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(54) Title: DOUBLE-ACTION ELECTRICITY GENERATOR

(57) Abstract: An electrical generator has an armature locate inside a co-axial magnetic field. Each of the armature and the magnetic field has a first axial end mounted to a drive shaft and a second axial end which is free. The respective drive shafts are at opposite axial ends of the generator, and are arranged to counter rotate such that rotation of the drive shafts causes direct relative rotation of the armature and the magnetic field.

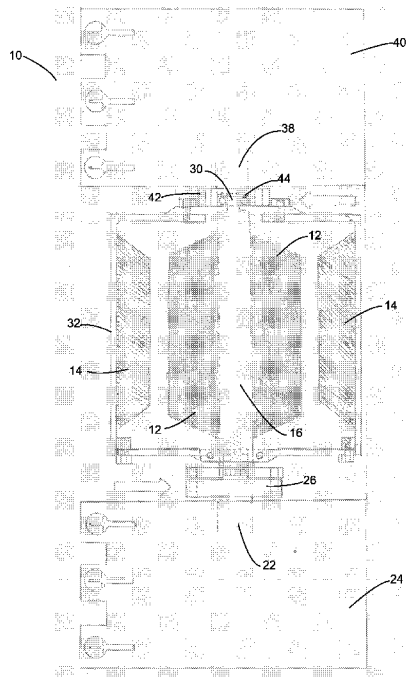

Fig. 3

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"DOUBLE-ACTION ELECTRICITY GENERATOR"

Field of the Invention

[0001] The present invention relates to a generator for the production of electricity.

Background to the Invention

[0002] The principles of conversion of mechanical energy to electrical energy via rotation of a wire coil through a magnetic field are well known.

[0003] The design of a generator according to these principles is subject to many constraints, including the available input mechanical power (generally available as input speed and torque); the desired electrical output; and the size of both the generator itself and the overall system.

[0004] The present invention proposes a design which seeks to provide efficient electricity production within these constraints.

Summary of the Invention

[0005] According to one aspect of the present invention there is provided an electrical generator having an armature and a magnetic field, one of the armature and the magnetic field being arranged to locate inside the other; the armature and the magnetic field being co-axial; at least one of the armature and the magnetic field having a first axial end mounted to a first drive shaft and a second axial end which is free, such that rotation of the drive shaft causes direct relative rotation of the armature and the magnetic field.

[0006] In one embodiment, the other of the armature and the magnetic field has a first axial end mounted to second drive shaft and a second axial end which is free, the second drive shaft being axially aligned with the first drive shaft, the first and second drive shafts being arranged to counter-rotate.

[0007] In an alternative embodiment, the other of the armature and the magnetic field has a first axial end mounted to a fixed position.

[0008] The electrical generator may include two armatures and two magnetic fields. In one such embodiment, the electrical generator has a rotor which is generally hollow cylindrical, the rotor having a magnetic field located around an interior surface of the rotor and an armature located around an exterior of rotor, the rotor being arranged to locate within a stator, the stator having an internal armature which is positioned within the interior of the rotor and an outer magnetic field which is positioned around the exterior of the rotor. In an alternative embodiment, the respective positions of armatures and magnetic fields is reversed.

[0009] According to a second aspect of the present invention there is provided an electrical generator having an armature and a magnetic field, one of the armature and the magnetic field being arranged to locate inside the other, the armature and the magnetic field being co-axial, the armature being axially moveable relative to the magnetic field.

Brief Description of the Drawings

[0010] It will be convenient to further describe the invention with reference to preferred embodiments of the present invention. Other embodiments are possible, and consequently the particularity of the following discussion is not to be understood as superseding the generality of the preceding description of the invention. In the drawings:

[0011] Figure 1 is a schematic exploded view of a generator in accordance with a first embodiment of the present invention;

[0012] Figure 2 is a closer view of a portion of Figure 1;

[0013] Figure 3 is a schematic view of the generator of Figure 1,shown in an assembled configuration;

[0014] Figure 4 is a schematic view of an internal armature from within a generator in accordance with a second embodiment of the present invention;

[0015] Figure 5 is a schematic view of a rotor for use in conjunction with the internal armature of Figure 4;

[0016] Figure 6 is a schematic view of a stator for use in conjunction with the internal armature of Figure 4;

[0017] Figure 7 is an exploded view of a generator including the internal armature of Figure 4; the rotor of Figure 5 and the stator of Figure 6;

[0018] Figure 8 is a schematic assembled view of the generator of Figure 7;

Detailed Description of Preferred Embodiments

[0019] Referring to Figures 1 to 3, there is shown a generator 10, having an armature 12 and a magnetic field 14.

[0020] The armature 12 is located on a central shaft 16. The central shaft 16 has a first axial end 18 and a second axial end 20.

[0021] The first axial end 18 of the central shaft 16 is mounted to a first drive shaft 22, arranged to be driven by a motor 24. The central shaft 16 may be mounted directly to the drive shaft 22, or may be mounted via a gearing arrangement 26 if it is desired to have the armature 12 rotating at a different speed to the drive shaft 22.

[0022] The second axial end 20 of the central shaft 16 has a step reduction in diameter, to produce a shoulder 28 and an outer spigot 30.

[0023] The magnetic field 14 is formed by magnets mounted to the inside of a generally cylindrical stator 32. The stator 32 has a substantially closed first axial end 34 and an open second axial end 36.

[0024] The first axial end 34 of the stator 32 is mounted to a second drive shaft 38, arranged to be driven by a motor 40. The stator 32 may be mounted directly to the drive shaft 38, or may be mounted by a gearing arrangement 42 if it is desired to have the stator 32 rotating at a different speed to the drive shaft 38.

[0025] The first drive shaft 16 is arranged to be coaxial with the second drive shaft 38.

[0026] The mounting of the stator 32 to the second drive shaft 38 includes an axial recess 44 within which the spigot 30 of the central shaft 16 may locate. The axial recess 44 may include bearings to support the central shaft 16.

[0027] When the generator 10 is assembled, as shown in Figure 3, the first drive shaft 22 and the second drive shaft 38 are arranged to counter-rotate. In this way, the relative speed of the armature 12 passing through the magnetic field 14 is equal to the sum of the two drive shaft rotation speeds.

[0028] It will be appreciated that the generator 10 can be operated without requiring complicated bearings, or a flywheel. It will also be appreciated that the generator 10 can operate with only one of the drive shafts 22, 38 being powered, albeit at a lower relative speed.

[0029] It will also be appreciated that the generator 10 can be readily assembled and disassembled by relative movement of the armature 12 and the magnetic field 14 along a common central axis.

[0030] Figures 4 to 8 show a generator 100 in accordance with a second embodiment of the present invention.

[0031] The generator 100 includes an internal armature 110 shown in Figure 4. The internal armature 110 is generally cylindrical, and extends from a first axial end 112 to a second axial end 114. The internal armature 110 is mounted to a circular base plate 116 at its first axial end 112. The circular base plate 116 includes a central portion 118 which is of the same diameter as the internal armature 110, and an annular outer portion 120 which extends around the central portion 118.

[0032] The generator 100 also includes a rotor 130 as shown in Figure 5. The rotor 130 is generally cylindrical, with an internal diameter slightly larger than the external diameter of the internal armature 110. The arrangement is such that the internal armature 110 can locate within the rotor 130 with sufficient clearance to allow one to rotate relative to the other around a common central axis.

[0033] The rotor 130 has an inner surface 132 and an outer surface 134. The inner surface 132 is formed by a plurality of magnets 136 which cooperate to form a magnetic field. The movement of the internal armature 110 relative to the magnetic field formed by the magnets 136 generates electricity in the assembled generator 100.

[0034] The outer surface 134 contains wiring arranged to form a second armature 138.

[0035] The rotor 130 has a first axial end 140 and a second axial end 142. The rotor 130 is open at the second axial end 142. At the first axial end 140 the rotor 130 is closed by a circular top plate 144.

[0036] The generator 100 has a stator 150 shown in Figure 6. The stator 150 is generally cylindrical, with an internal diameter slightly larger than the external diameter of the rotor 130. The arrangement is such that rotor 130 can locate within the stator 150 with sufficient clearance to allow one to rotate relative to the other around a common central axis.

[0037] The stator 150 has an inner surface 152 formed by a plurality of magnets 154 which cooperate to form a magnetic field. The movement of the second armature 138 relative to the magnetic field formed by the magnets 152 generates electricity in the assembled generator 100.

[0038] The stator 150 has a first axial end 156 and a second axial end 158. At the first axial end 156 the stator 150 is closed by the base plate 116. The annular outer portion 120 of the base plate 116 is of the same diameter as the stator 150. The stator 150 is open at its second axial end 158.

[0039] The generator 100 can be assembled as shown in Figures 7 and 8.

[0040] The base plate 116 includes a plurality of countersunk first bolt receiving apertures 160 angularly spaced around the central portion 118. There are six first bolt receiving apertures 118 in the embodiment shown. These first bolt receiving

apertures 160 are arranged to receive first bolts 162, which extend through the base plate 116 into internally threaded securing apertures 164 at the first axial end 112 of the internal armature 110. In this way the base plate 116 can be fixed to the internal armature 110.

[0041] The base plate 116 includes a plurality of second bolt receiving apertures 166 angularly spaced around the annular outer portion 120. There are six second bolt receiving apertures 166 in the embodiment shown. These second bolt receiving apertures 166 are arranged to receive second bolts 168, which extend through the base plate 116 into internally threaded securing apertures 170 at the first axial end 156 of the stator 150. In this way the base plate 116 can be fixed to the stator 150, and the stator 150 fixed to the internal armature 110.

[0042] The top plate 144 includes a plurality of third bolt receiving apertures 172 angularly spaced around its periphery. There are four third bolt receiving apertures 172 in the embodiment shown. These third bolt receiving apertures 172 are arranged to receive third bolts 174, which extend through the top plate 144 into internally threaded securing apertures 176 at the first axial end 140 of the rotor 130. In this way the top plate 144 can be fixed to the rotor 130.

[0043] The top plate 144 includes a plurality of countersunk fourth bolt receiving apertures 178 angularly spaced around an inside thereof. There are six fourth bolt receiving apertures 178 in the embodiment shown. These fourth bolt receiving apertures 178 are arranged to receive fourth bolts 180, which extend through the top plate 144 into internally threaded securing apertures 182 within a mating flange 184 of a drive shaft 186. The drive shaft 186 is powered by a motor 188.

[0044] The top plate 144 also includes a centrally located cylindrical coupling 190, on which are mounted slip rings 192. These are arranged to receive current from brushes 194, which extend from a brush unit 196 mounted to the second axial end 114 of the internal armature 110.

[0045] When the generator 100 is assembled as shown in Figure 8, the motor 188 can be powered to turn the drive shaft 186, which acts to rotate the rotor 130. The

magnetic field created by the magnets 136 rotates relative to the internal armature 110, generating electrical current which is provided via the brushes 194 to the slip rings 192. At the same time, the second armature 138 rotates within the magnet field formed by the magnets 152, creating further electrical current.

[0046] It will be appreciated that this arrangement requires no bearings other than to support the drive shaft 186, and no fly wheel. The generator can be readily disassembled by the simple expedient of moving the stator 150 in an axial direction.

[0047] It will also be appreciated that the relative position of armatures and magnetic fields can be swapped.

[0048] Modifications and variations as would be apparent to a skilled addressee are deemed to be within the scope of the present invention.

Claims

1. An electrical generator having an armature and a magnetic field, one of the armature and the magnetic field being arranged to locate inside the other; the armature and the magnetic field being co-axial; at least one of the armature and the magnetic field having a first axial end mounted to a first drive shaft and a second axial end which is free, such that rotation of the drive shaft causes direct relative rotation of the armature and the magnetic field.

2. An electrical generator as claimed in claim 1, wherein the other of the armature and the magnetic field has a first axial end mounted to second drive shaft and a second axial end which is free, the second drive shaft being axially aligned with the first drive shaft, the first and second drive shafts being arranged to counter-rotate.

3. An electrical generator as claimed in claim 1, wherein the other of the armature and the magnetic field has a first axial end mounted to a fixed position.

4. An electrical generator having an armature and a magnetic field, one of the armature and the magnetic field being arranged to locate inside the other, the armature and the magnetic field being co-axial, the armature being axially moveable relative to the magnetic field.

5. An electrical generator as claimed in any preceding claim, wherein the electrical generator includes two armatures and two magnetic fields.

6. An electrical generator as claimed in claim 5, wherein the electrical generator has a rotor which is generally hollow cylindrical, the rotor having a magnetic field located around an interior surface of the rotor and an armature located around an exterior of rotor, the rotor being arranged to locate within a stator, the stator having an internal armature which is positioned within the interior of the rotor and an outer magnetic field which is positioned around the exterior of the rotor.

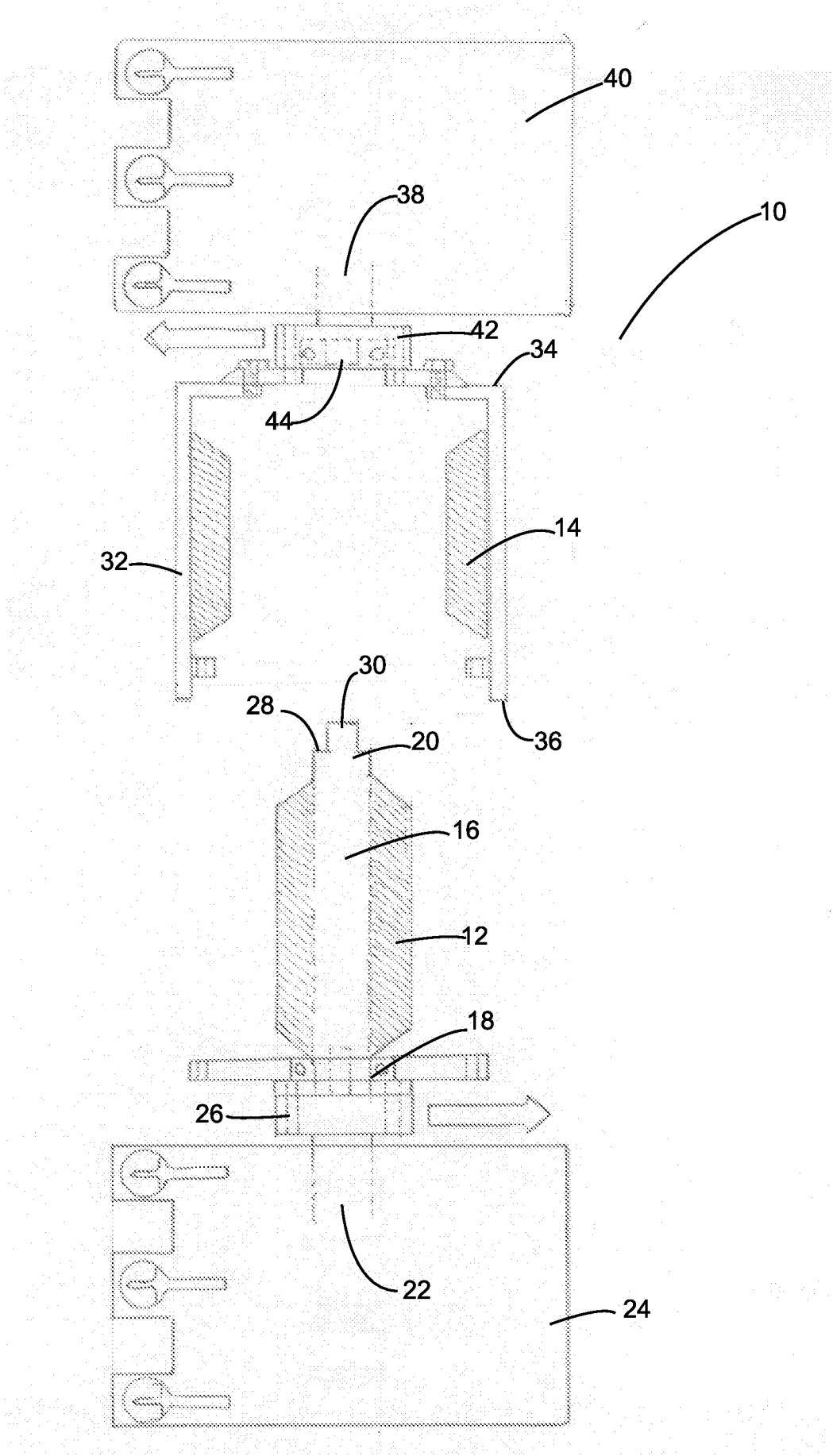

Fig. 1

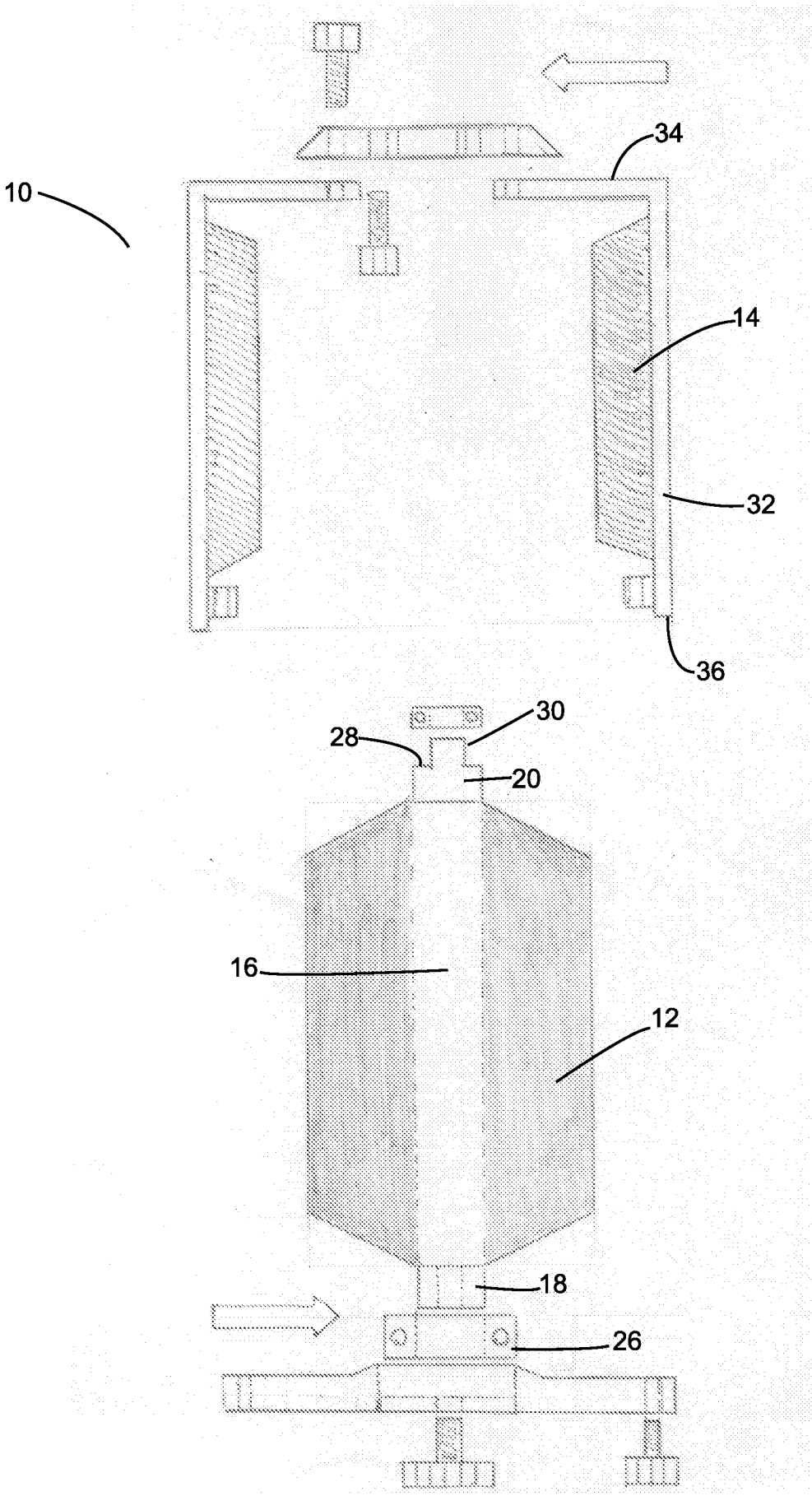

Fig. 2

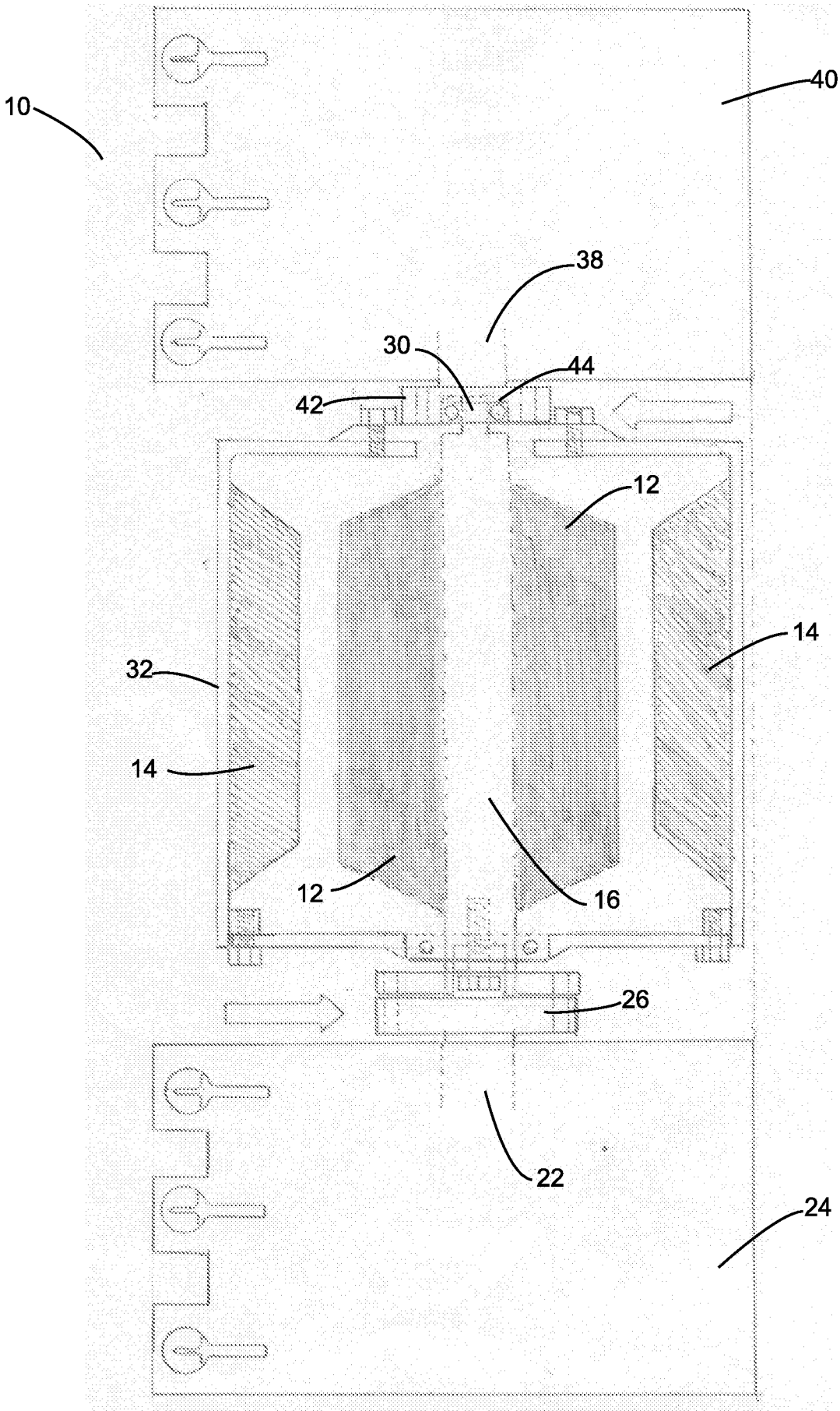

Fig. 3

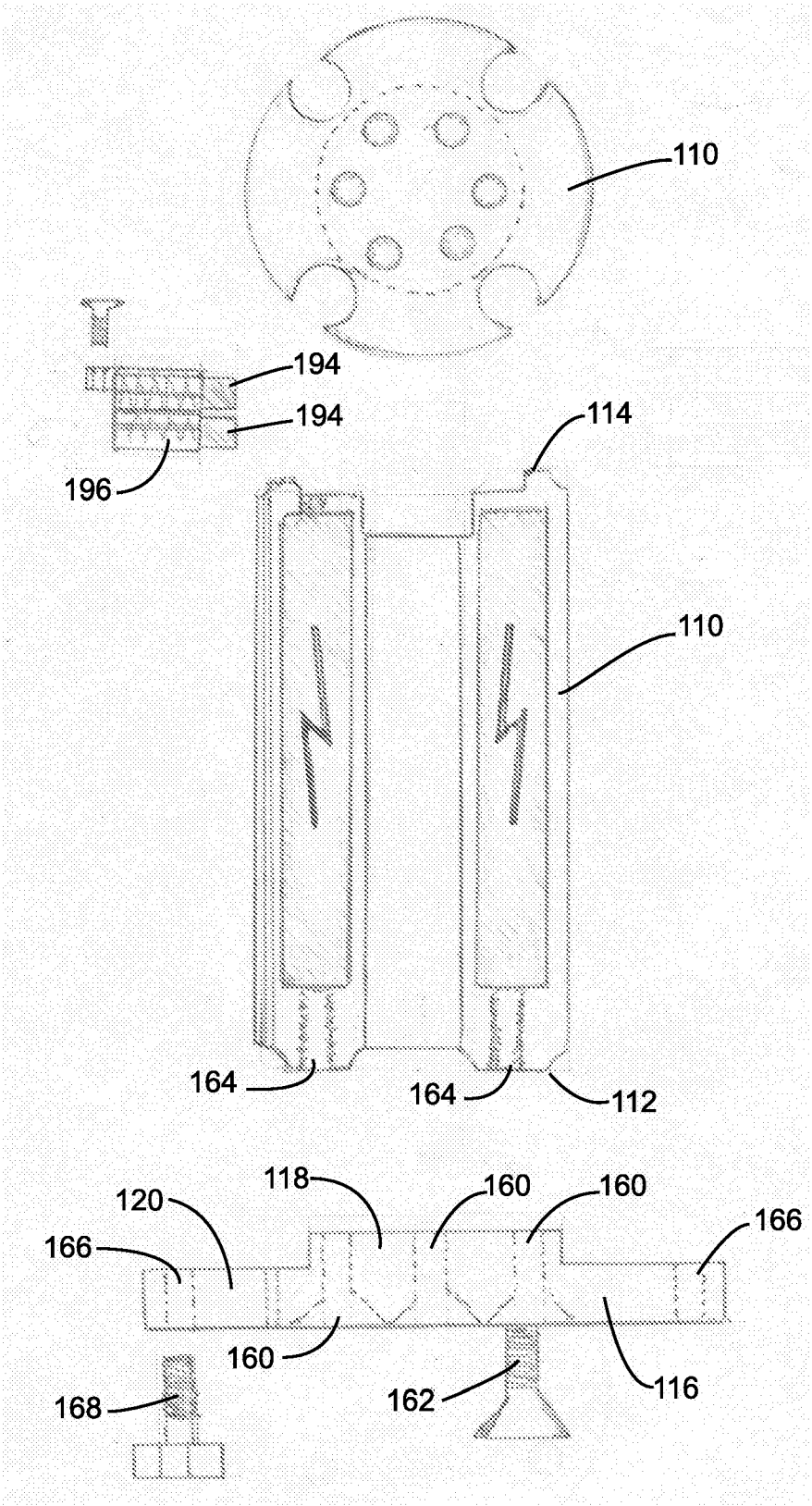
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Fig. 4

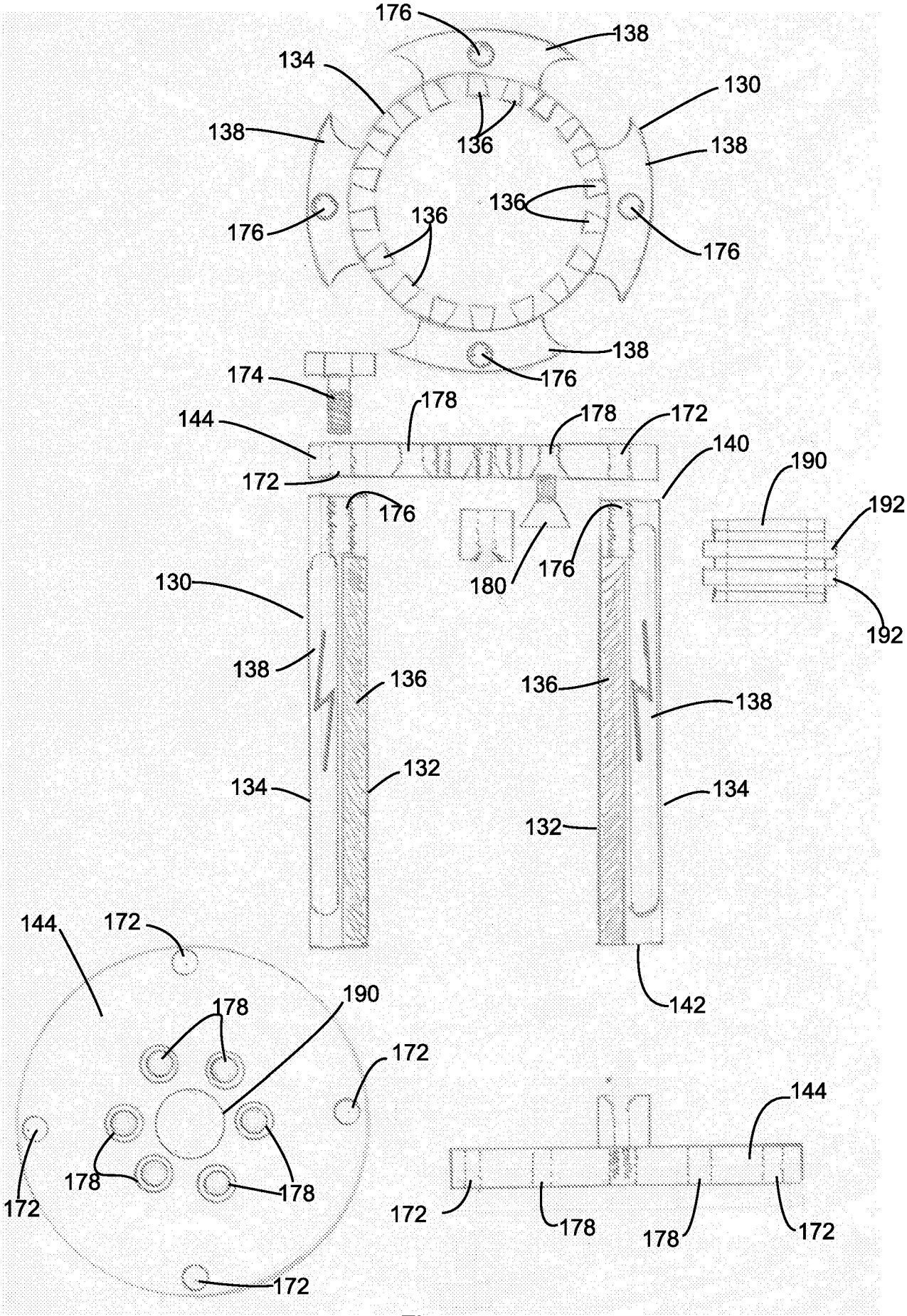
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Fig. 5

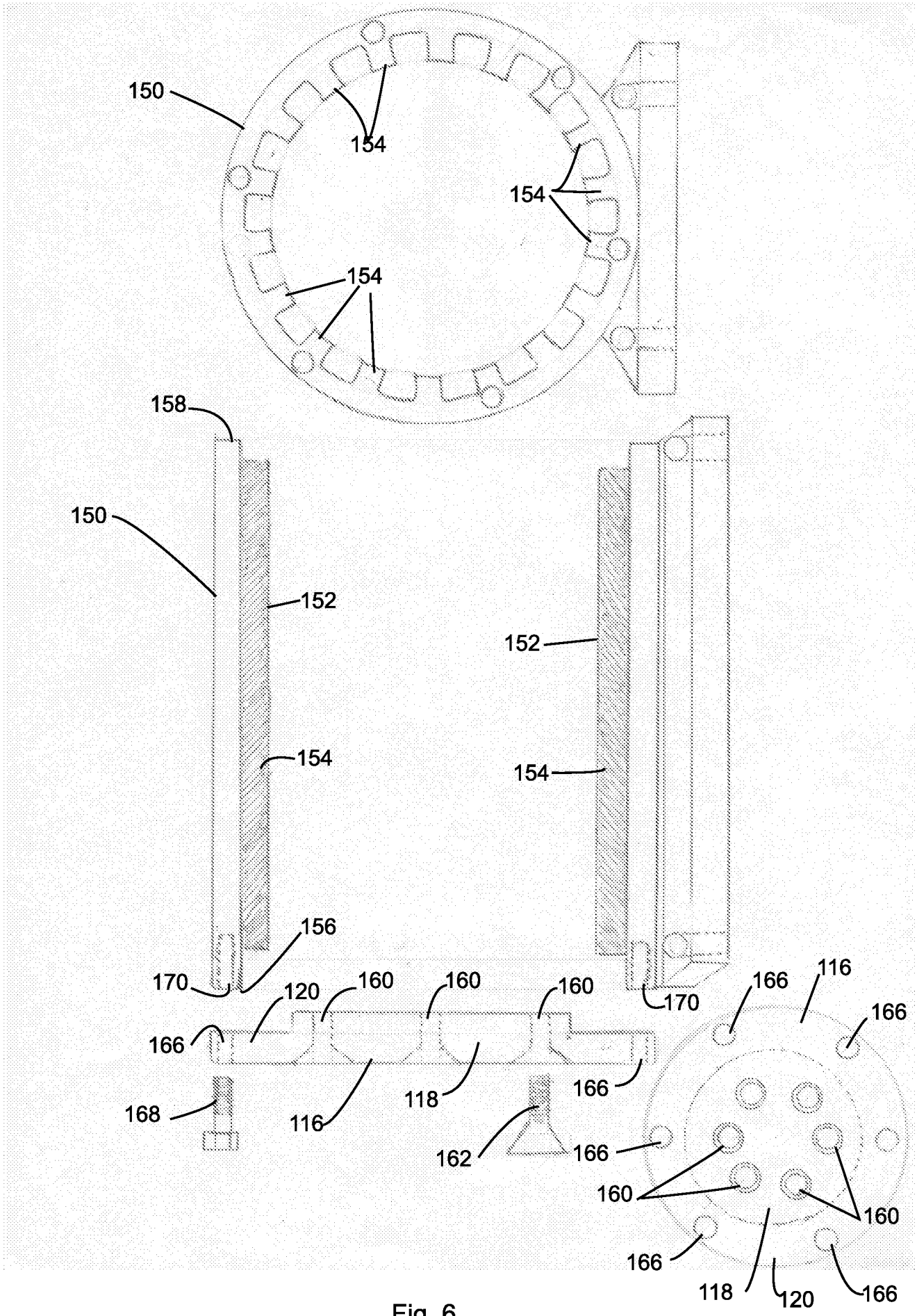
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Fig. 6

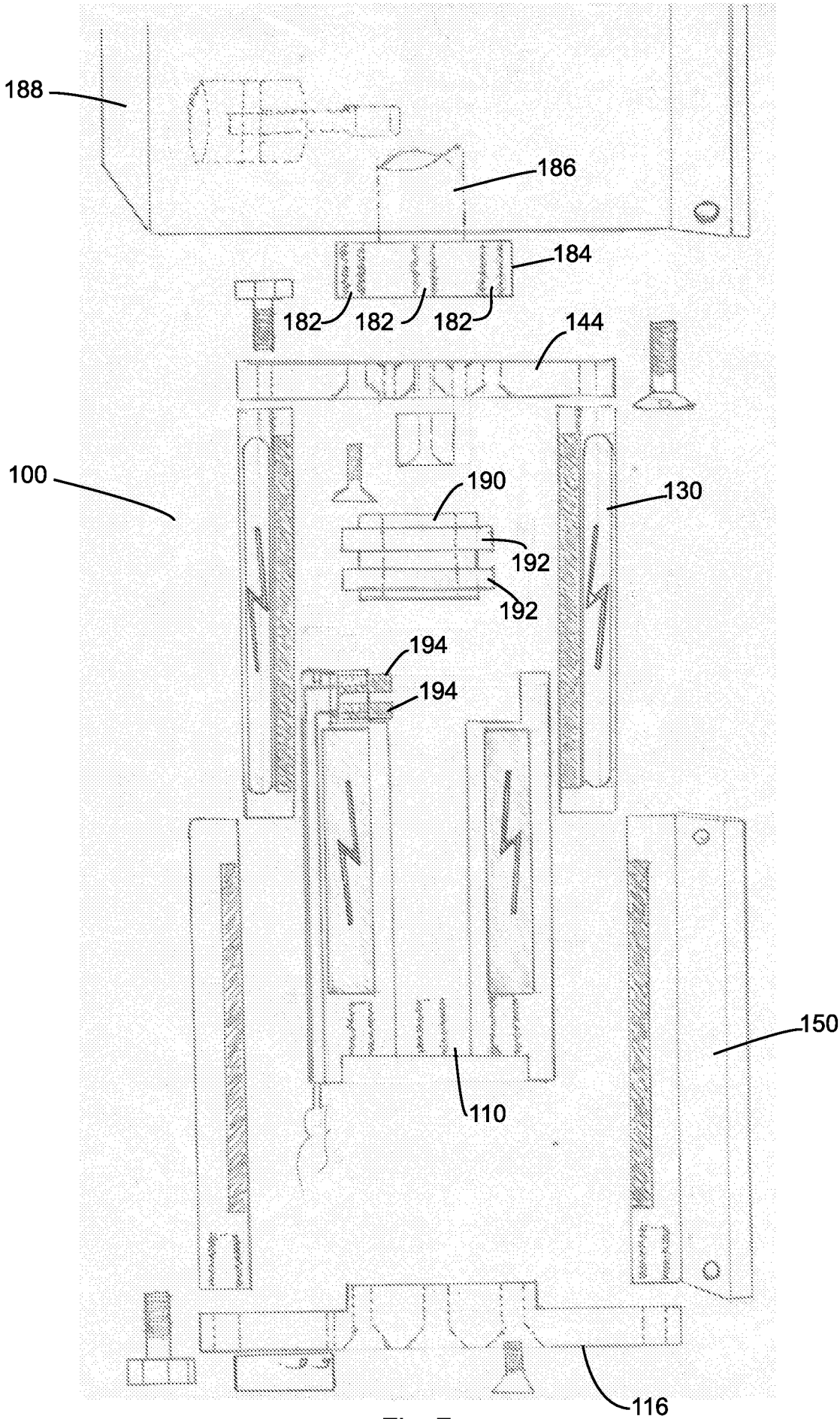
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Fig. 7

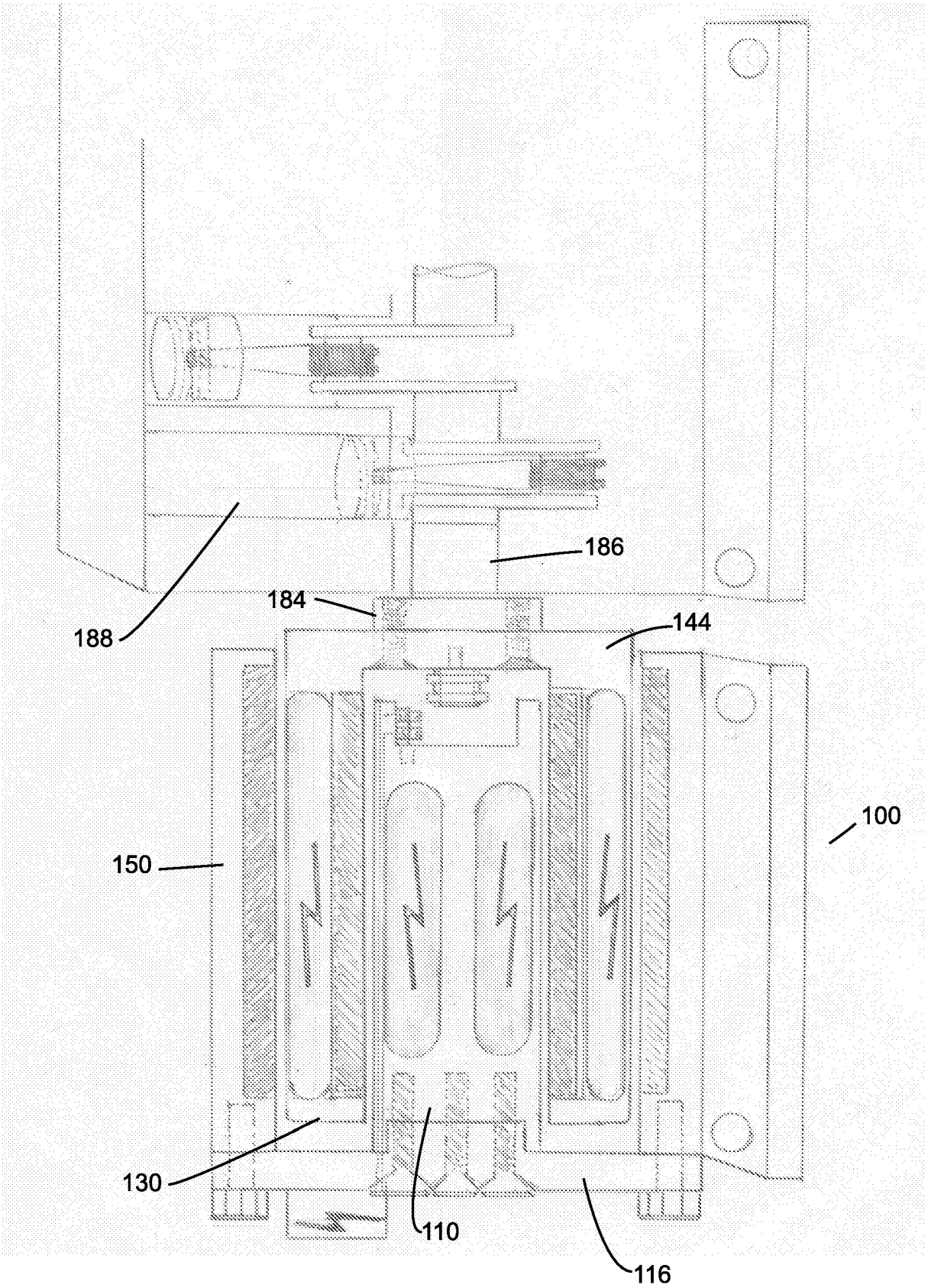

Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2017/050787

A. CLASSIFICATION OF SUBJECT MATTER

H02K 16/02 (2006.01) H02K 16/04 (2006.01) H02K 23/60 (2006.01)

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)

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)

PATENW, Google Scholar, Google Patents & ESPACENET with keywords:generator, armature, magnetic field, stator, rotor, shaft, coaxial, counter-rotation, opposite direction, and similar terms and classification symbols: H02K16/00, H02K16/005, H02K16/02, H02K16/025, H02K23/60.

Applicant name and inventor name searches were conducted in AUSPAT, ESPACENET and internal databases provided by IP Australia.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

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Date of the actual completion of the international search	Date of mailing of the international search report
24 October 2017	24 October 2017
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Mu-en Tien AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. +61262832598

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2017/050787**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/0211236 A1 (APPA et al.) 04 September 2008 See the whole document, particularly Abstract; FIG. 1, 6, 9; para. [0003], [0007]-[0009], [0021]-[0022], [0030]-[0033].	1-2, 4
X	US 6,278,197 B1 (APPA) 21 August 2001 See the whole document, particularly Abstract; FIG. 1-4; Col. 5, line 7 to Col. 6, line 8.	1-2, 4
X	US 2006/0163963 A1 (FLORES, JR.) 27 July 2006 See the whole document, particularly Abstract; FIG. 1, 4, 6-7; para. [0019]-[0022], [0026]-[0027].	1-2, 4
X	US 2010/0259117 A1 (GOODZEIT et al.) 14 October 2010 See the whole document, particularly Abstract; FIG. 1-3; para. [0037], [0039], [0053]-[0056].	1, 3-4
X	US 2012/0326539 A1 (WEBSTER) 27 December 2012 See the whole document, particularly FIG. 1; para. [0057]-[0066].	1-5
X	WO 03/078834 A1 (KREITEL, MICHAEL et al.) 25 September 2003 See the whole document, particularly Abstract; FIG. 2; page 4, line 16 to page 5, line 6.	1-6
P,X	WO 2016/147038 A1 (BARREIRO, MANUEL VIEIRA) 22 September 2016 Abstract; page 16, line 13 to page 17, line 18; FIG. 29-30	1-5

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2017/050787**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
US 2008/0211236 A1	04 September 2008	US 2008211236 A1	04 Sep 2008
		US 7679249 B2	16 Mar 2010
		WO 2009105098 A1	27 Aug 2009
US 6,278,197 B1	21 August 2001	US 6278197 B1	21 Aug 2001
US 2006/0163963 A1	27 July 2006	US 2006163963 A1	27 Jul 2006
US 2010/0259117 A1	14 October 2010	US 2010259117 A1	14 Oct 2010
		US 7843094 B2	30 Nov 2010
		US 2011025146 A1	03 Feb 2011
		US 7956503 B2	07 Jun 2011
		US 2011148238 A1	23 Jun 2011
		US 8084909 B2	27 Dec 2011
		WO 2010117459 A2	14 Oct 2010
		WO 2012118467 A1	07 Sep 2012
US 2012/0326539 A1	27 December 2012	US 2012326539 A1	27 Dec 2012
		US 9184649 B2	10 Nov 2015
		EP 2538529 A2	26 Dec 2012
WO 03/078834 A1	25 September 2003	WO 03078834 A1	25 Sep 2003
		AU 2003218783 A1	29 Sep 2003
		DE 10211476 A1	25 Sep 2003
WO 2016/147038 A1	22 September 2016	WO 2016147038 A1	22 Sep 2016
		AU 2015201365 A1	06 Oct 2016

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.