


FIG. 7H

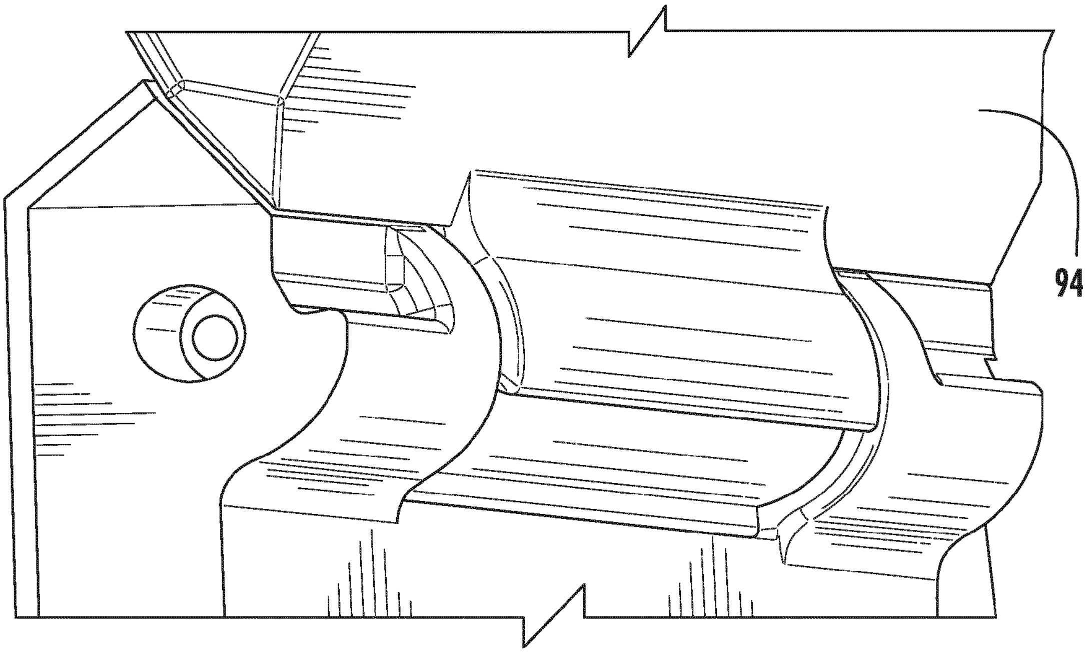


FIG. 7I

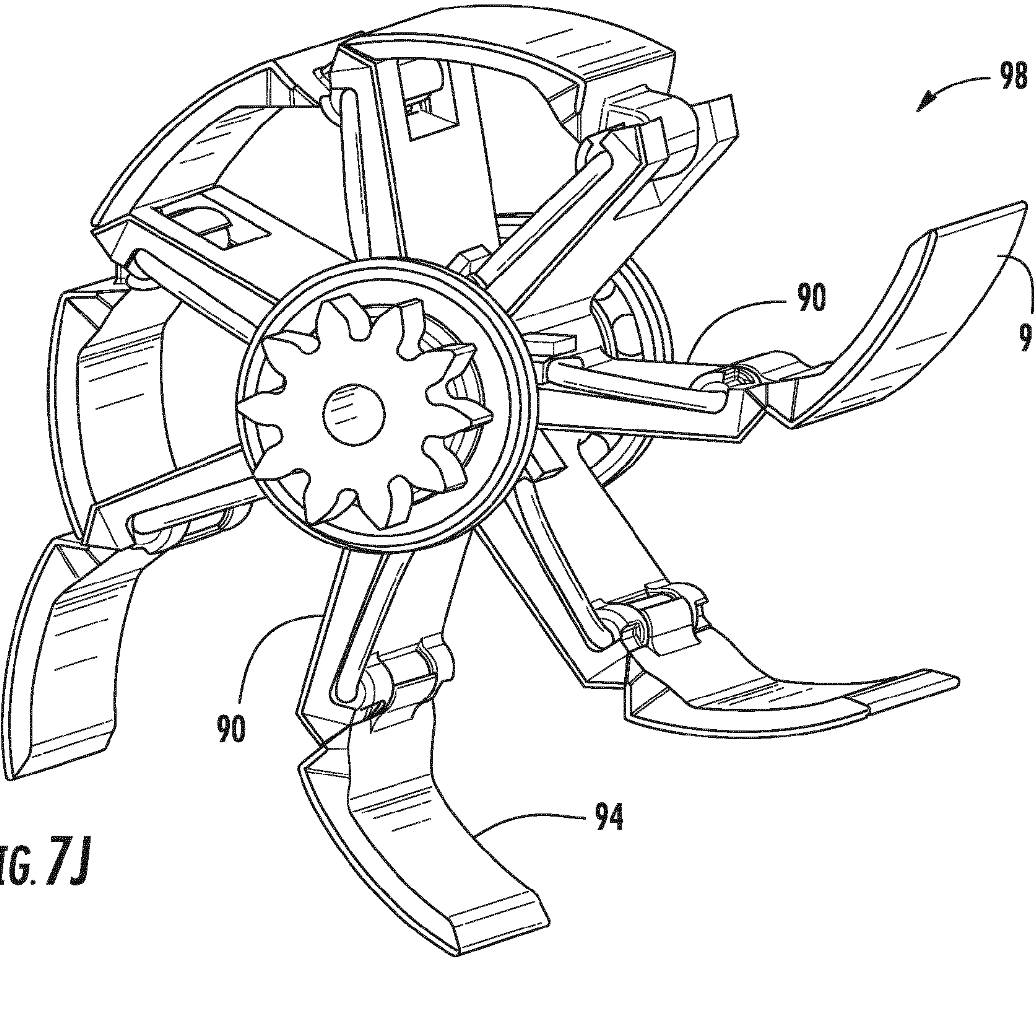
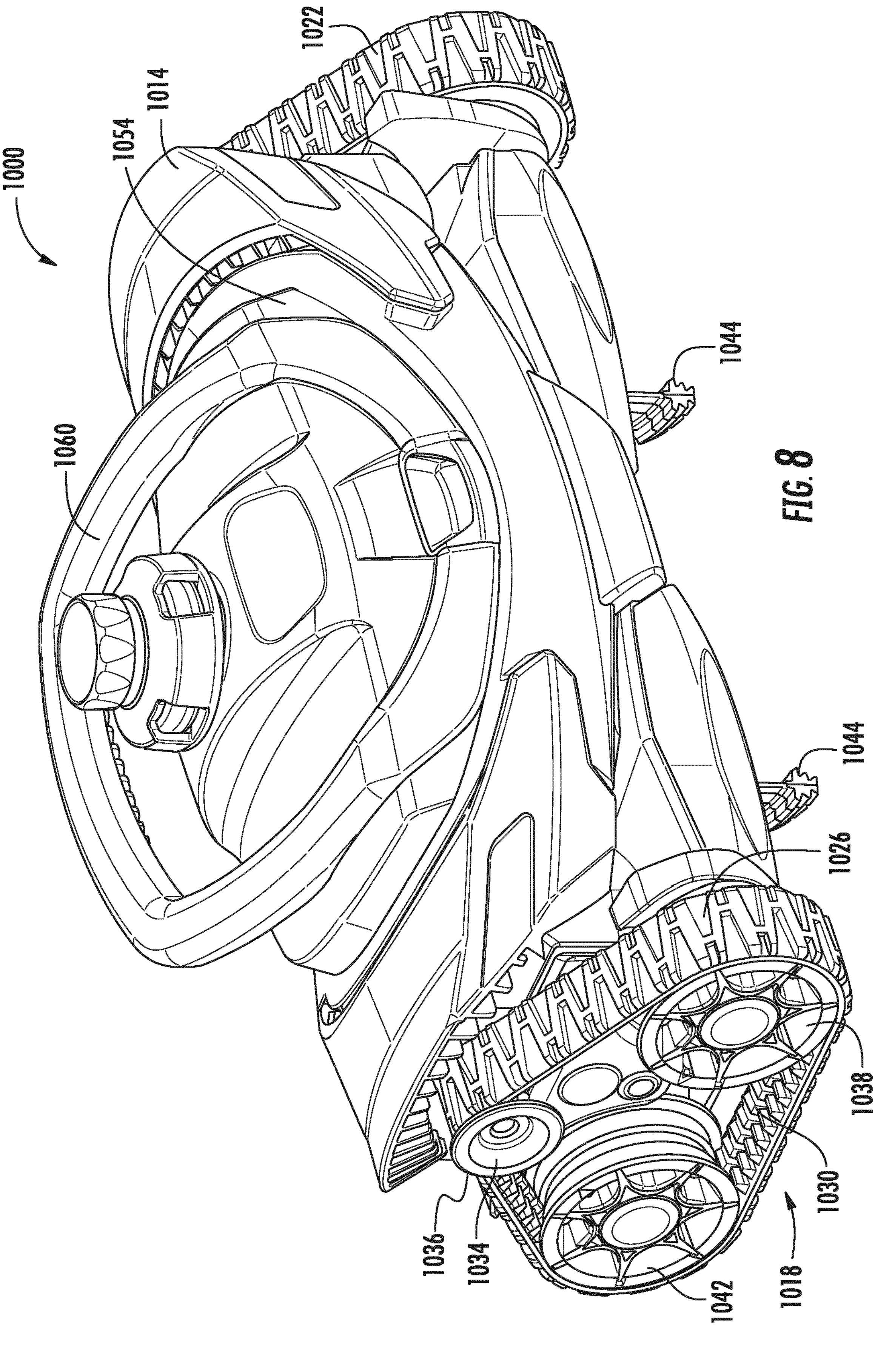


FIG. 7J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1036

FIG. 8

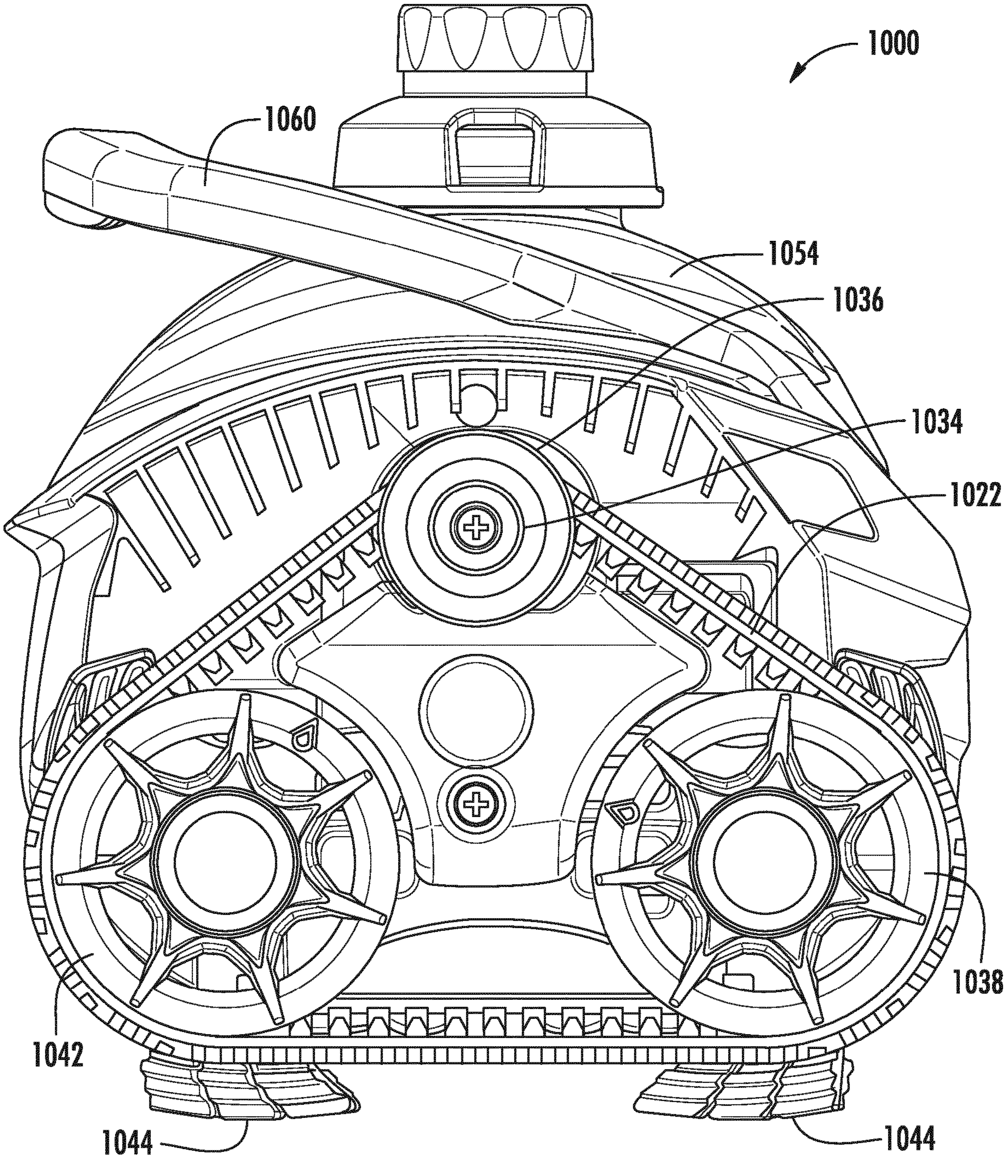

FIG. 9

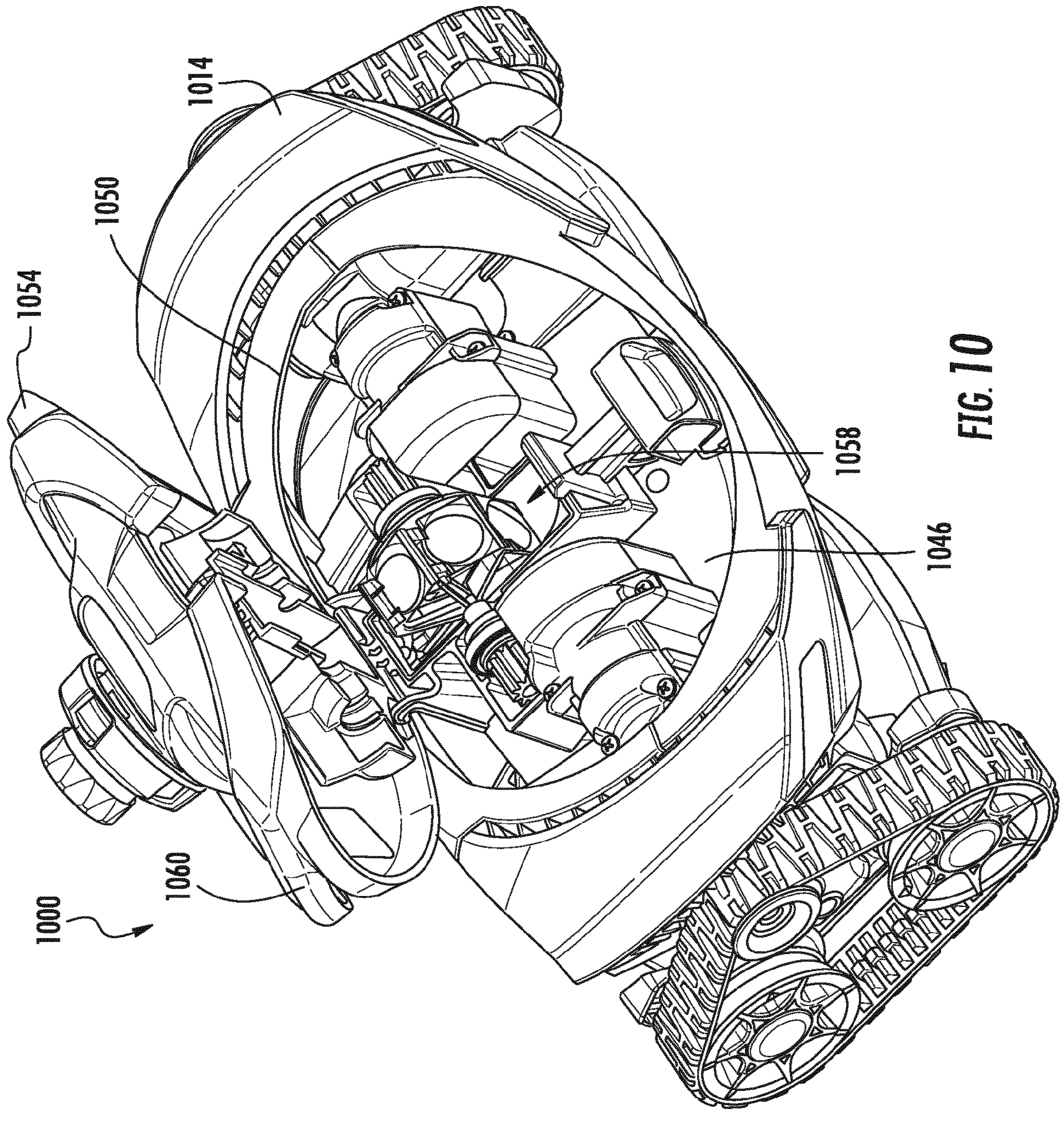

FIG. 10

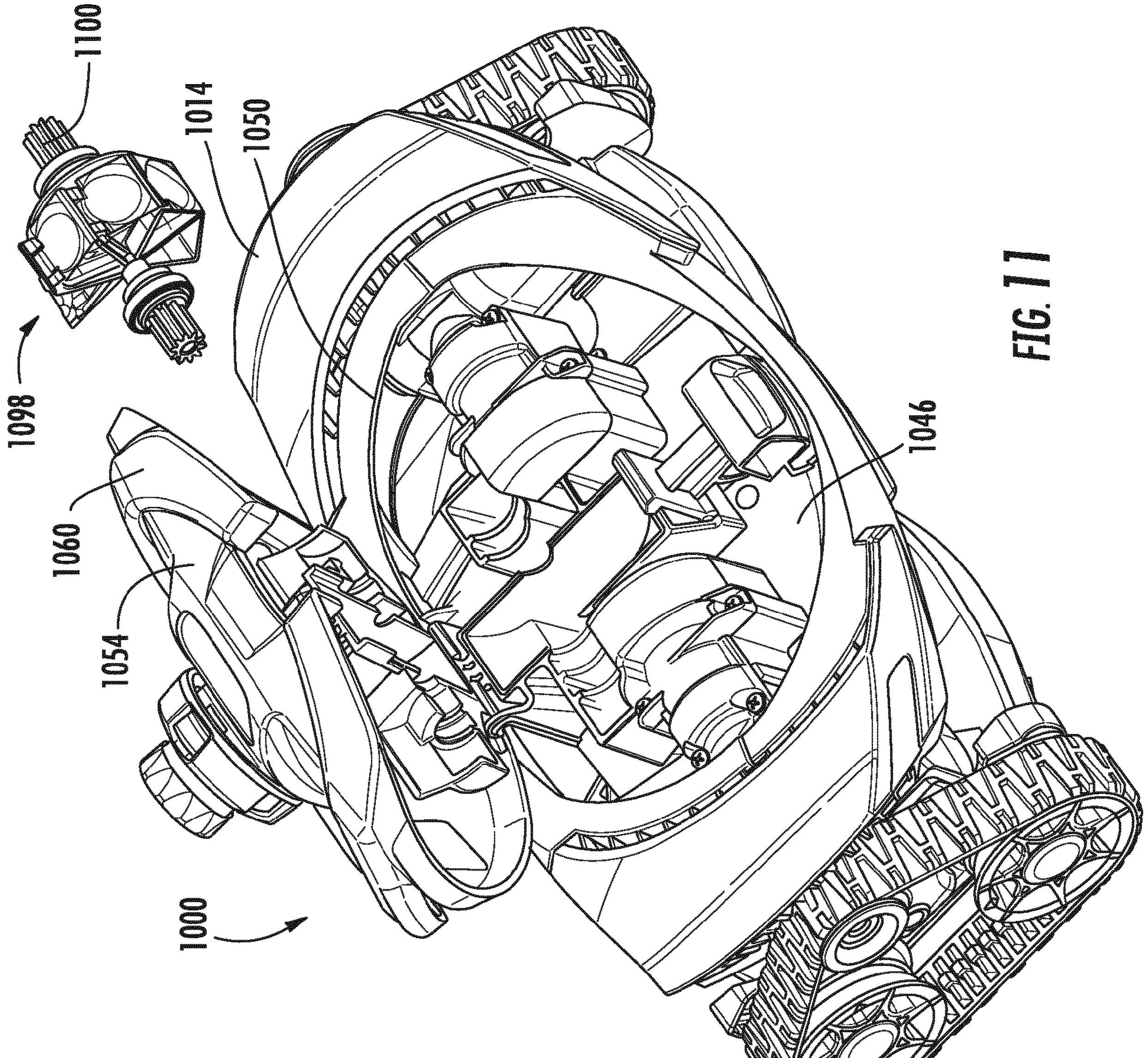

FIG. 11

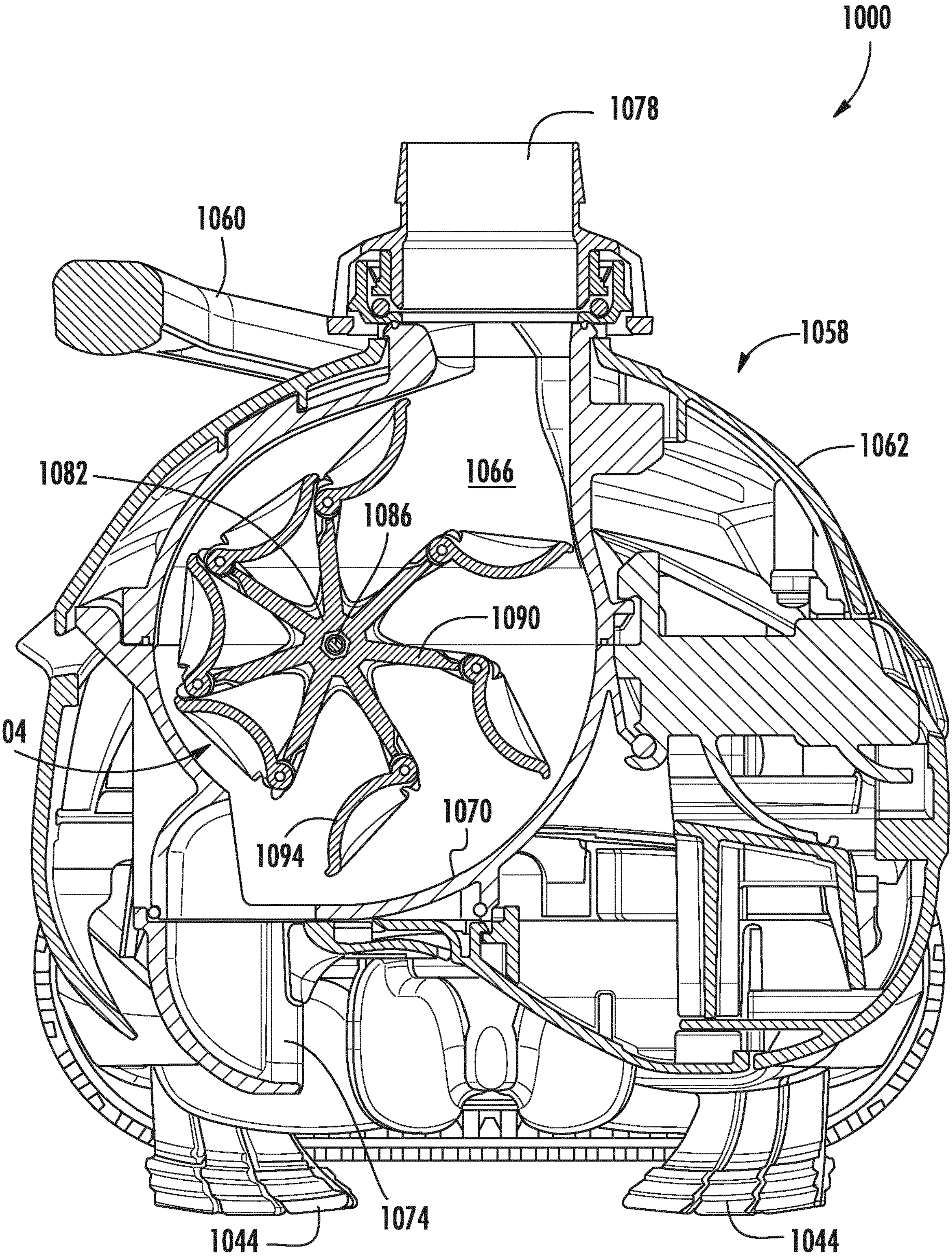
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FIG. 12

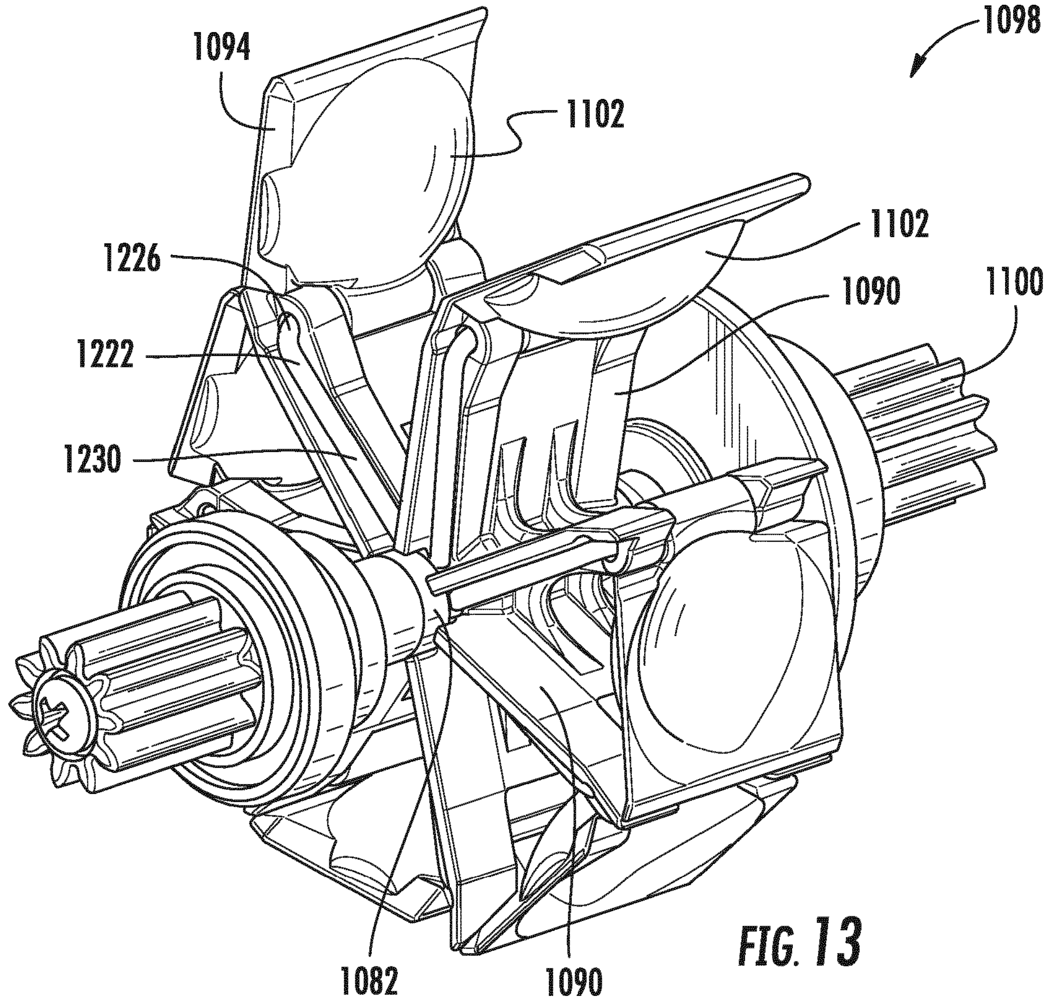

FIG. 13

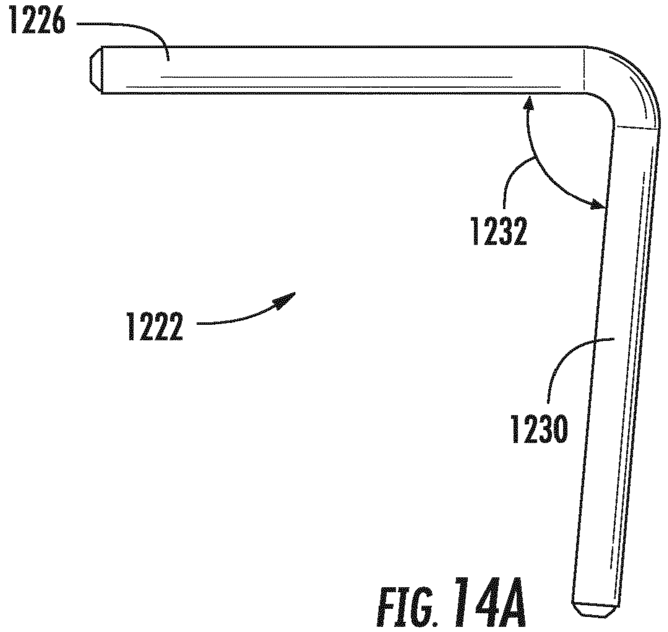

FIG. 14A

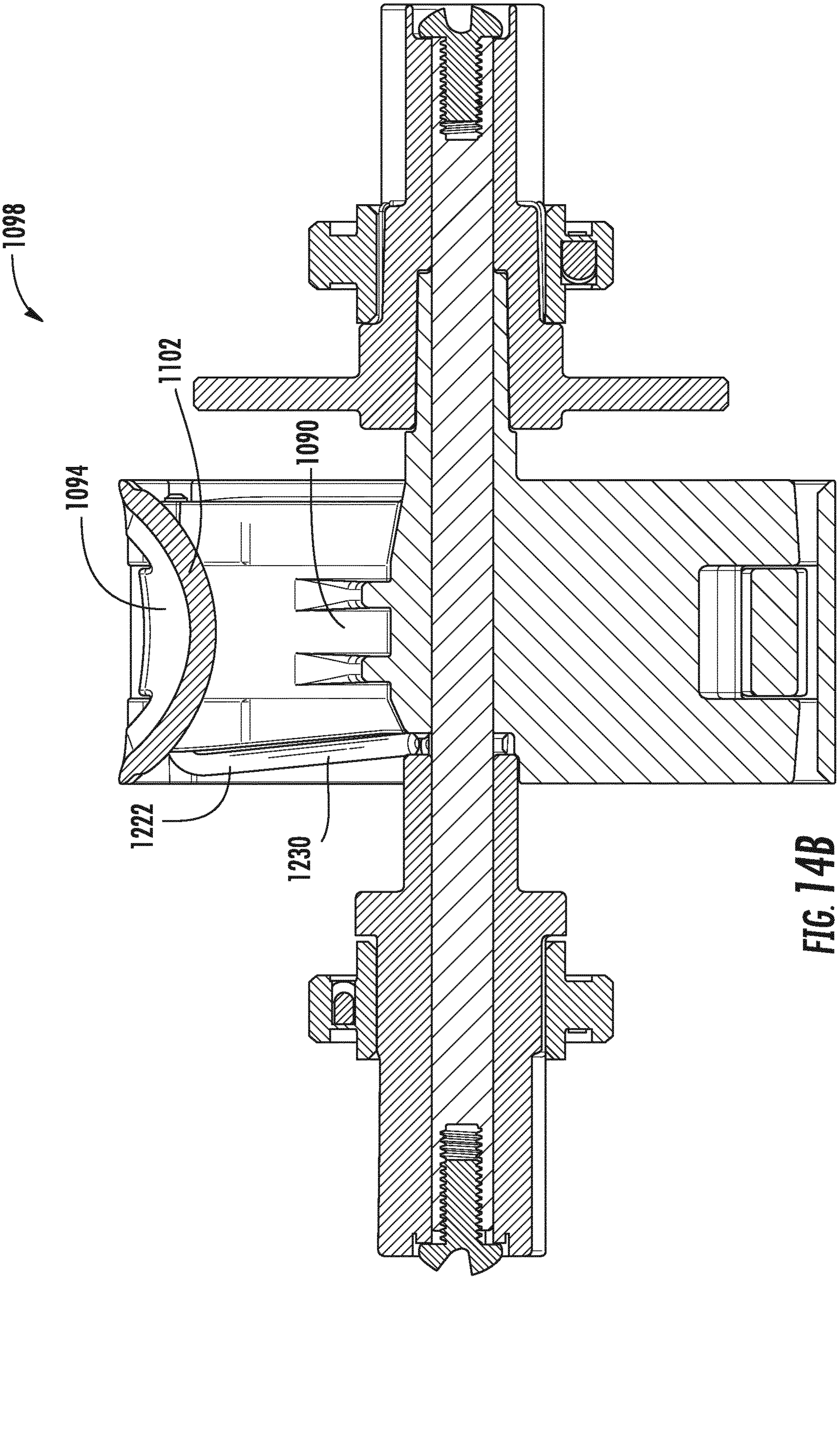

FIG. 14B

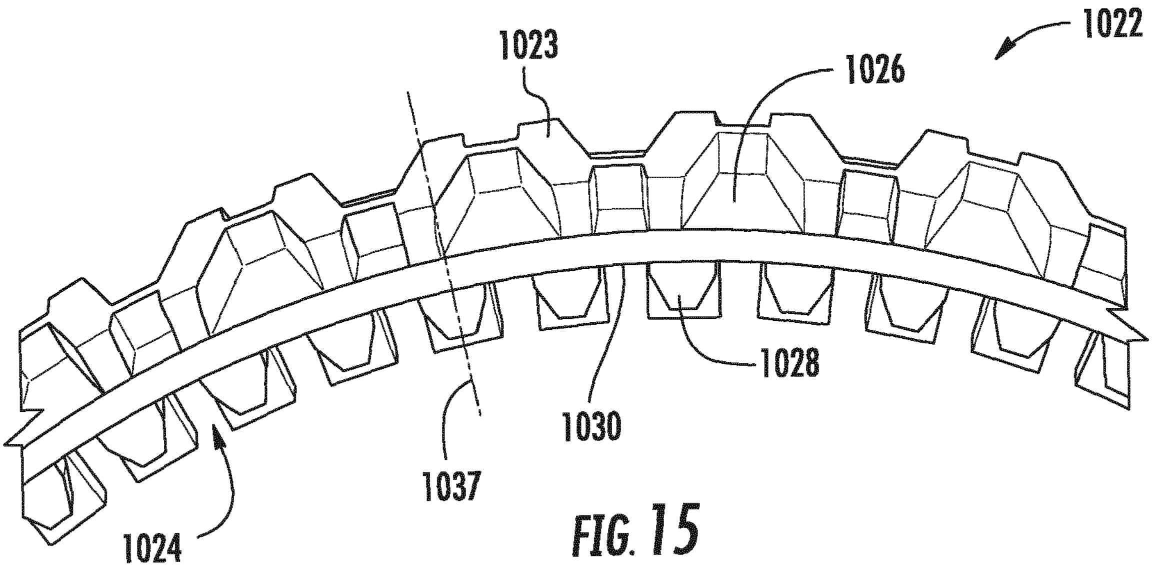

FIG. 15

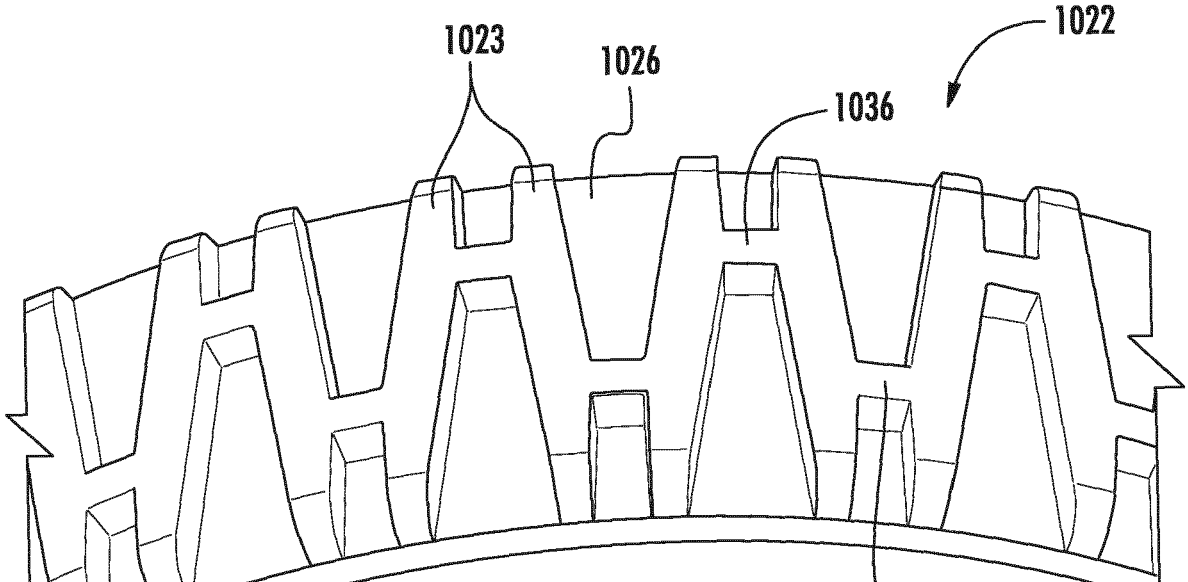

FIG. 16

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 62837017 **[0001]**
- US 9611668 B, van der Meijden **[0003]**
- US 20100119358, van der Meijden **[0004]**
- US 6292970 B, Rief **[0005]**