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(54) **Title:** SOLID-STATE, COMPACT, HIGH-EFFICIENCY, ELECTRIC POWER GENERATOR BATTERY ALTERNATIVE

(57) **Abstract:**

# SOLID-STATE, COMPACT, HIGH-EFFICIENCY, ELECTRIC POWER GENERATOR BATTERY ALTERNATIVE

## FIELD OF INVENTION

Systems and methods for generation of direct current (DC) with reduced electromagnetic drag, commonly referred to as reverse torque, thereby improving the operating efficiency of a generator that can be used as a battery replacement for, for example, electronic devices such as a smartphone.

## BACKGROUND

The rapid expansion in the area of electronic information technology and communication services increases the demand for and makes small, point of use, stand-alone power supplies desirable. The singular contribution to resolving Earth's demand for increasing energy consumption, particularly in the area of information management and communications, is to increase the efficiency of electric power generation by removing reverse torque from electric power generators of all sizes, from megawatt sizes down to fractions of a watt. Removal of reverse torque from generators associated with converting mechanical energy into electrical power can provide an opportunity for an electrically powered power generator for a multitude of sizes and applications. Removal of the reverse torque allows a generator to operate with 400-500% increase in efficiency. This permits the opportunity to drive the generator with a smaller electric driver and, therefore, greatly improve the generator's efficiency as well as allow for miniaturizing of a generator.

The World's first known electrical generator was Faraday's disk dynamo. Michael Faraday discovered the operating principle of electromagnetic generators in the years 1831 – 1882. These observations were later reduced into a principle called Faraday's Law by James Clerk Maxwell, a mathematician and physicist from Edinburgh, Scotland. The law simply states that an electromagnetic force is generated in an electrical conductor that encircles a varying magnetic flux. Faraday built the first magnetic rotary induction generator called a Faraday Disc. This first machine was a type of homo-polar generator, using a copper disc rotating between the poles of a horseshoe magnet. This generator produced a small DC voltage but high amperage. The Faraday dynamo or uni-pole (or uni-polar) generator, however, does not lend itself well to practical commercial development because of the nature of its output, i.e., very low DC voltage at extremely high current. The Faraday generator does lend itself well, however, to the study the mechanisms of reverse torque in electrical induction machines.

Conventional generators in use today require, by definition, 1 horsepower (HP) of kinetic energy input to generate 746 watts (W) of electrical energy. This relationship of mechanical horsepower to electrical watts involves derived units of power which have evolved from observations and measurements on physical and electrical machines (as well as horses).

The term "watt" was named after James Watt, a Scottish scientist, for his work on improving the steam engine and quantifying the power of the steam engine. The unit "watt" was recognized by the Second Congress of the British Association for the Advancement of Science in 1889, concurrent with the start of commercial power production. The dynamo was the first electrical generator capable of delivering power to industry and is still an important generator in use even to this day. The dynamo uses a particular machine design and electromagnetic principles to convert mechanical rotation into an alternating electric current. The first commercial power plants which were operated in Paris in the 1870's were designed by Zenobe Gramme. The use of electric generators made it desirable to establish a common unit for electrical power in order to standardize this newly evolving energy source. The watt is a derived unit of power (i.e., an algebraic combination of base units) and is now an approved unit of the International System of Units (SI).

As defined, 1 watt is the rate at which work is done when an object's velocity is held constant at 1 meter per second against a constant opposing force of 1 Newton.

W = J / S = N.M / S = Kg.M2 / S3

J = Joule M = Meter N = Newton Kg = Kilogram

Joule = Work done when a force of 1 Newton is displaced through a distance of 1 Meter

1 Joule = 1 watt-second, 107 ergs = 0.2390 calories or 0.738 ft-lb.

Therefore, if one mechanical horsepower is equal to 550 ft-lb per second (or 33,000 ft-lb per minute), then by definition of the watt being 0.738 ft-lb per second, 1 HP = 550 ft-lb per second / 0.738 ft-lb per second = 745.257 watts. Therefore, by definition, the electrical watt is the rate at which work is done when 1 ampere (A) of current flows through an electric potential difference of 1 volt (V):

W = V x A

745.257 W = 27.299 V × 27.299A or any combination of amps and volts in which the product is equal to 745.257 watts. Therefore, by definition and derivation, 1 HP = 746 watts.

The original work on which these standards units hinge was performed by James Watt who introduced the term "horsepower" when he wanted to explain how powerful his steam engines were compared to horses. After some tests (not with engines, rather with horses), he established that, on average, the horses being used could pull coal up a mine shaft at the rate of 22,000 ft-lb per minute. For whatever reason, he decided to raise this number by 50% and arrived at a number which is commonly accepted as 33,000 ft-lb per minute. So, if an engine or any rotary machine can push 33,000 lbs. of something 1 foot in 1 minute, the machine is considered a 1 HP engine.

As noted above, a conventional generator requires, by definition and measurement, 1 HP to generate 746 watts plus enough additional horsepower to turn the physical mechanisms of the rotor at proper speed to maintain the desired frequency. The horsepower required to spin the mechanism is usually about 0.2 HP in a conventional generator to generate 746 watts for a total 1.2 horsepower to generate 746 watts, although only 0.2 HP of that energy is used to actually generate electrical power. The remaining 1 HP which is equal to 746 watts is required to overcome the reverse torque or so-called "back electromotive force" (back EMF).

The back EMF or reverse torque of rotary generators in use today can best be described by reference to "Lenz's Law." It, in summary, states that when an EMF is generated by a change in magnetic flux according to Faraday's Law, the polarity of the induced EMF is such that it produces a current whose magnetic field opposes the magnetic flux which produces it. The induced magnetic field inside any loop of wire always acts to keep the magnetic flux in the loop constant. If the magnetic field B is increasing, the induced magnetic field acts in equal and opposite direction to it; if it is decreasing, the induced magnetic field acts in the direction of the applied field with equal force. In conventional generators, the rotor is stationed inside the coil loops of the stator and, thus, the rotor generates a current which in turn generates a magnetic field which is equal in force and opposite in polarity. Therefore, reverse torque is a product of the design.

In the case of the generators of the present disclosure, the rotors do not rotate; instead, the flux from the magnetic poles, in one embodiment, rotates and in another embodiment, transgresses laterally across the stationary "rotor"/armature. Additionally, in one design, the rotors are outside of the coil loop and, therefore, do not interact with the induced pole. This induced pole is induced by current flow and is not responsible for a current flow, as is evidenced by the fact that the generator reaches full voltage prior to current going to an electrical load.

Due to the reverse torque in conventional generators, about 85% more mechanical energy is required to turn the rotor than is required to generate power. However, in the case of the current disclosure, the generator only requires energy to excite the rotor poles to generate the rotating or transgressing magnetic flux from the poles. Therefore, the systems and methods take the power required and cycles it back to aid in driving the generator and the remaining power is usable electric power to be used for whatever purpose is required.

In the case of the generators disclosed herein, they only require energy to excite the rotor/alternator of the generator not rotate our moves the rotor itself or about 10% of power output to drive the generator. Therefore, the system takes that 10% and cycles it back to drive the generator and the remaining 90% is usable electric power to be used for whatever purpose is required.

In conventional generators, as noted above, the rotor is stationed inside the coil loops of the stator. Therefore, the rotor generates a current which in turn generates a magnetic field which is equal in force and opposite in polarity, hence reverse torque is a product of the design. The Lenz losses are related to inductive coupling between the rotor standing poles and the stator induced poles.

Concerning efforts to reduce reverse torque, Nikola Tesla published an article entitled "Notes on an Uni-polar Dynamo", Nikola Tesla, The Electrical Engineer, N.Y. September 2, 1891. Tesla reported on a modification of the Faraday Dynamo design. The design varied in two major ways:

1. First, he used a magnet that was bigger in diameter than the disc, so that the magnet completely covered the disc.

2. Second, he divided the disc into sections with spiral curves out from the center of the outside edge.

The Tesla modification caused the current to make a full trip around the outside edge of the disc. Because the current is flowing in a large circle at the rim of the disc, the magnetic field created does not work against the inducing/standing pole. This modification eliminated a significant problem of electric power generation, i.e., the reaction to every action or, as is commonly called, reverse torque or back EMF.

This design change and its effect on reverse torque were accomplished by geometric isolation of the standing pole from the induced pole of the machine. In the case of the current disclosure, the rotors are static, i.e., non-rotating or otherwise moving, and in some embodiments, are outside of the induction coil loop. Therefore, the standing coils of the rotor are geometrically isolated from the induction coils of the stator. The induced pole is induced by current flow which is generated by the standing pole. Again, the induced pole is not responsible for current flow or power generation in the induced coils. These design changes remove Lenz losses produced by the induced stator poles attracting and repelling polar coupling between the stator poles and the rotor poles. To the extent that stator coupling occurs, it will act to produce additional magnetic drag upon the rotor which is linearly proportional to the load current drawn and thereby satisfy Lenz's Law.

## SUMMARY

Consistent with the present disclosure, systems and methods are provided for an electric generator with reduced reverse torque which generator can be appropriately scaled up or down for many applications. The power in the generator is generated by using a rotor that is stationary with respect to the stator and it field windings and sequentially exciting the pole pieces of the rotor to generate moving magnetic fields emanating from the excited pole pieces to provide a moving magnetic flux to the field windings of the stator. This generator or compact electric machine can be reduced in size to allow placement into the battery compartment of any operated appliance to replace the battery for powering to the appliance. Such appliances include, for example, cell phones, smartphones, computers, tablets, e-readers, implantable devices for medical uses, and other portable electrical devices. The generator, when scaled up, can be used to provide electricity to small homes in areas devoid of electricity.

In accordance with an aspect of the power generation disclosed herein, systems and methods are disclosed for reducing drag in an electric generator that include a design of the rotor and stator of the generator and a rotor pole piece excitation system. The stator includes wire slots, stator field coil wires in the slots, and power leads to provide the generated power to a load. The rotor contains rotor poles, wire slots between the poles, rotor coil wires in the rotor wire slots, and excitation leads connected to the coil wires to provide power to a pole's coil wires to excite the pole and generate a polar magnetic flux in the form of a distinct magnetic pole which emanates from the pole, wherein the rotor does not move with respect to the stator. Excitation circuitry provides power to leads of the rotor coil wires to sequentially excite the poles, providing a moving magnetic field emanating from the rotor poles and comprised of distinct magnetic poles. The wound stator and wound rotor are contiguous to one another to provide the moving magnetic field emanating from the rotor poles to the associated stator field coil wires and produce current in the field coil wires to generate power to be output from the generator. The stator and rotor can be planar. Additionally, the rotor can be circular or another shape enabling the rotor's wire slot surface to be in sufficiently close proximity to the stator field coils to induce current in the stator field coil wires when the moving magnetic field emanates from the rotor poles.

In accordance with another aspect of the power generation, systems and methods are disclosed for reducing drag in an electric generator that includes a geometric design of the stator, placement of a unique series of "uni-polar" solid-state rotors in relation to the stator coils along with magnetic shielding which results in minimal destructive interaction of the rotor magnetic fields with the magnetic fields of the stator when the generator is connected to an electric load. These designs include distributing first members of slot rotors along the outer periphery of a first stator section having induction windings accommodated in slots. The slots of the first stator section are axially aligned along a lengthwise and depthwise axis. The first members of slot rotors contain solid-state electromagnets that have a first magnetic polarity or a second magnetic polarity on the outer face. The slot rotors distributed along the outer periphery are distributed in alternating polarity from first magnetic polarity to second magnetic polarity. The slot rotors may be activated in such manner that the first pole having a first magnetic polarity and the second pole having a second magnetic polarity are located in geometrically adjacent corners of the stator, such that a first side of a stator armature coil is excited by a first magnetic polarity, a second side of a stator armature coil is excited by a second magnetic polarity such that maximum moving flux density in the provided in the induction windings to induce a DC current to flow therein. The rotor is static and, therefore, reverse torque is not an issue.

The rotor can be made by cutting the laminates from electrical steel in the desired diameter with, for example, 16 pole pieces of equal size and distribution. Material of high magnetic permeability, such as graphene, can be used. The pole pieces are wound with the desired and appropriate electrical magnetic wire, and the magnetic wire coils are terminated in the leads connected to a programmable logic controller (PLC)-controlled excitation system. The pole windings can be, for example, aluminum, copper, or graphene-coated or some other appropriate electrical conductor. The system allows switching in an alternate fashion from a first polarity to second polarity and vice versa by use of a gating system, such as a MOSFET diode gating system, in the excitation circuitry. The rotor poles can be wired into four groups of four polls per group, for example.

The PLC can be powered by a battery which also powers an appropriate electrical load, such as a smartphone. An on-off switch can be used to break the circuit from the battery to the PLC. The circuit may also be broken or closed by a MOSFET transistor which opens the circuit when the battery is fully charged or needs additional charge. The voltage from the generator to the battery is controlled by, for example, a transistor voltage regulator.

The stator is of appropriate thickness and is constructed of laminated electrical steel, laminated graphene, or like material. The stator wire is of such material such as copper, aluminum, graphene, or high temperature super conductor material, such as ceramic.

In a preferred embodiment, the stator section can have substantially a square shape, but not confined to a square shape, with the rotor cavities located in the corners of the square, where the stator section is concentric about the longitudinal axis. Shape affords geometric isolation from the magneto-motive poles in the stator and, thereby, reduces the drag forces between the stator and the magnetized rotors. The first polarity of slots and the second polarity may contain up to 48 slots, but not restricted nor limited to 48, without increasing the drag forces.

The slots can be wired such that the 360° of slots are wound in a counterclockwise direction and are lapped by 360° slots wound in a clockwise direction. Therefore, the induced North pole cancels the induced South pole, thereby electromagnetically isolating the rotor magnetic field from the induced potential stator magnetic field.

If the coil conductor material with very low resistance to electron flow is employed (e.g., a room temperature superconductor), such as a graphene coated magnet wire, is used for the windings of both the stator and the rotors, significant increase in power output can be realized for the same power input. Alternatively, a generator one-fifth or one-tenth the size could generate the same power output while using the superconductor coils.

Before explaining certain embodiments of the present disclosure in detail, it is to be understood that the disclosure is not limited to the arrangements of the components set forth in the following description or illustrated in the drawings. The disclosure is capable of embodiments in addition to those described and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein, as well as in the abstract, are for the purpose of description and should not be regarded as limiting.

As such, those skilled in the art will appreciate that the conception and features upon which this disclosure is based may readily be utilized as a basis for designing other structures, methods, and systems for carrying out the several purposes of the present disclosure. Furthermore, the claims should be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present disclosure.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute part of this specification, and together with the description, illustrate and serve to explain the principles of various exemplary embodiments. In the drawings:

FIG. 1 is a diagram illustrating a cross-sectional end view of an exemplary rotor laminate of a high efficiency generator, revealing the pole iron with angulation in a clockwise fashion, the mu metal flux return iron, and simple pole iron windings, consistent with embodiments of the present disclosure.

FIG. 2 is a diagram illustrating an exemplary first polarity (North pole) uni-pole or alternating single pole rotor with pole excitation circuitry of a generator, consistent with embodiments of the present disclosure.

FIG. 3 is a diagram illustrating an exemplary pole, but in a second polarity (South pole), of the uni-pole or alternating single pole rotor with the pole excitation circuitry of a generator, consistent with embodiments of the present disclosure.

FIG. 4 is a diagram illustrating a magnetic flux field from the end view of the solid state four pole rotor of a generator with pole windings and excitation polarity sequencing along with the flux field which is rotating clockwise, consistent with embodiments of the present disclosure.

FIG. 5 is a diagram of a cross-section of a stator containing the rotors and with stator coils in place, consistent with embodiments of the present disclosure.

FIG. 6 illustrates a smartphone with the screen detached revealing the high efficiency generator with control module and battery in place, consistent with embodiments of the present disclosure.

FIG. 7 illustrates a smartphone with the screen detached and removed, revealing the high efficiency generator with its control module and battery in the form of a battery replacement for the phone's battery, consistent with embodiments of the present disclosure.

FIG. 8 illustrates a top view of a hard power pack protective case for smartphones containing the high efficiency generator, consistent with embodiments of the present disclosure.

FIG. 9 illustrates a hard power pack protective case for smartphones absent the mu metal foil and outer cover, revealing an embodiment of the high efficiency generator, consistent with embodiments of the present disclosure.

FIG. 10 illustrates a hard power pack protective case for smartphones with the outer protective cover removed, revealing the mu metal foil shield.

FIG. 11 illustrates a flat, solid state "rotor" (armature) with preformed coils in place for an embodiment of the high efficiency generator, consistent with embodiments of the disclosure.

FIG. 12 illustrates a flat, solid state stator with preformed field coils in place for an embodiment of the high efficiency generator, consistent with embodiments of the disclosure.

FIG. 13 illustrates the armature and stator of the generator being installed into the hard power pack protective case of a smartphone, consistent with embodiments of the disclosure.

FIG. 14 illustrates a side view of the hard power pack protective case of a fully assembled smartphone with armature and stator of the high efficiency generator installed with mu metal foil in place covering the back and sides of the stator, consistent with embodiments of the disclosure.

FIG. 15 illustrates a bottom view of the hard power pack protective case of a fully assembled smartphone containing the high efficiency generator, consistent with embodiments of the disclosure.

FIG. 16 illustrates an end view of the flat solid-state armature with preformed coils in place, consistent with embodiments of the disclosure.

FIG. 17 illustrates an end view depiction of the armature with preformed coils in place and evolving lines of North pole flux off the face of North pole #1 and evolving lines of South pole flux off of the face of South pole #1.

FIG. 18 illustrates an end view depiction of the armature with preformed coils in place with left to right evolving North pole and South pole flux, consistent with embodiments of the disclosure.

FIG. 19 illustrates an end view depiction of the armature with preformed coils in place with further evolving, left to right North pole and South pole flux, consistent with embodiments of the disclosure.

FIG. 20 illustrates an end view depiction of the armature with preformed coils in place with yet further evolving, left to right North pole and South pole flux, consistent with embodiments of the disclosure.

FIG. 21 illustrates an end view depiction of the armature and stator of the generator, invention revealing the armature pole windings and the lap wound stator windings and lines of flux moving across the stator windings, consistent with embodiments of the disclosure.

FIG. 22 illustrates a circuit diagram, revealing a armature excitation system and interaction of the PLC and pole switching circuitry for the embodiments of the high efficiency generator, consistent with embodiments of the disclosure.

FIG. 23 illustrates a circuit diagram, revealing PLC and pole switching circuitry for the excitation system of the embodiments of the high efficiency generator, consistent with embodiments of the disclosure.

## DETAILED DESCRIPTION

Embodiments herein include systems and methods. At least some disclosed methods may be executed, for example, by at least one processor that receives instructions from a non-transitory computer-readable storage medium. Similarly, systems consistent with the present disclosure may include at least one processor and memory, and the memory may be a non-transitory computer-readable storage medium. As used herein, a non-transitory computer-readable storage medium refers to any type of physical memory on which information or data readable by at least one processor may be stored. Examples include random access memory (RAM), read-only memory (ROM), volatile memory, nonvolatile memory, hard drives, CD ROMs, DVDs, flash drives, disks, and any other known physical storage medium. Singular terms, such as “memory” and “computer-readable storage medium,” may additionally refer to multiple structures, such a plurality of memories and/or computer-readable storage mediums. As referred to herein, a “memory” may comprise any type of computer-readable storage medium unless otherwise specified. A computer-readable storage medium may store instructions for execution by at least one processor, including instructions for causing the processor to perform steps or stages consistent with an embodiment herein. Additionally, one or more computer-readable storage mediums may be utilized in implementing a computer-implemented method. The term "computer-readable storage medium" should be understood to include tangible items and exclude carrier waves and transient signals.

Embodiments of the present disclosure provide numerous advantages over prior systems and methods. For example, various exemplary embodiments are discussed and described herein involving aspects of an electric machine, such as a generator, that produces power with high efficiency and very low electromagnetic drag. The relevance of elimination of the drag to its uses and applications along with the use of superconductor coils is presented and discussed. For example, embodiments of the present disclosure provide systems and methods for a generator design virtually free of reverse torque and one in which can be made small enough to be used as a battery replacement in electronic devices as discussed above. These design features, including Geometric Isolation, Singular Stator Winding Pattern, Shielding and Unique Rotor Design are explained next.

1. Geometric Isolation: Each stator armature induction coil may be located in two separate rotor cavities, such that only one side of a stator coil is in close proximity to a first magnetized rotor, while the opposite side of the coil is in close proximity to a second magnetized rotor. Both rotors are outside of a closed induction loop. Reverse torque of a conventional generator may be formed when a single rotor excites both sides of a stator coil, one being at least one North pole and the other at least one South pole. Based on Lenz's Law, there is an induced current in a closed loop if the magnetic flux through the loop is changing. The direction of the induced current is such that the induced magnetic field opposes a change in flux. In the case of the present disclosure, the magnetic field of the rotor is geometrically removed and isolated from a magnetic axis or center line of a stator magnetic pole. Therefore, reverse torque does not occur to any significant extent due to this geometric separation of the would-be opposing magnetic poles.

2. Singular Stator Winding Pattern: A stator armature may be wound with lapping coils in wire slots such that a direction of current flow in the lapping coils is identical in all slots of an individual rotor cavity. However, as the coils exit stator induction slots, the coils are physically wound in opposite directions thereby creating opposite magnetic polarities and

effectively canceling available magnetic polarity which may otherwise form a small amount of effective reverse torque.

3. Shielding: A stator armature iron also contains a series of mu metal shields between wire slots, which allow flux linkage between narrow segments of side iron and back iron and a uni-pole rotor flux such that an armature coil inductive power generation may be attained. (Mu metal can, for example, be an annealed metal of 75% nickel, 15% iron, plus copper, and molybdenum.) However, no significant reverse torque is developed.

4. Unique Rotor Design: A modified pole rotor may be a singular alternating uni-pole (function as single-pole) rotor. The design of the modified pole rotor allows North magnetic pole flux for 360° of rotation followed by South magnetic pole flux for 360° of rotation. This rotor design does not exhibit a detectable magnetic center pole or center line which could tend to line up on small magnetic poles of a stator and thereby develop some counter torque. Rotor magnetic coils are excited through slip rings by a solid state DC power excitation system which allows alternation between North magnetic pole and South magnetic pole for a full 360° of rotor surface. The frequency may be controlled by a separate small motorized sensor wheel or a solid-state frequency generator and PLC, which may be regulated to any desired frequency through a master computer control regardless of the speed of generator rotors.

In accordance with a preferred embodiment of the generator described herein, the classic rotor or armature of a generator has been replaced by flat members of high efficiency electric steel and/or graphene laminated high efficiency electrical steel alone and/or laminated with graphene. The armature and stator are fabricated from laminated material of high magnetic permeability. The two members are flat and may be in a variety of shapes – square, rectangular, etc. The armature and stator are manufactured with wire slots in parallel. Preformed or pre-wound coils are placed into the slots and connected in an appropriate manner. The two parts are assembled by placing them with wire slots facing each other and with wire slots in parallel. This design allows the generator to be downsized to be used as a replacement for batteries in electronic devices as discussed herein.

Reference will now be made in detail to the exemplary embodiments implemented according to the disclosure, the examples of which are illustrated in the accompanying drawings

FIG. 1 illustrates a cross-sectional view of an exemplary rotor laminate with 16 pole irons numbered 1 through 16. The rotor laminates are supported on a support staff 2 surrounded by a mu metal sleeve 1. A single pole 3 is shown with North and South pole leads 4 and 5 connected to the pole's winding to provide excitation pulses to pole 3. The poles are angulated in a clockwise rotational fashion which allows the evolving magnetic field from each pole to emanate at a 45° angle (not limited to 45°) in a clockwise direction, and as the field is repelled by the existing adjoining like pole, the flux is encouraged to rotate parallel the surface of the rotor in a clockwise direction.

FIG. 2 illustrates an exemplary a uni-polar rotor 6 in the first polarity (North in the illustration), wiring 7-11, and excitation system. The excitation circuitry includes control panel 14, PLC 15, and conduits 16 from PLC 15 to exciter channels 17. The exciter channels are shown in this embodiment as channels CH1-CH4, the output of which is provided to wiring 11 by way of conduits 13 to provide excitation pulses to the rotor's poles. An exemplary battery 12 provides power to the excitation circuitry by way of conduit 18. As will be discussed later, some of the power generated by the generator is returned by way of conduit 19 to recharge battery 12 as needed.

The pole pieces are divided into four groups. Group #1 (poles 1 – 4), #2 (poles 5 – 8), #3 (poles 9 – 12), and #4 (poles 13 – 16). The first pole in each group is excited with DC current from the relays of the excitation system. (The excitation system will be discussed below with respect to the excitation board illustrated in FIG. 22 and the pole switching board illustrated in FIG. 23.) The relays are opened by a PLC pulse to a MOSFET transistor gate within the relay circuitry. The excitation is in a first polarity. Then 2.084 milliseconds (ms) later, the second pole in each group is excited with a DC current from the excitation board and pole switching board operation. The channel is opened by a PLC pulse to a MOSFET transistor within the relay. The excitation is also in the first polarity. Then 2.084 ms later, the third pole in each group is excited with a DC current from the boards' operation. The channel is opened by a PLC pulse through a MOSFET transistor within the relay. The 2.084 ms duration stated is merely exemplary. The excitation again is first polarity. Then 2.084 ms later, the fourth pole in each group is excited with a DC current from the boards. The channel is opened by a PLC pulse to the MOSFET transistor gate within the relay. The excitation is again in first polarity. Then, 2.084 ms later, the first poles in each group are again excited with first polarity.

FIG. 3 illustrates an exemplary uni-polar rotor in a second polarity (South in the illustration) with the wiring and excitation system. The pole pieces are, like in the exemplary embodiment in FIG. 2, divided into four groups. Group #1 (poles 1 – 4), #2 (poles 5 – 8), #3 (poles 9 – 12), and #4 (poles 13 – 16). The poles in each group are excited in the same way as those above with respect to FIG. 2; however, the excitation places the poles in the second polarity instead of the first polarity.

FIG. 4 illustrates the magnetic flux field from the end view of an exemplary solid state four pole rotor 20 disclosed herein with pole windings and excitation polarity sequencing and flux field rotation clockwise. Flux field 21 of pole 1 is a first polarity (e.g., North N) and is collapsing as indicated by the downward arrow (↓), and flux field 22 from pole 5 is a second polarity (e.g., South S) and is also collapsing. Both poles 1 and 5 have been excited for 4.167 ms, creating flux fields 21 and 22. Flux field 23 of pole 2 is the first polarity and is at peak excitation, as indicated by the vertical dash (—), after 4.167 ms of excitation. Flux field 22 of pole 5 is collapsing (↓) after 4.167 ms of excitation. Flux field 24 of pole 6 is a second polarity and is at peak excitation (—) after 4.167 ms of excitation. Flux field 27 of pole 12 is a first polarity and flux field 28 of pole 16 is a second polarity and both are increasing (↑) and are only microseconds into the excitation phase. This FIG. 4 depicts the sweeping clockwise rotation of the magnetic poles. This rotational effect is generated by the adjacent like pole deflecting the flux in a clockwise direction as the poles are sequenced in a clockwise fashion. As above, the stated durations are merely exemplary.

FIG. 5 is a cross-section of an exemplary stator 29 with multiple rotar cavities R1 – R8, rotors 34-38, and windings (not numbered) in place in which the first side of each coil is wound in one rotary cavity and the second side of each coil is wound in an adjoining rotor cavity. In this embodiment, the rotor is stationed outside of the stator coil loops and uses the solid state uni-pole rotor discussed above. As shown in FIG. 6, the generator illustrated in FIG. 5, along with the excitation system, can be used to replace the battery of a smartphone or other electronic device requiring a battery as discussed herein.

The exemplary uni-pole rotor of the DC generator has 16 pole pieces, as illustrated, wired into four groups of four pole pieces per group. Pole pieces in each group are connected to the excitation system. The DC current generator/battery replacement has alternate rotor cavities which are continuously excited either North pole or South pole. For example, rotor 34 in rotar cavity R1 is a North pole; rotor 31 is a South pole; rotor 32, North pole; rotor 33, South pole; rotor 35, South pole; rotor 36, North pole; rotor 37, South pole; and rotor 38 is North pole. Each uni-pole rotor can have a magnetic pole speed, for example, of 30,000 RPMs. With times being exemplary, pole piece 1 of each group (see, for example, FIGS. 1-4) is excited and one millisecond later, pole piece 2 is excited, and one millisecond later, pole piece 3 is excited and one millisecond later, pole piece 4 is excited, subsequently one millisecond later, pole piece 1 is again excited, and the cycle is repeated continuously. Each pole is excited for two milliseconds with two millisecond collapse times. The pole of each rotor is excited by an excitation system as disclosed herein.

FIG. 6 illustrates an exemplary smartphone 42 with the open screen 41, revealing the solid state generator 43, stator – rotors 44 and 45 installed along with the excitation system described herein illustrated as power control module 47 and battery 46.

FIG. 7 illustrates smartphone 42 with a battery replacement generator pack 48. The phone’s screen is off revealing the phone’s battery compartment with the solid state generator, rotorsand stator 44 and 45, power control module 47, and battery 46 configured to be and being installed in the battery compartment. The battery replacement also includes contact plugged 48a to connect with the phone for signals and current.

FIG. 8 depicts a hard power pack protective case 49 for smartphones, for example, containing the generator disclosed herein. The wound armature and wound stator of the embodiments of the generator (see, for example, generator illustrated FIG. 9 and the generator embodiment illustrated in FIGS. 11-21 below) are contained within the body covered by the outer covering 51. The generator is not activated, however, until control containment member 54 is plugged onto the male members 52 and 53 and includes the excitation system illustrated as power control module 56 and its battery 55. The smartphone is plugged onto charging member 50 and containment member 54 is plugged onto male members 52 and 53. This maneuver activates and starts the generator and powers the phone, either by charging the phone’s battery or by serving as the phone’s battery itself.

FIG. 9 illustrates the hard power pack protective case 49 for a smartphone containing generator pack 48. As noted above, the generator is not activated until control containment member 54 is plugged onto male members 52 and 53

FIG. 10 illustrates hard power pack protective case 49 with the outer protective cover removed, revealing the mu metal foil shield 51 on the generator. The mu metal foil shield deflects the armature flux at right angles and encourages the armature flux line to progress across the stator coils.

FIG. 11 illustrates an exemplary flat solid state “rotor” or armature 59 of an embodiment of the generator disclosed herein and the armature’s preformed coils 60 and 61 in wire slots terminating in (-)/(+) leads 61L, 62L to provide pole excitation. Each pole, for example, poles 57 and 58, is wound individually to yield approximately 150 – 300 amp turns of conductor. This number of amp turns will yield 3,000 to 6,000 gauss per pole. In the armature illustrated, the coils are wound such that when excited the North pole’s N are on the left side of the armature from the viewing perspective and South poles are on the right side. The armature laminates are stacked, as indicated by the lines drawn across the armature, together to create the armature.

FIG. 12 illustrates an exemplary flat solid state stator 63 of the generator with preformed, lap wound field coils 70 and terminal leads 69 (+) and 68 (-) for power output. Stator poles 64 and 67 and wire slots 65 and 66 are illustrated as is mu metal shield 71.

FIG. 13 depicts armature 59 and stator 63 being installed into hard power pack protective case 49 of a phone. Also shown, as discussed above, are control containment member 54 with its control power module 56 and battery 55 and male members 52, 53. (Note: only a portion of the laminate lines are illustrated for clarity.) The armature 59 and stator 63 will be folded together in the installation process into hard power pack protective case 49. (See, FIG. 21 for an illustration of a cross-sectional view of the armature and stator when folded together.) The outer mu metal shield 71 will be in place on the backside of armature 59.

FIG. 14 is a side view of hard power pack protective case 49 with the generator module in place and the control/battery containment means 54 in place such that the self-sustaining generator is functioning.

FIG. 15 illustrates the back of hard power pack protective case 49 with containment means 54 in place.

FIG. 16 is an end view of the flat solid state armature 59 with pole structures. With reference to the left of FIG. 16 up to the mid structure of armature 59, North pole 58 includes poles 58(1)-58(4) and are followed by South pole 57’s poles 57(1)-57(4). The poles are excited by North pole leads 61L and the armature pre-formed coils 61 and South pole leads 60L and armature pre-formed coils 60. For a North pole flux generation, a DC pulse on a lead of leads 61L is routed to a coil of coils 61 in a counterclockwise direction and for South pole flux generation, a DC pulse on a lead of leads 60L is routed to a coil in coils 60 is executed in a clockwise direction. The power generation mechanism of action of exemplary armature 59 is depicted in FIGS. 17-21.

In FIG. 17, pole 58(1) is emitting a North pole flux 58a since a DC pulse has been provided to the coil of coils 61 for pole 58(1) by way of the lead of leads 61L for that pole to excite the pole. Similarly, pole 57(1), excited by a pulse on the coil of coils 60 for that pole via the lead of leads 60L for the pole, is emitting a South pole flux 57a.

The progression of the North pole flux and South pole flux across armature 59 is further demonstrated in FIG. 18. Pole 58(1) emits North pole flux 58a as discussed above which repels North pole flux 58b which emanates from pole 58(2) which has been excited by a pulse on the lead of leads 61L for the coil of coils 61 for pole 58(2). Flux 58b evolves from pole 58(2), 1.043 milliseconds (times are exemplary) after pole 58(1) is excited. The repulsion of flux 58b by flux 58a sets up a pulsing field which progresses across all of the armature’s North poles. Pole 57(1) emits South pole flux 57a as discussed above which repels South pole flux 57b which emanates from excited pole 57(2) and which evolves from pole 57(2) 1.043 milliseconds after pole 57(1) is excited. The repulsion of flux 57b by flux 57a sets up a pulsing field which progresses across all of armature 59’s South poles.

FIG. 19 illustrates the further evolution of the North-South pulsing pole magnetic field which generates the DC power when armature 59 is associated with stator 63. Similar to the generation of flux 58b and 57b described above, pole flux 58c and 57c are generated by the excitation of poles 58(3) and 57(3), respectively, and are repelled by flux 58b and 57b, respectively, further pushing the pole field from left to right in North and South poles 58, 57.

FIG. 20 depicts the further evolution of the North-South pulsing pole magnetic field which generates the DC power. Again similar to the generation of flux 58b, 57b, 58c, and 57c described above, pole flux 58d and 57d are generated by the excitation of poles 58(4) and 57(4), respectively, and repelled by flux 58c and 57c further pushing the pole field from left to right.

The poles are sequenced in the following exemplary fashion. North pole 58(1) and South pole 57(1) are simultaneously excited with DC current; 1.043 milliseconds later pole

North pole 58(2) and South pole 57(2) are excited; 1.043 milliseconds later North pole 58(3) and South pole 57(3) South are excited; and then 1.043 milliseconds later, North pole 58(4) and South pole 57(4) are excited. Then 1.043 milliseconds later, the cycle begins all over again. Each pole is excited for four milliseconds and then allowed to collapse for the next period prior to being excited again. Again, all times are exemplary.

FIG. 21 depicts stator 63 pressed against armature 59; armature pole windings pre-formed coils 61, 60; armature coil leads 61L and 60L; North pole flux 58(1)-58(4) and South pole flux 58(1)-58(4) generated by and emanating from armature 59 as described above into stator 63 and its lap wound stator coils 70; mu metal shield 71; and power leads 62a and 62b. Power leads 62a and 62b conduct the DC power generated by the solid state generator and is carried to an electrical load, such as a smart phone or other battery-operated electrical device.

Exemplary control circuits for all embodiments of the solid-state generators disclosed herein are illustrated in FIGS. 22 and 23 showing exemplary circuitry for an excitation board (FIG. 22) and a pole switching board (FIG. 23) with its MOSFET programmable logic controller (PLC) system which allows sequencing of the alternating magnetic poles of the generators disclosed herein. The sequencing for each pole is described as follows.

A DC pulsed signal is generated by a frequency generator 240 shown in FIG. 23. The DC pulse signal is sent to the first and second channels of PLC 239 through conduit 242. PLC channel 1 controls the signal to the excitation board (FIG. 22) through conduits 244 and 243. PLC channel 2 controls the signal to the pole switching board through conduits 231 and 245. The excitation is transmitted to the excitation board and enters the circuit through contact block 277 in FIG. 22. The signals control MOSFET gates 272 and 269. MOSFET gates 272 and 279 have 12 volts of DC current, but not limited to 12 volts, on them constantly to maintain the gates' closure. The default position for these gates is to be open. PLC channel 1 and channel 2 turn the DC current off to the MOSFETs for a specified period of time and allows the gates to open for channel 1 and channel 2 which allows current to be routed in the case of channel 1 through conduits 279 and 263 to contact block 278. Contact block 278 has four contact points, C#1, A#1, A#2, and C#2. Jumper connections connect contact C#1 of block 278 to contact C#1 213 on the pole switching board. Jumper connections connect contact A#1 of block 278 to contact A#1 214 on the pole switching board. Jumper connections connect contact A#2 of block 278 to contact A#2 215 on pole switching board. Jumper connections connect contact C#2 of block 278 to contact C#2 216 on the pole switching board. These circuits provide a times alternating pulse of DC current to the pole switching board side #1 and side #2. PLC channel #2 sends signal to MOSFET gates 209 and 225 on the pole switching board to open the gates for a specified period of time for current to flow through conduit 245 to side #1 and 231 to side #2. The DC power to operate the excitation circuit is provided by batteries. Battery 248 (battery A in FIG. 22) is connected to contact block 250 through conductor 259 to side A anode and through 260 to side A cathode. Battery 249 (battery B in FIG. 22) is connected to the contact block 250 through conductor 257 to side B anode and through conduit 258 to side B cathode. The pulse current to the rotor/armature poles is controlled by 3.2 ohm, but not limited to 3.2 ohm resistors 261 and 262.

The first polarity current (e.g., North pole) is generated as follows. MOSFET gates 209, 225, 272, and 269 are closed by the DC current (as note above, the default position is open) when frequency generator 240 sends a signal to PLC channel 1 (CH 1), CH 1 in turn sends a signal to discontinue the voltage to MOSFET 269 on the excitation board for the desired time. Channel 2 (CH 2) simultaneously receives the signal and opens MOSFET 225 for the desired period of time. When these two gates are open, the DC current flows from battery A into cathode A (IN) through resistor 262 (3.2 ohms). When the power is on to cathode A and anode A, MOSFET 270 opens and allows current to flow through the MOSFET 270 and conduit 268, MOSFET 269, and conduit 279 into cathode C#1 post on contact block 278. A jumper carries current from cathode post C#1 on contact block 278 (FIG. 22) to contact block post C#1 213 (FIG. 23). The current then flows into Cathode #1 IN through conduit 204 with IN Anode #1 connected through conduit 206 on the pole switching board . The current flows through open MOSFET 207 and on through conduit 207a to rotor contact block 219 and through lead 221 to a North pole wound coil and out through lead 220 and through conduit 224, and then through open MOSFET 225 and through conduit 226 to earth ground. This circuit delivers a first polarity current to the rotor/armature pole (e.g., North pole). At the end of the first cycle, MOSFET 269 and MOSFET 225 closes.

The second circuits of PLC channel 1 (CH 1) and channel 2 (CH 2) are operative at the end of the first cycle. Channel 1 turns off the power to MOSFET 272 on the excitation board for the desired duration of time. Channel 2 of the PLC opens MOSFET 209 on the pole switching board for the desired period. DC current flows from battery B into Cathode B through resistor 261 (e.g., 3.2 ohms). When power is on to Cathode B and Anode B (FIG.

23) MOSFET 256 opens and allows current to flow through MOSFET 256, conduit 271 into MOSFET 272, on through conduit 273 into cathode post C#2 on contact block 278. A jumper carries current from cathode post C#2 on contact block 278 in FIG. 22 to contact block 216 in FIG. 23. The current then flows into IN cathode #2 through conduit 276 with IN anode #2 connected through 227 on pole switching board (FIG. 23). Current flows through open MOSFET 223 on through conduit 223a to rotor contact block 219 and to through lead 220 to a South pole wound coil, out through lead 221 and through conduit 207a and 208, and then on through open MOSFET 209 through conduit 210 to earth ground. After the desired time, the second MOSFET 272 on the excitation board (FIG. 22) closes, and after the desired time, MOSFET 209 on the pole switching board (FIG. 23) closes and the cycle begins all over again.

**Claims:**

1. An electric generator, comprising:

a stator containing wire slots, stator field coil wires in the slots, and power leads to provide the generated power to a load;

a rotor containing rotor poles, wire slots between the poles, rotor coil wires in the rotor wire slots, and excitation leads connected to the coil wires to provide power to a pole's coil wires to excite the pole and generate a polar magnetic flux in the form of a distinct magnetic pole which emanates from the pole, wherein the rotor is static and does not move with respect to the stator;

excitation circuitry to provide power to leads of the rotor coil wires to sequentially excite the poles, providing a moving magnetic field emanating from the rotor poles and comprised of distinct magnetic poles,

wherein the wound stator and wound rotor are contiguous to one another to provide the moving magnetic field emanating from the rotor poles to the associated stator field coil wires and produce current in the field coil wires.

2. The generator of claim 1, wherein the stator is planar.

3. The generator of claims 1 and 2, wherein the rotor is planar.

4. The generator of claim 1, wherein the rotor is circular, planar, or another shape enabling the rotor's wire slot surface to be in close proximity to the stator field coils to induce current in the stator field coil wires when the moving magnetic field emanates from the rotor poles.

5. The generator of claim 1, wherein the rotor consists of laminates stacked together.

6. The generator of claim 5, wherein the rotor is graphene and/or a ferromagnetic material.

7. The generator of claims 1-6, further comprising:

a power storage device to store at least a portion of the generated power to provide a portion of the stored power to the excitation circuitry to re-excite the rotor poles.

8. The generator of claim 7, wherein the power storage device is one or more batteries or capacitor banks.

9. The generator of claims 1-8, wherein the excitation circuitry sequentially excites the rotor poles for a predetermined amount of time.

10. The generator of claim 9, wherein the excitation circuitry delays the excitation of a rotor pole a predetermined amount of time after the excitation of the immediately preceding pole.

11. The generator of claims 1-10, wherein the rotor poles are excited, respectively, North pole/South pole.

12. The generator of claims 1-11, further comprising:

shielding on the outer surfaces of the rotor and stator to separate magnetic fields in the rotor and stator from electronics outside of the rotor and stator.

13. The generator of claim 12, wherein the shielding is mu metal.

14. The generator of claim 13, wherein the mu metal is 75% nickel, 15% iron, copper, and molybdenum.

15. The generator of claims 1-14, wherein the rotor, stator, and their windings are configured to be placed in the battery compartment of an electronic device and electronically connected to the device to provide power to it from the generator.

16. The generator of claim 15, wherein the battery compartment configured rotor, stator, and windings fit in and provide power to a cell phone.

17. The generator of claim 16, wherein the battery compartment configured rotor, stator, and windings provide power to the cell phone by replacing its battery and powering the cell phone from the generator.

18. A solid-state electromagnetic rotor and stator, comprising:

a plurality of rotor pole pieces on the rotor arranged on a supporting structure, wherein a first end of each pole piece is attached to the support structure and a second end of each pole piece points outward away from the supporting structure toward the stator, and includes coil wires wound around each pole piece, and wherein when the rotor coil wires of the plurality of pole pieces are sequentially excited by an excitation current to energize the pole pieces to provide a moving polar magnetic field in the form of distinct magnetic poles to field coil windings of the stator as desired to accomplish power generation and wherein the rotor does not rotate or move with respect to the stator.

19. The solid-state electromagnetic rotor of claim 18, wherein the rotor pole pieces are excited in a different polarity at any given time.

20. The solid-state electromagnetic rotor of claims 18 and 19, wherein the pole pieces are sequentially excited each for a predetermined amount of time.

21. The solid-state electromagnetic rotor of claim 18-20, wherein the pole pieces are sequentially excited, each delayed from the previous pole piece's excitation, each for the predetermined amount of time.

22. The solid-state electromagnetic rotor of claims 18-21, wherein the wires wound around each pole piece includes an inner wire closer to the supporting structure and an outer wire farther away from the supporting structure, wherein the inner wire and the outer wire are excited so that the pole piece forms a dipole magnet.

23. The solid-state electromagnetic rotor of claims 18-22, wherein the plurality of pole pieces include at least one pair consisting of a first pole piece and a second pole piece 180° opposite to the first pole piece, wherein the wires are wound around the first and second pole pieces such that when the wires are excited, the first and second pole pieces form two complete dipoles.

24. The solid-state electromagnetic rotor of claim 18-23, further comprising shielding between the first pole piece and the second pole piece.

25. The solid-state electromagnetic rotor of claim 24, wherein the shielding contains mu metal.

26. The solid-state electromagnetic rotor of claim 25, wherein the mu metal is made of 75% nickel, 15% iron, copper, and molybdenum.

27. The solid-state electromagnetic rotor and stator of claims 18-26, wherein the stator includes multiple rotor cavities in which is a rotors.

28. A power generation system, comprising:

an electric power generator stator having a housing and a solid state power generator rotor placed into and attached to the stator housing, wherein the solid state power generator rotor remains stationary with respect to the stator and generates moving magnetic fields formed by sequentially exciting poles of the rotor by an excitation system,

wherein a portion of output power generated by the system is fed back to the excitation system to power the excitation system.

29. The power generation system of claim 28 , wherein the solid state rotor includes a series of adjacent poles attached to a central support surface.

30. A solid-state electric generator, comprising:

a stator and one or more rotors that are stationary with respect the stator, wherein the rotor includes a plurality of pole pieces, each wound with wires when energized excite the pole pieces to generate magnetic flux fields;

a controller for controlling the generator, the controller comprising:

electric circuitry coupled to the wires of the rotor pole pieces; and

a processor configured to:

determine an excitation cycle based on a target frequency of the generator; and switch the electric circuitry to excite the rotor wires to energize the plurality of pole pieces sequentially according to the excitation cycle, such that each pole piece is energized in a first polarity in a first half of the excitation cycle and energized in a second polarity in a second half of the excitation cycle.

31. The controller of claim of claim 30, wherein the processor is further configured to receive a signal from a solid-state frequency generator and determine the target frequency for the generator based on the signal.

32. The controller of claims 30 and 31, wherein the electric circuitry includes a plurality of switching elements and wherein the processor is configured to sequentially switch on and off the plurality of switching elements within the excitation cycle.

33. The controller of claims 30-32, wherein the plurality of switching elements are MOSFET solid state relays.

34. The controller of claims 30-33, wherein the processor is further configured to switch the electric circuitry to excite the plurality of pole pieces in a single polarity at any given time.

35. The controller of claims 30-34, wherein the processor is further configured to divide the plurality of pole pieces into N groups, and switch the electric circuitry to excite each group of pole pieces in a different polarity at any given time.

36. The controller of claims 35, wherein the processor is further configured to excite the pole pieces within each group sequentially, each for a predetermined amount of time.

37. The controller of claims 32-36, wherein the plurality of switching elements are switched on and off to provide pulsed current to the wires to excite the pole pieces.

38. A method for controlling an electric generator having a rotor and a stator having field windings, wherein the rotor with a plurality of pole pieces does not move with

respect to the stator and each pole piece is wound with wires, the method comprising: determining an excitation cycle based on a target frequency of the generator; and switching an electric circuit connected to the rotor pole piece wires to excite the wires to energize the plurality of pole pieces sequentially according to the excitation cycle, such that each pole piece is energized in a first polarity in a first half of the excitation cycle and energized in a second polarity in a second half of the excitation cycle and the magnetic fields generated by the excited pole pieces to provide moving magnetic fields to the field windings of the stator to produce current in those windings.

39. The method of claim 38, further comprising receiving a signal from a solid-state frequency generator and determining the target frequency of the power generator based on the signal.

40. The method of claims 38 and 39, wherein switching the electric circuit includes sequentially switching on and off a plurality of switching elements of the electric circuit within an excitation cycle.

41. The method of claims 38-40, wherein switching the electric circuit comprises exciting the plurality of pole pieces in a single polarity at any given time.

42. The method of claims 38-41, wherein switching the electric circuit includes dividing the plurality of pole pieces into N groups, and switching the electric circuit to excite each group of pole pieces in a different polarity at any given time.

43. The method of claims 38-42, wherein switching the electric circuit further includes exciting the pole pieces within each group sequentially each for a predetermined amount of time.

44. A non-transitory computer readable medium having instructions stored thereon, wherein the instructions, when executed by a processor, perform a method for controlling a power generator having a rotor, wherein the rotor includes a plurality of pole pieces each wound with wires, and a stator with field windings, the method comprising:

determining an excitation cycle based on a target frequency of the power generator; and switching electric circuitry connected to the wires to excite the wires to energize the plurality of pole pieces sequentially according to the excitation cycle, such that each pole piece may be energized in a first polarity in a first half of the excitation cycle and energized in a second polarity in a second half of the excitation cycle and the magnetic fields generated by the excited pole pieces provide moving magnetic fields to the field windings of the stator to produce current in those windings with the rotor remaining stationary with respect to the stator.

45. An electric circuit connected to coil wires of a rotor in a power generator having a stator with field windings, wherein therotor includes a plurality of pole pieces wound with the wires, the electronic circuit comprising:

a computer controlled excitation system having at least two control channels;

and a plurality of pole switching circuits coupled to the at least two control channels, wherein the pole switching circuits are connected to the wires of the plurality of pole pieces, wherein each pole switching circuit includes a plurality of switching elements switched on and off by the at least two control channels to excite the wires to energize the plurality of pole pieces sequentially to generate magnetic fields generated by the excited pole pieces to create moving magnetic fields to the field windings of the stator to produce current in those windings with the rotor remaining stationary with respect to the stator.

46. The electric circuit of claim 45, wherein the plurality of switching elements are switched according to an excitation cycle such that each pole piece is energized in a first polarity in a first half of the excitation cycle and energized in a second polarity in a second half of the excitation cycle.

47. The electric circuit of claim 45-46, wherein the plurality of switching elements are solid state switches.

48. The electric circuit of claims 45-47, wherein the plurality of switching elements are MOSFETs.

49. The electric circuit of claims 45-48, wherein the plurality of pole switching circuits are powered by at least one battery.

50. The electric circuit of claim 45-49, wherein the plurality of switching elements are switched on and off to provide pulsed current to excite the rotor pole pieces.

51. The electric circuit of claims 45-50, wherein the plurality of pole switching circuits provide a first pulsed current to a first pole piece for a predetermined amount of time and subsequently provide a second pulse current to a second pole piece adjacent to the first pole piece for the predetermined amount of time.

52. The electric circuit of claims 45-51, wherein the plurality of pole switching circuits are each connected to a group of pole pieces and configured to excite each group of pole pieces in a different polarity at any given time.

53. The electric circuit of claim 52, wherein the plurality of pole switching circuits is further configured to excite pole pieces within each group for a predetermined amount of time.

54. A solid-state electromagnetic rotor comprising:

a plurality of pole pieces arranged on a supporting structure wherein a first end of each pole piece is attached to the support structure and a second end of each pole piece points outward away from the supporting structure; and the rotor structure is made of compressed laminates of electrical steel; the pole pieces are insulated with an insulation paper and then wound with magnet wire; and the pole pieces are cut at an angle of approximately 45° off the radius such that when the rotor pole pieces are excited, the generated magnetic flux emanates at a 45° angle off the face of the rotor.

55. The solid-state rotor structure of claim 54, wherein angulation of the poles and sequential excitation of the poles allows the generation and propagation of distinct magnetic poles moving relative to the surface of the rotor pole pieces to provide moving magnetic flux to field windings of a stator of an electric power generator to permit generation of power out of the stator while the rotor remains stationary with respect to the stator.

56. A method of generating electric power from an electric generator, the method comprising:

providing in the generator a stator containing wire slots, stator field coil wires in the slots, and power leads to provide the generated power to a load; a rotor containing rotor poles, wire slots between the poles, rotor coil wires in the rotor wire slots, and excitation leads connected to the coil wires to provide power to a pole's coil wires to excite the pole and generate a polar magnetic flux in the form of a distinct magnetic pole which emanates from the pole, wherein the rotor is does not move with respect to the stator; and providing excitation circuitry to transmit excitation power to leads of the rotor coil wires;

sequentially exciting the poles to generate a moving magnetic field emanating from the rotor poles and comprised of distinct magnetic poles; and

providing the moving magnetic field to the field coil wires of the stator to generate current in the coil wires to output electric power from the electric generator to the load.

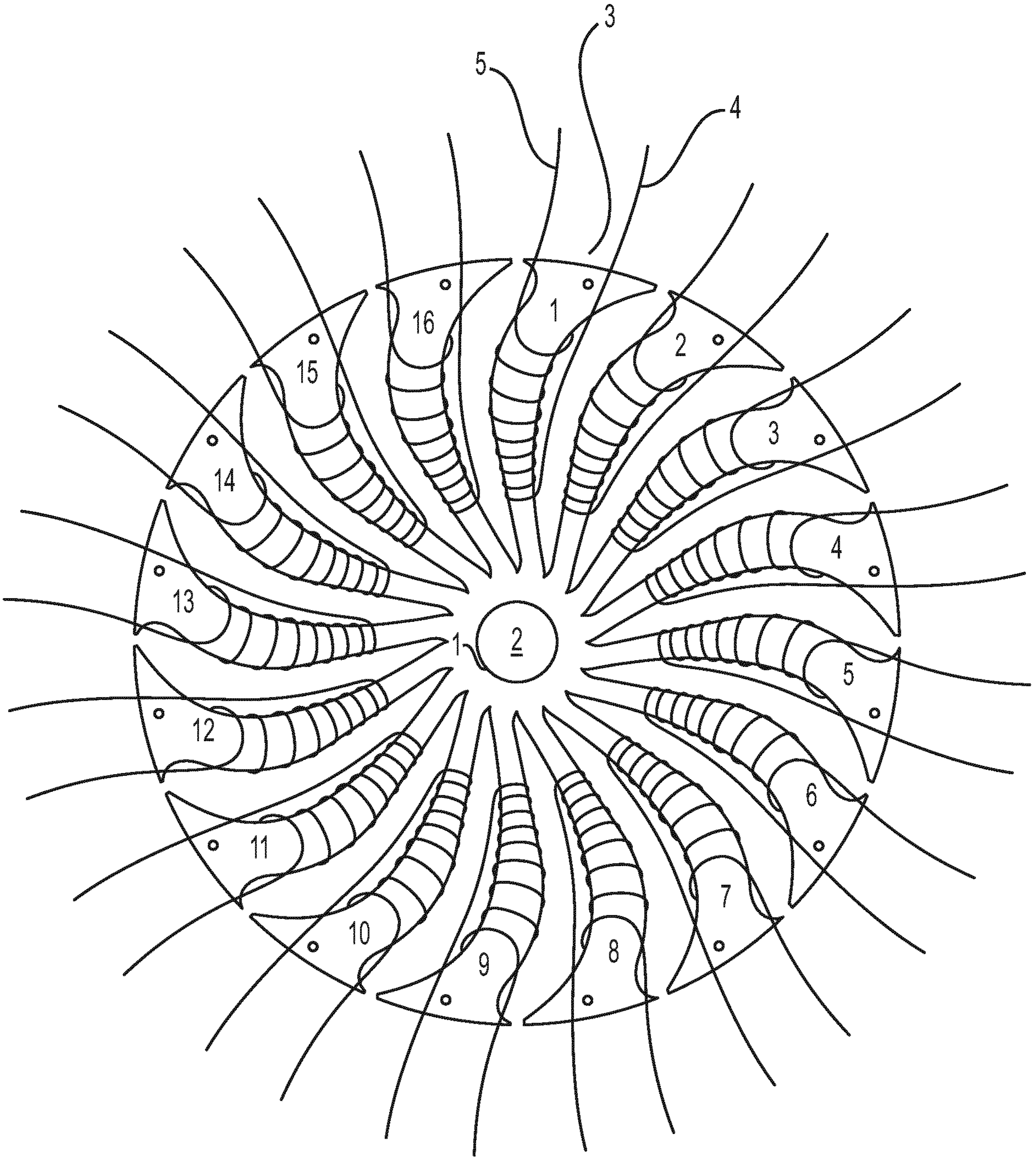
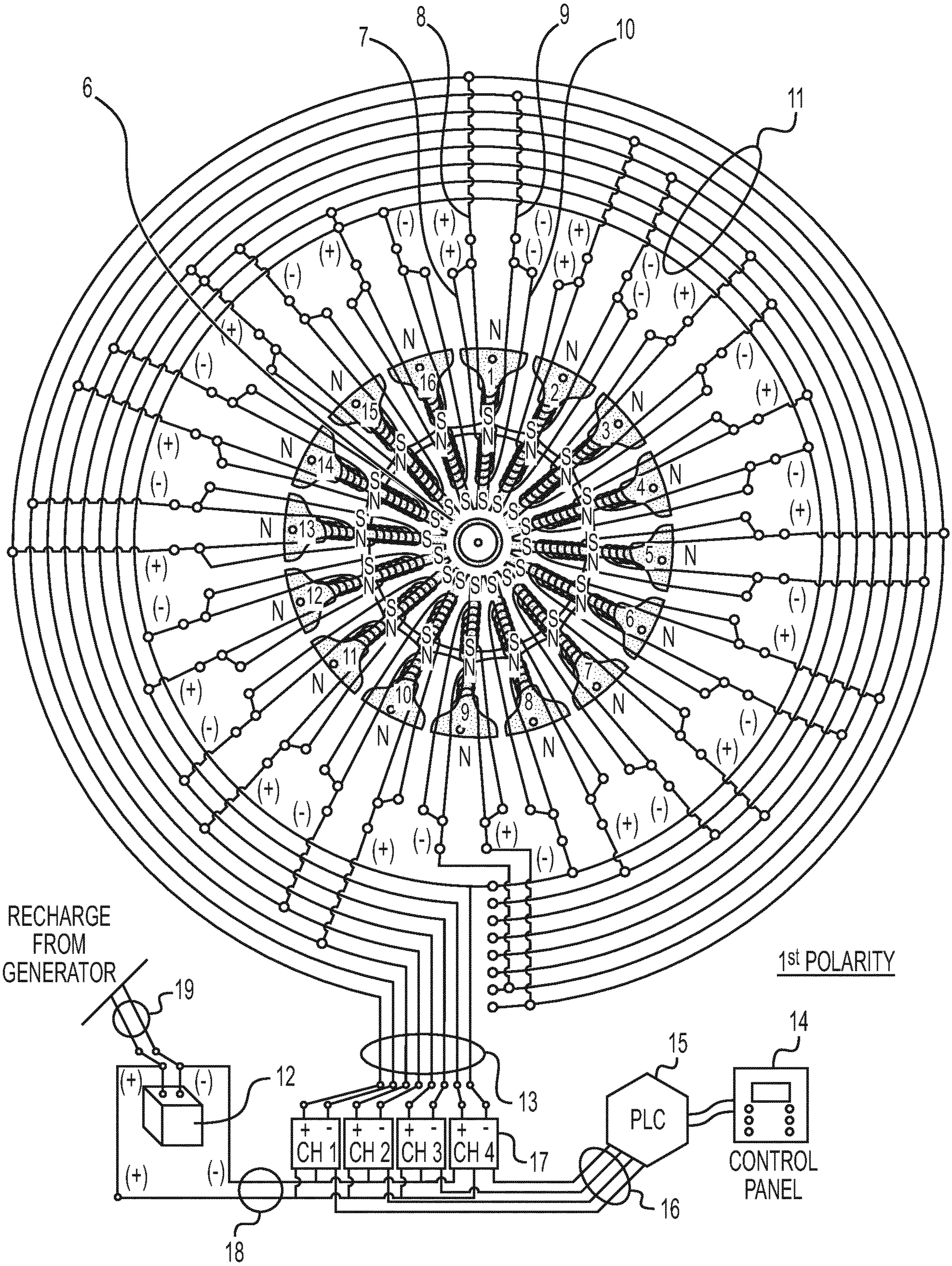


FIG. 1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(+)
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RECHARGE FROM GENERATOR
19
12
(+)
(-)
13
CH 1
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CH 3
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+
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18
16
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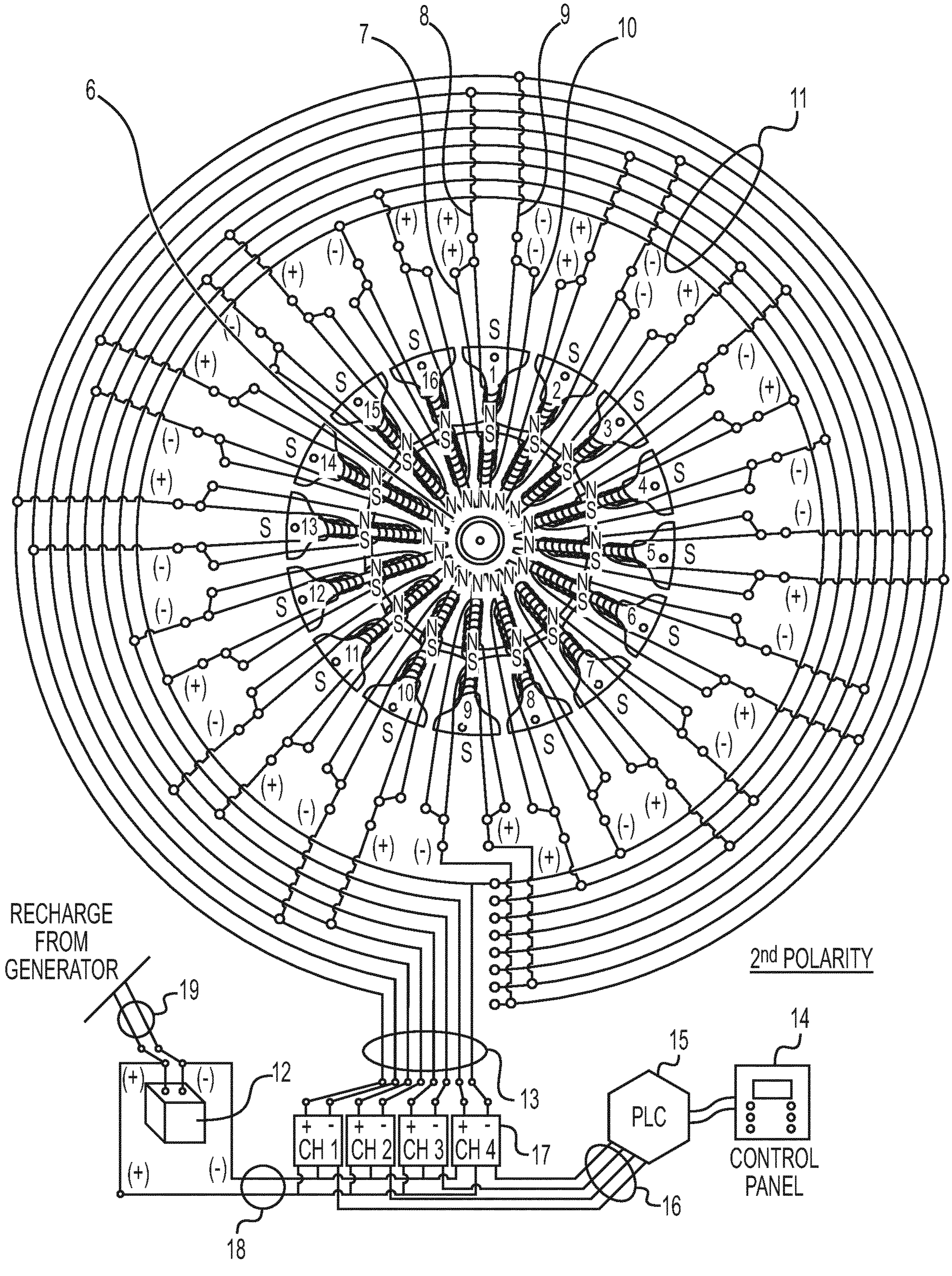
PLC
14
CONTROL PANEL
1st POLARITY

FIG. 2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16
N
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(+)
(-)
2nd POLARITY
RECHARGE FROM GENERATOR
19
12
13
14
15
PLC
CONTROL PANEL
CH 1
CH 2
CH 3
CH 4
17
16
18

FIG. 3

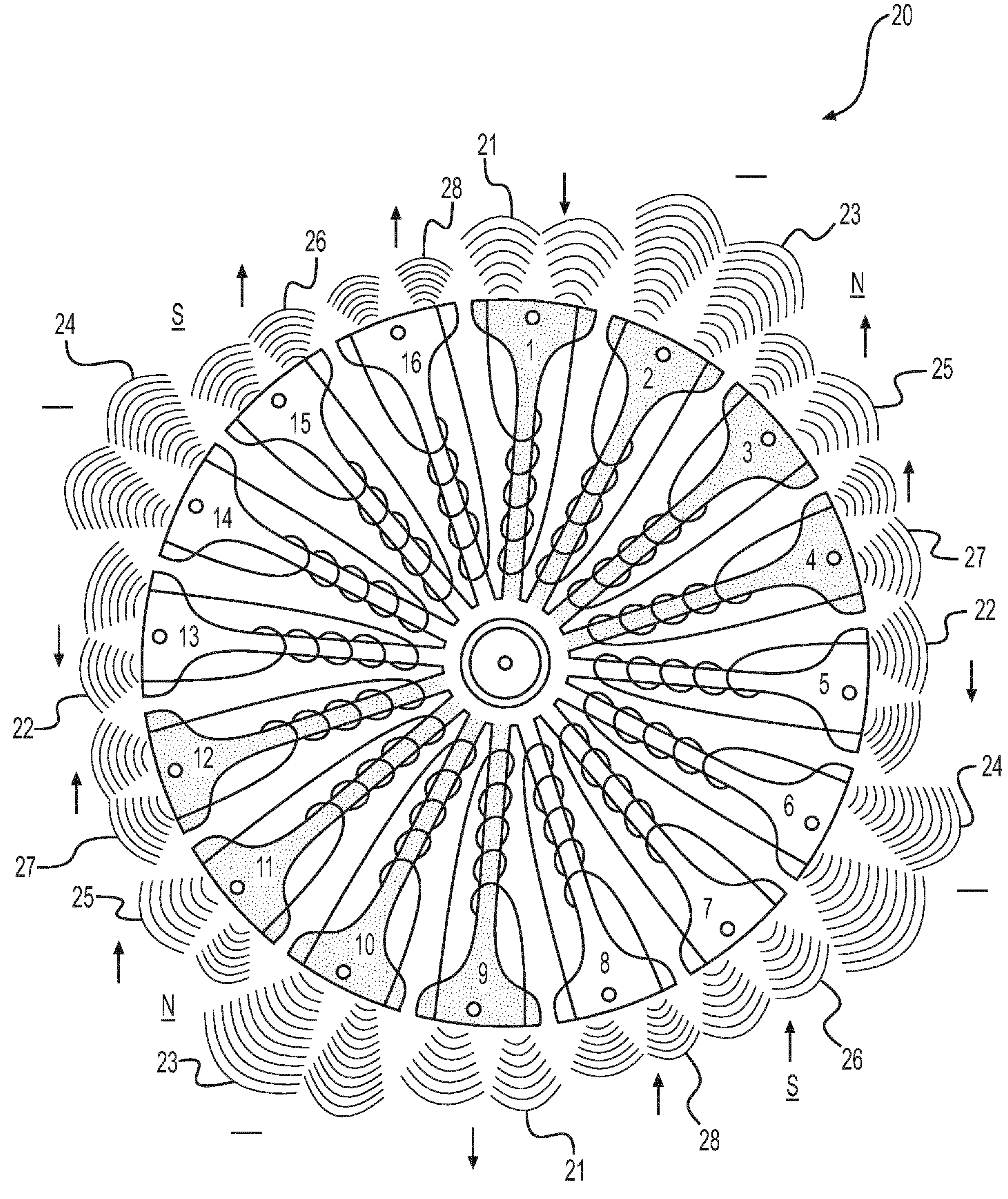
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FIG. 4

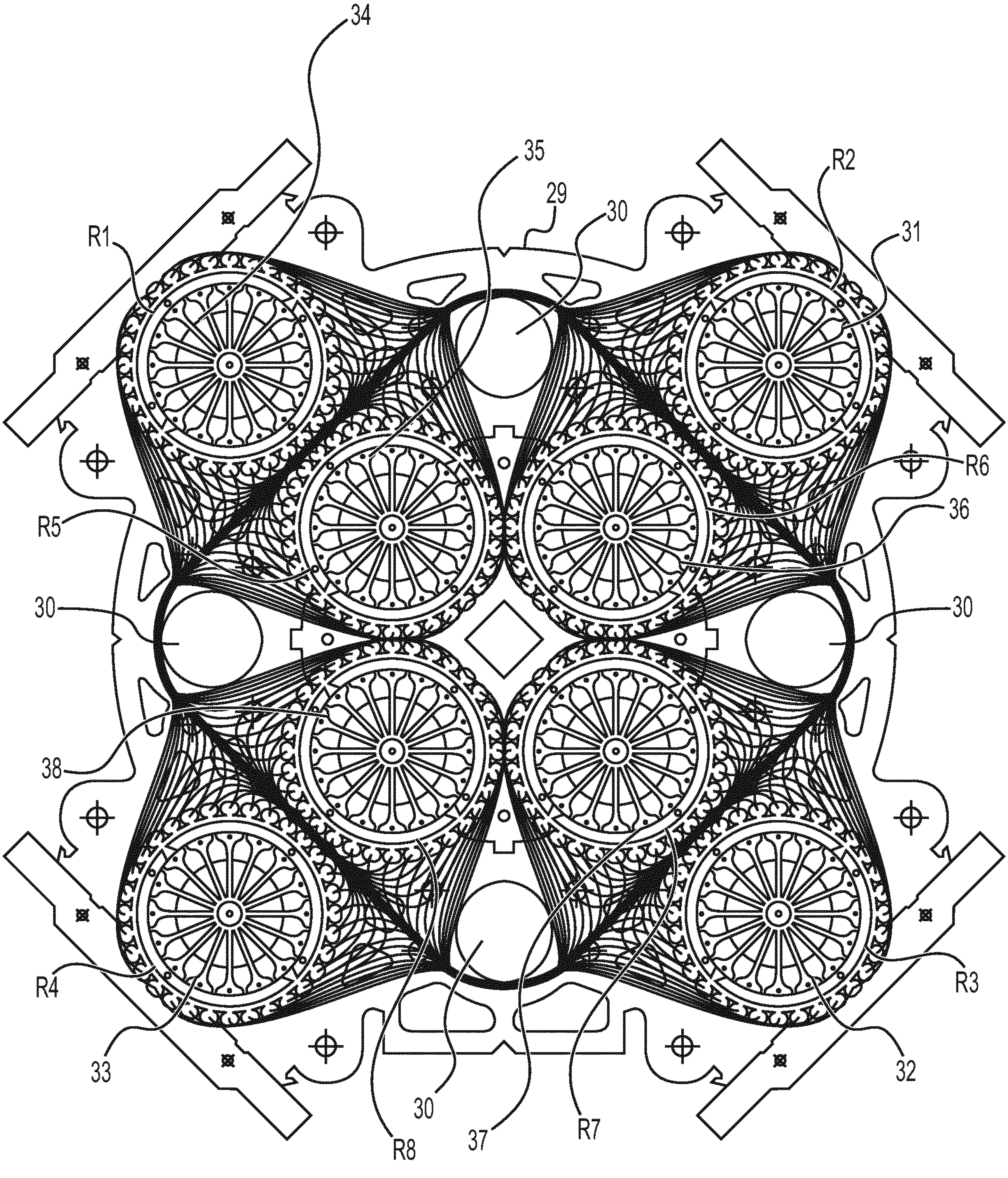


FIG. 5

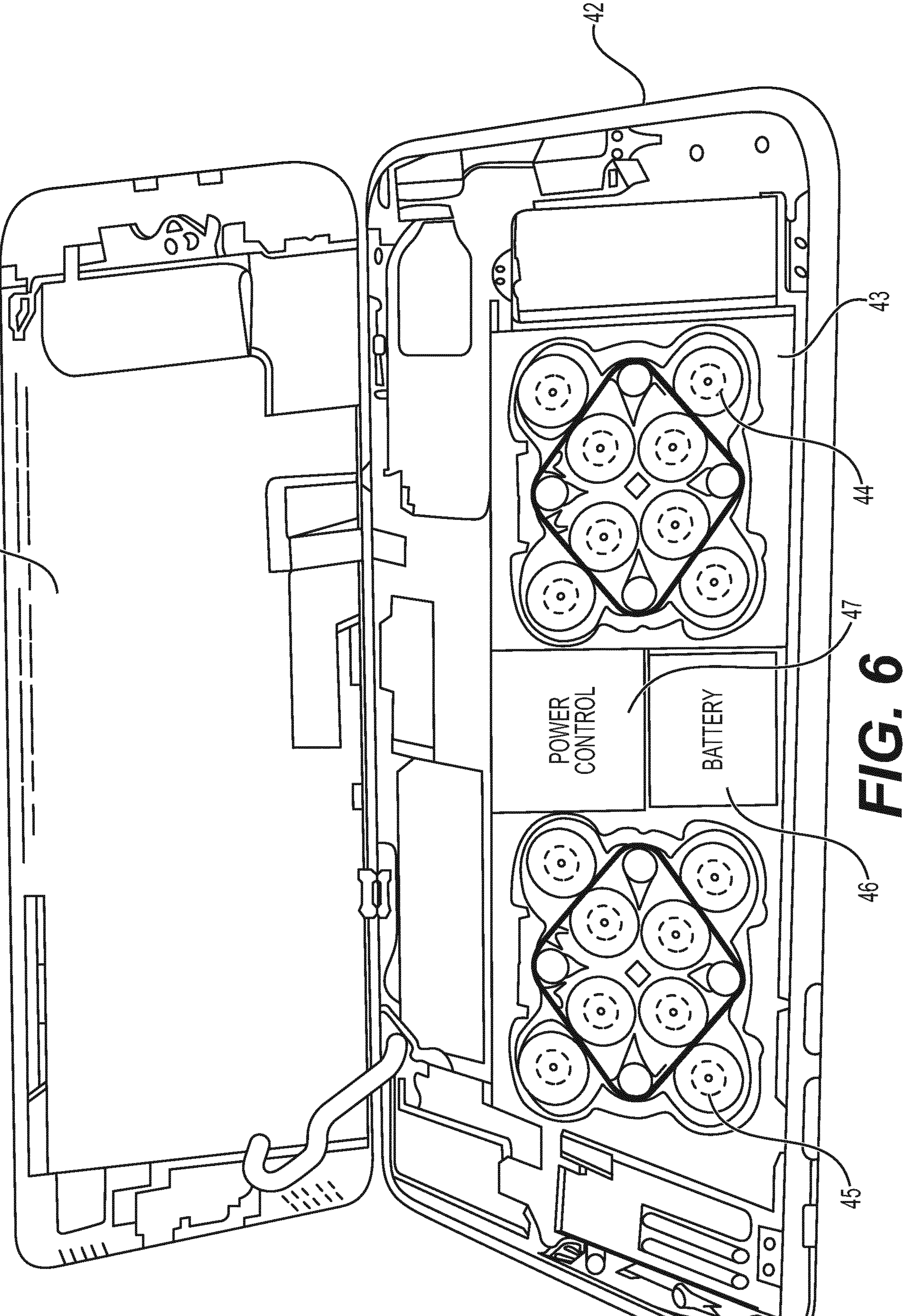


FIG. 6

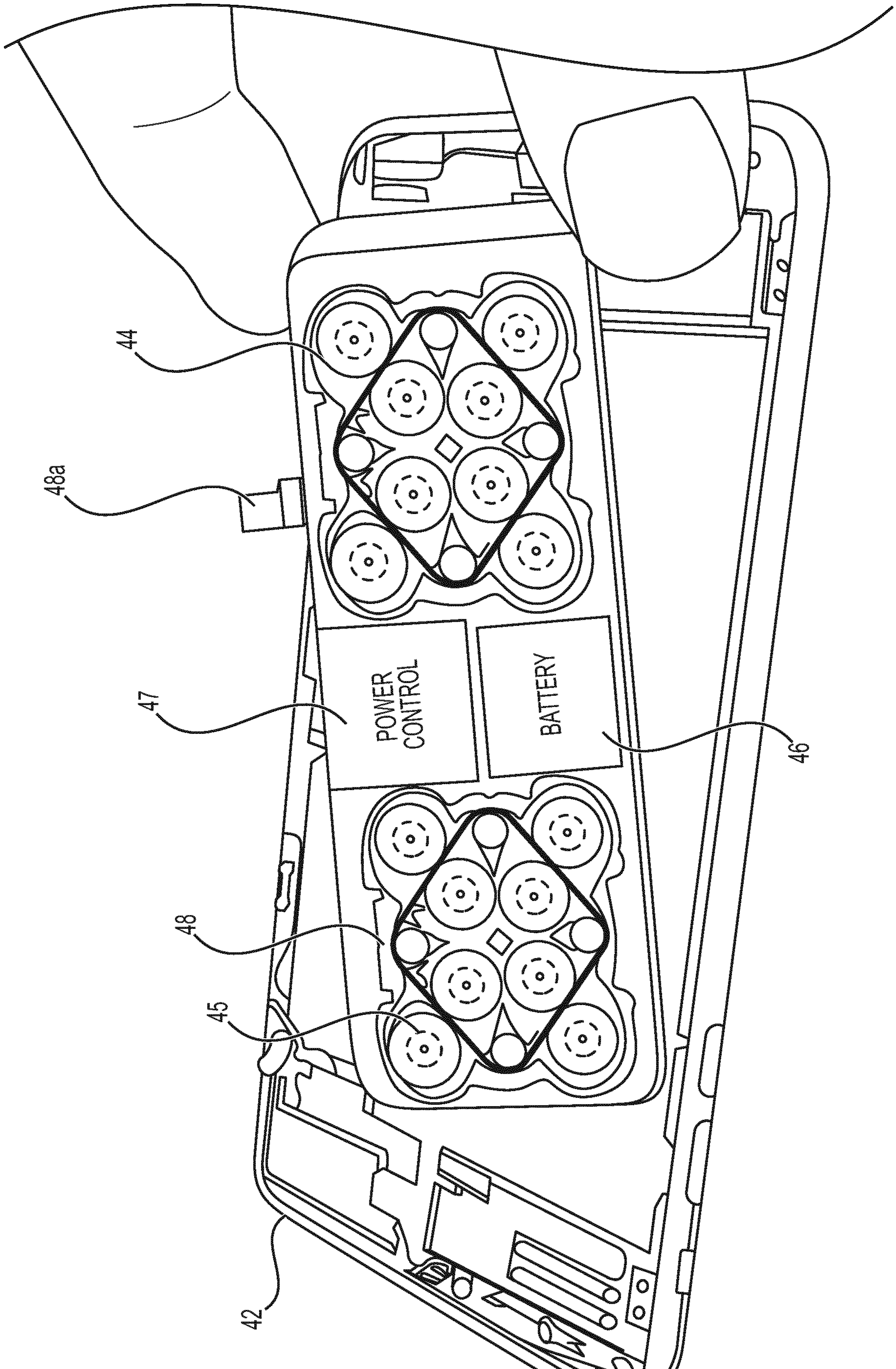


FIG. 7

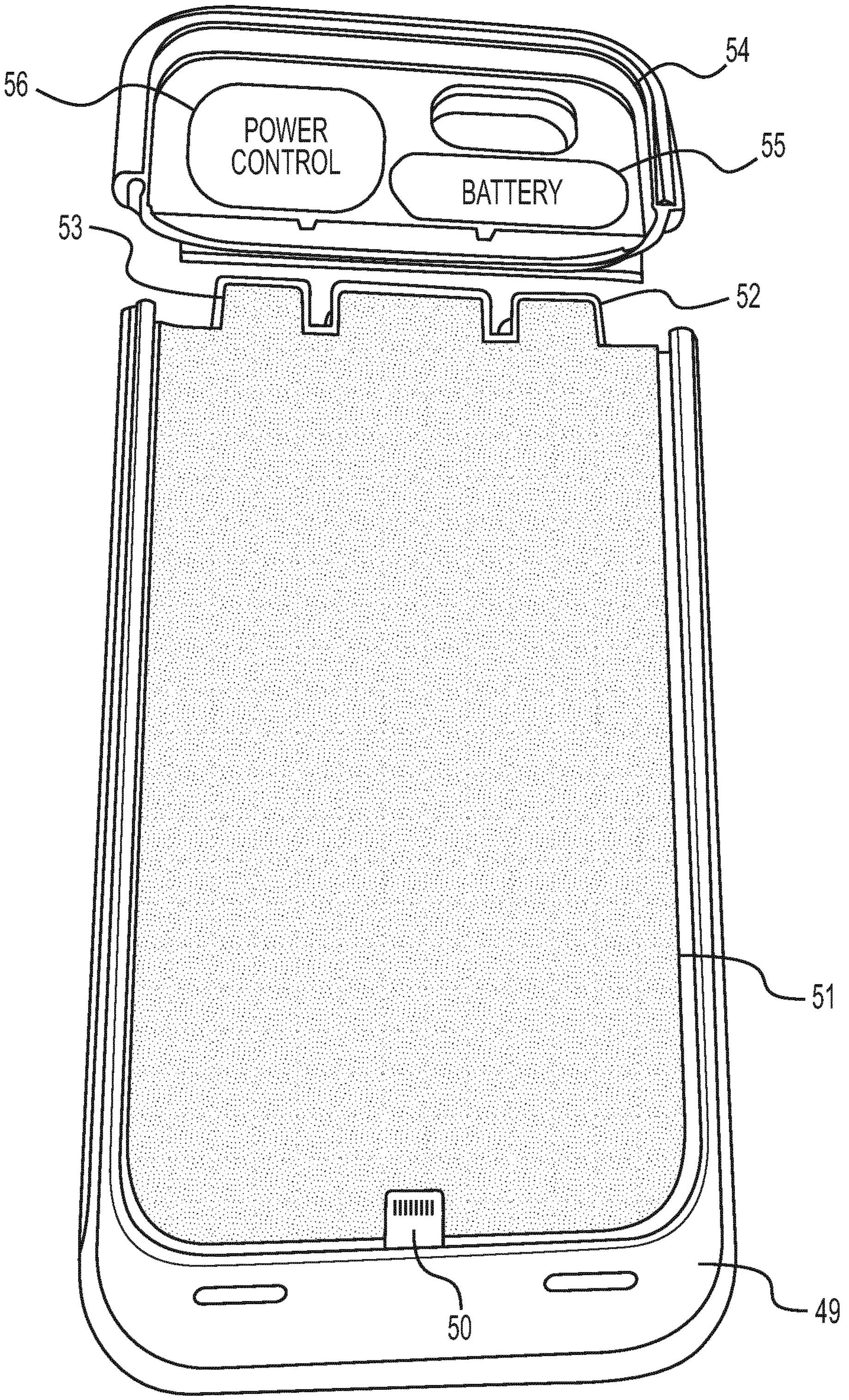


FIG. 8

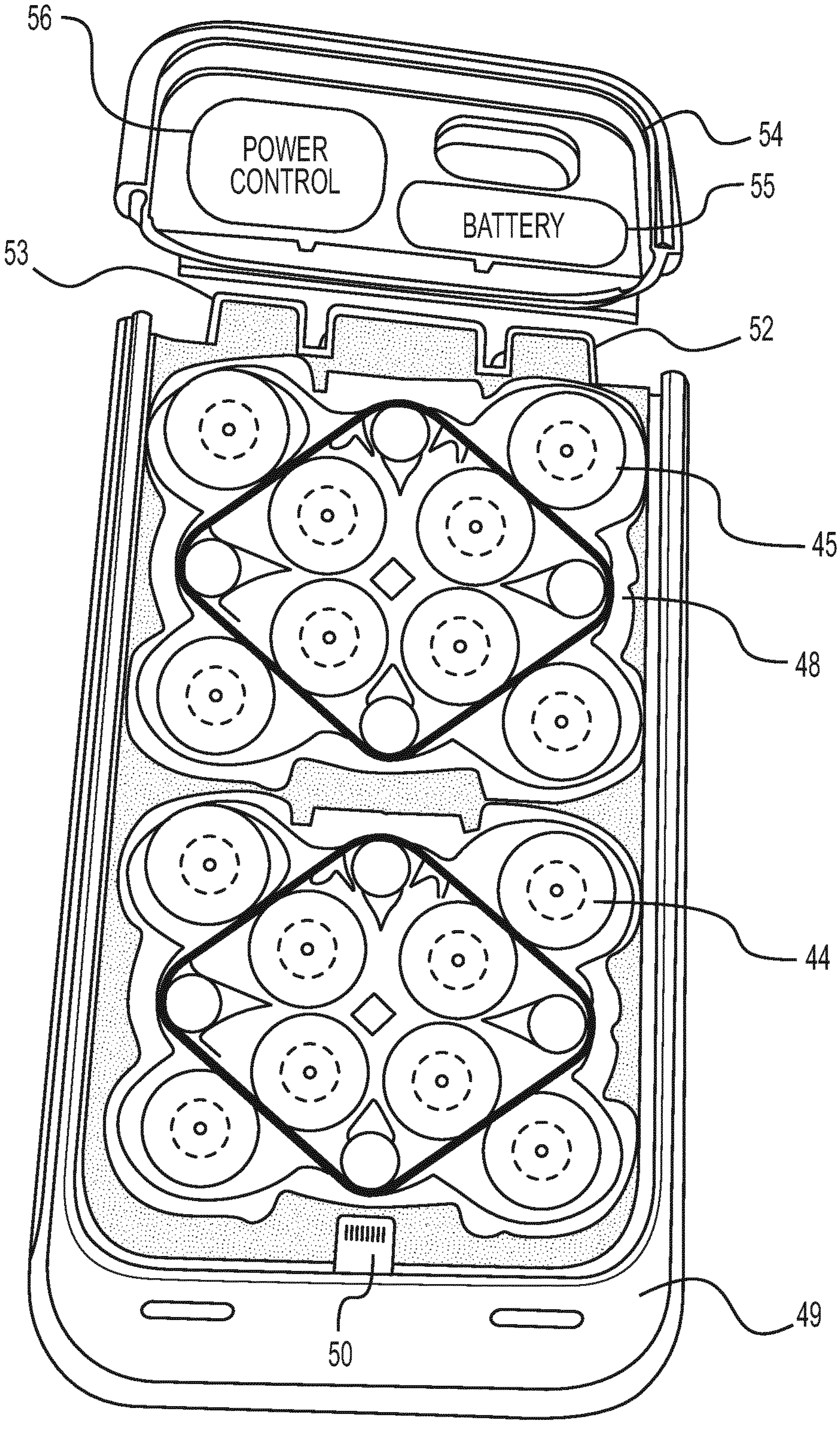


FIG. 9

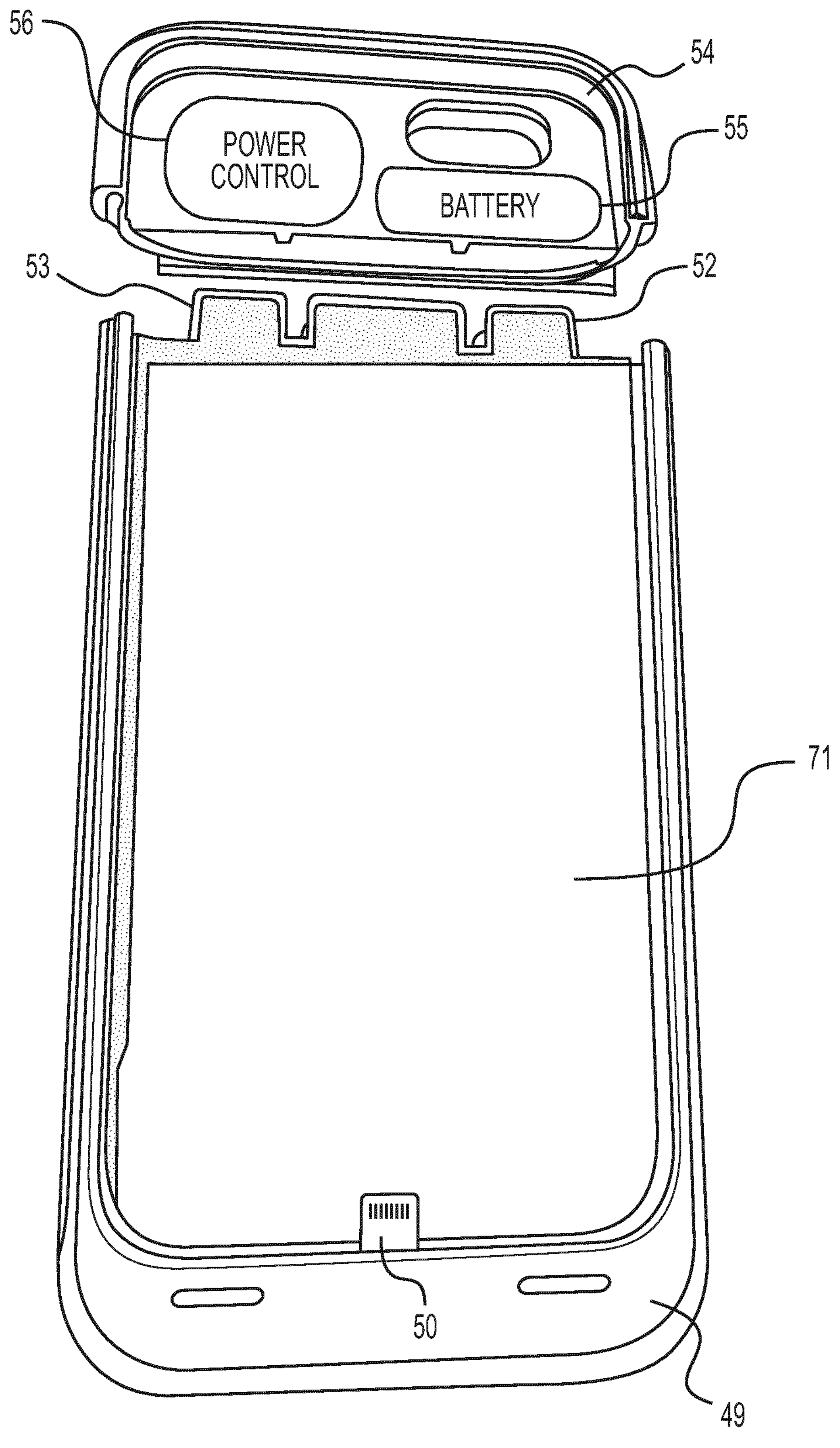


FIG. 10

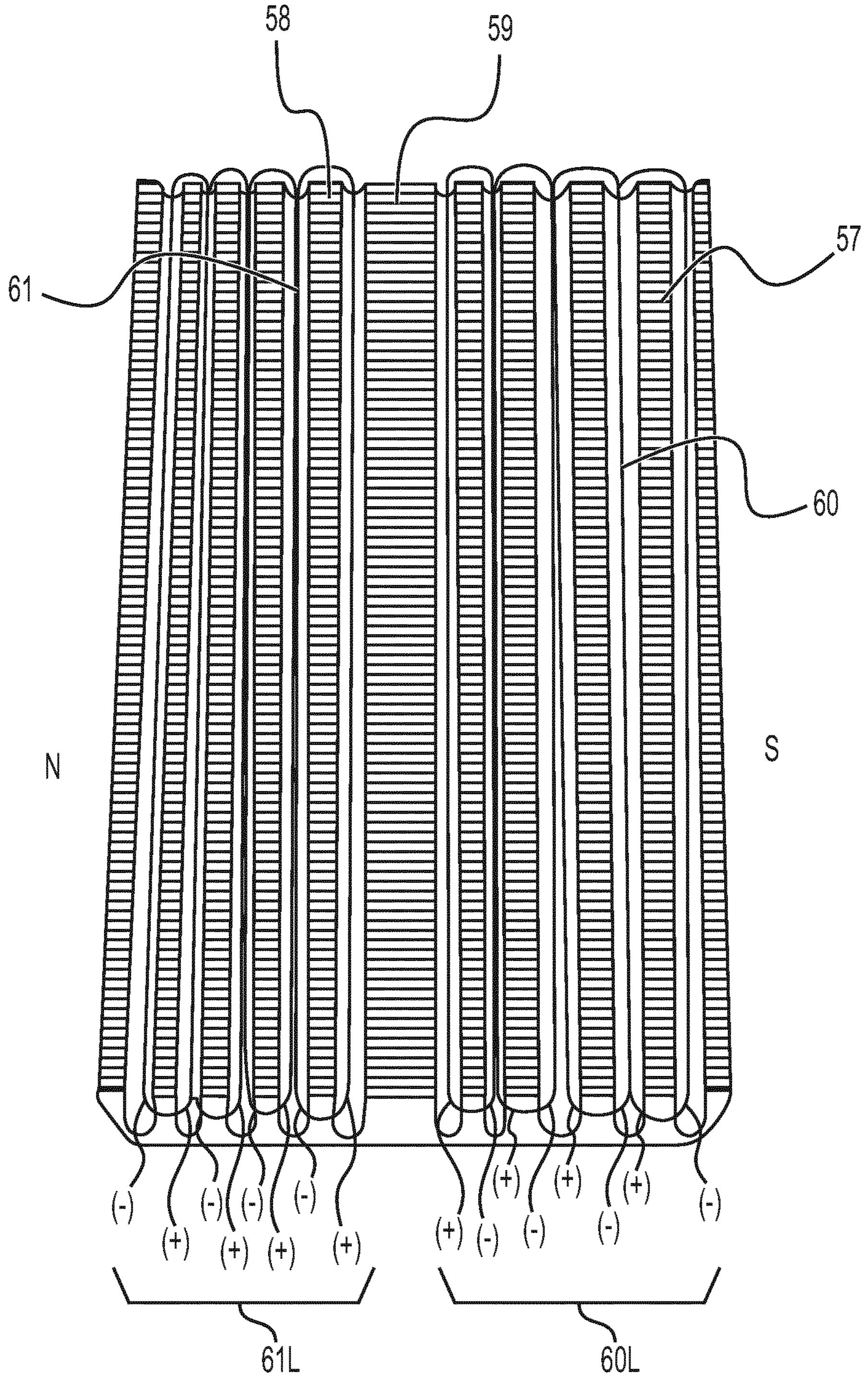


FIG. 11

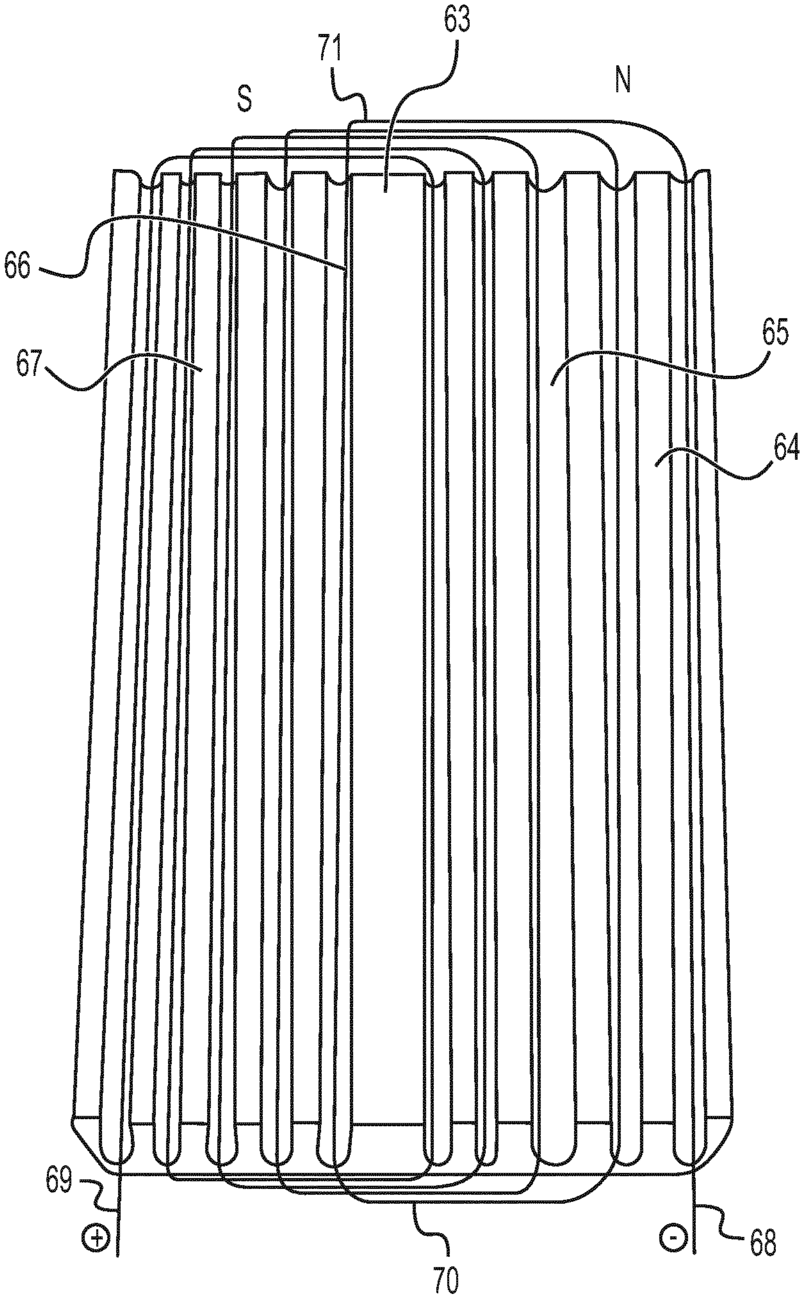


FIG. 12

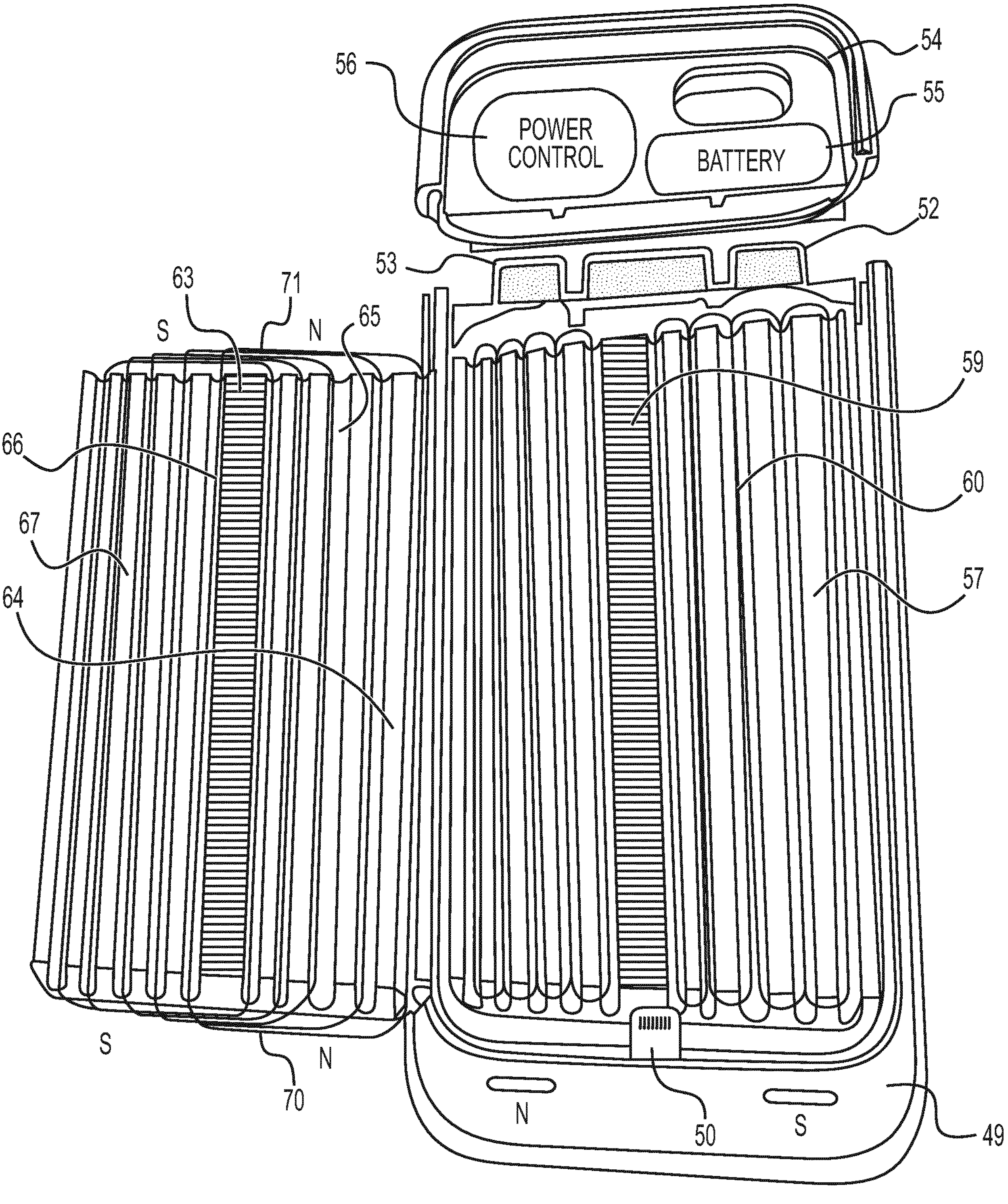

56
POWER CONTROL
BATTERY
54
55
52
53
63
71
S
N
65
59
66
60
67
57
64
S
N
70
N
50
S
49

FIG. 13

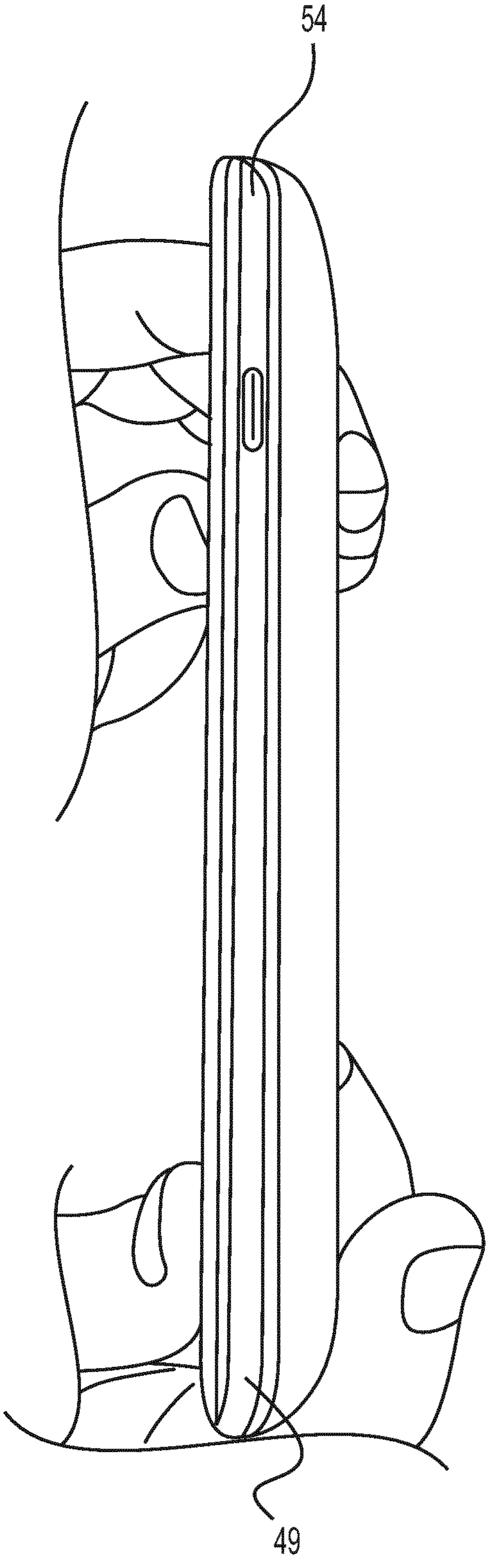


FIG. 14

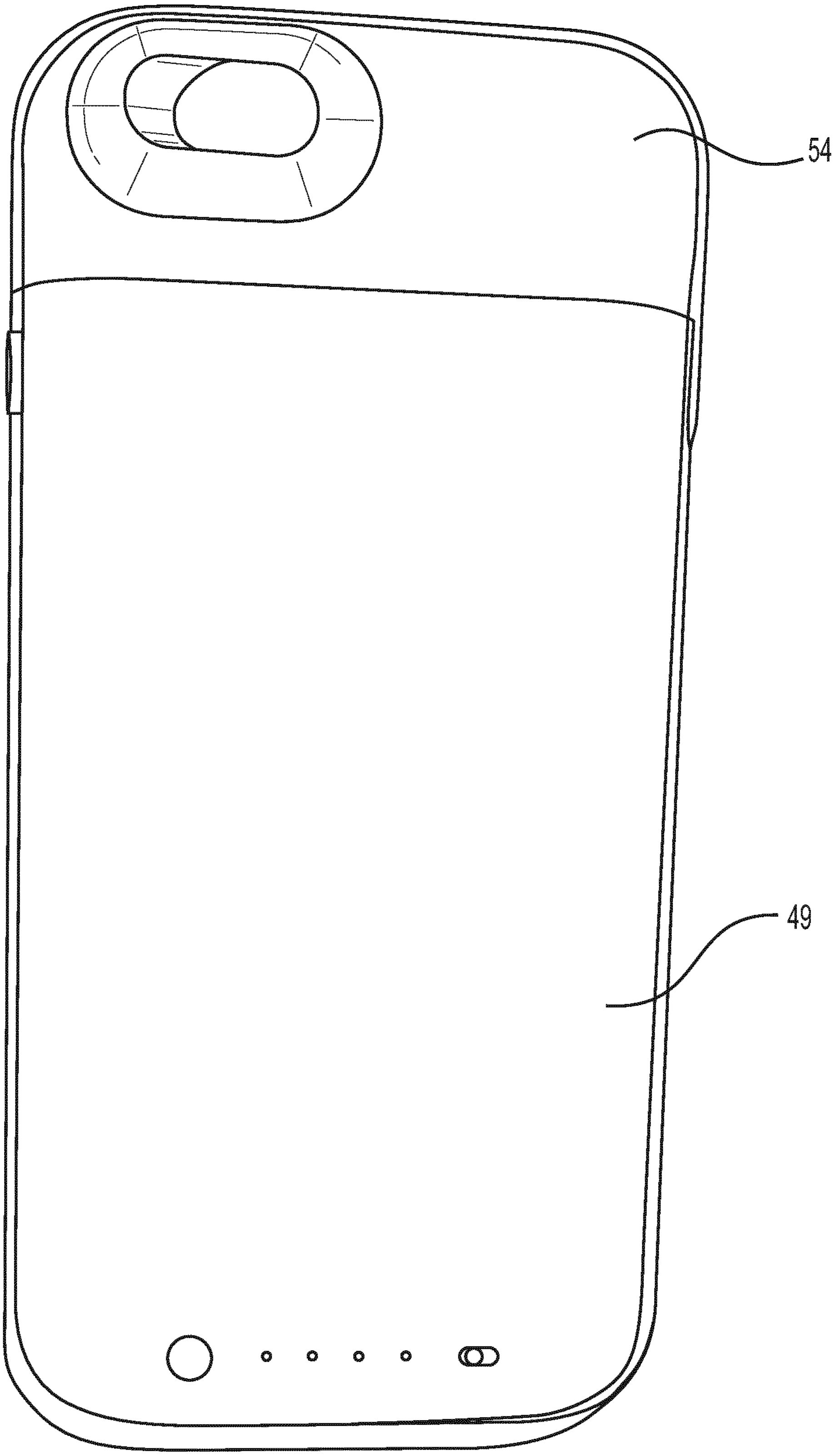


FIG. 15

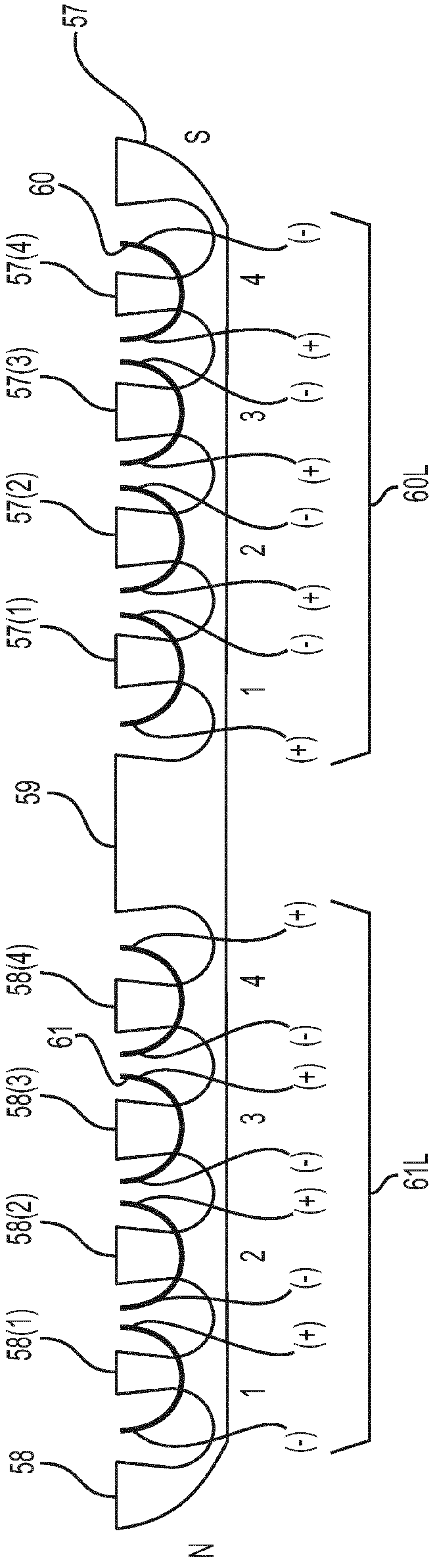


FIG. 16

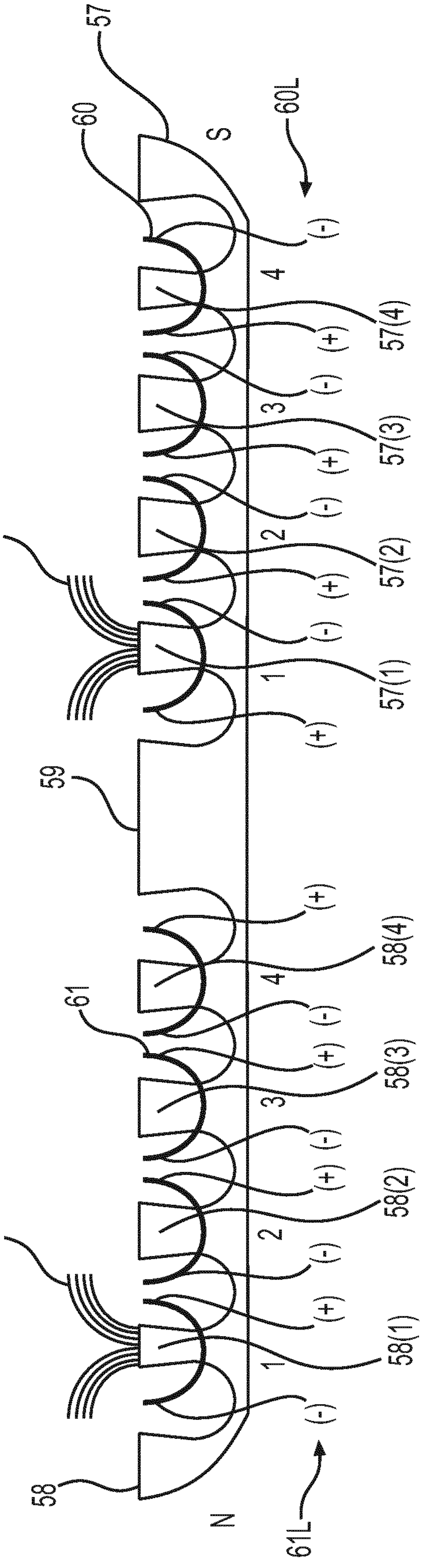

57
60
S
60L
(-)
4
(+)
(+)
57(4)
(-)
3
(+)
57(3)
(-)
2
(+)
57(2)
57a
(-)
1
57(1)
(+)
59
(+)
58(4)
4
61
(-)
(-)
(+)
58(3)
3
(-)
(-)
(+)
58(2)
2
(-)
58a
(+)
58(1)
1
(-)
58
N
61L

FIG. 17

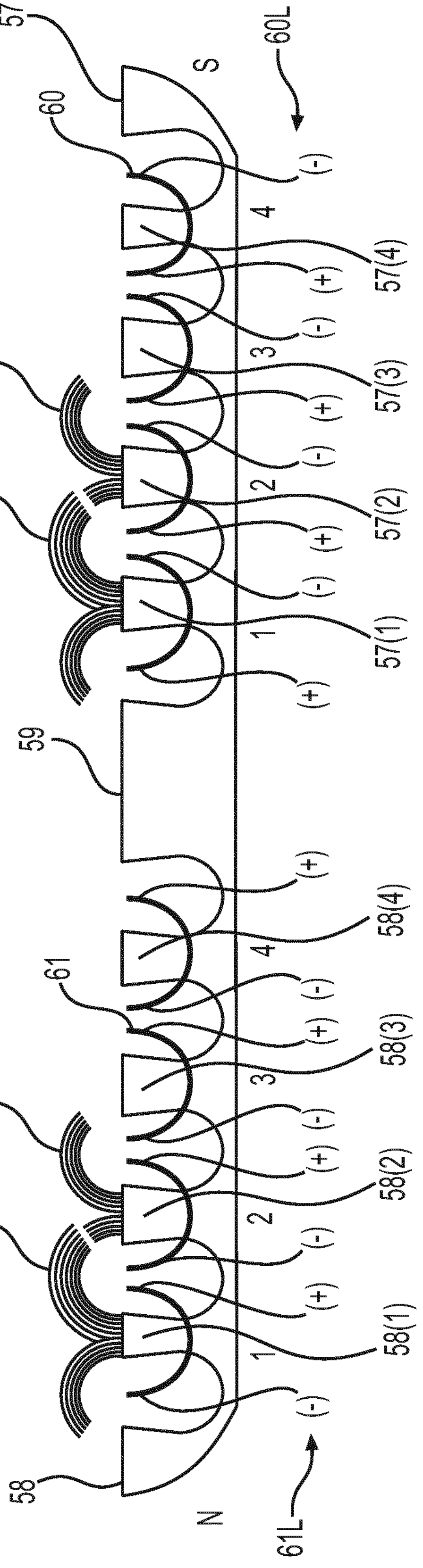

57
60
S
60L
(-)
4
(+)
(+)
57(4)
(-)
3
(+)
(+)
57(3)
57b
(-)
2
(+)
(+)
57(2)
57a
(-)
1
57(1)
(+)
59
(+)
58(4)
4
61
(-)
(-)
(+)
58(3)
3
58b
(-)
(-)
(+)
58(2)
2
58a
(-)
(+)
58(1)
1
(-)
58
N
61L

FIG. 18

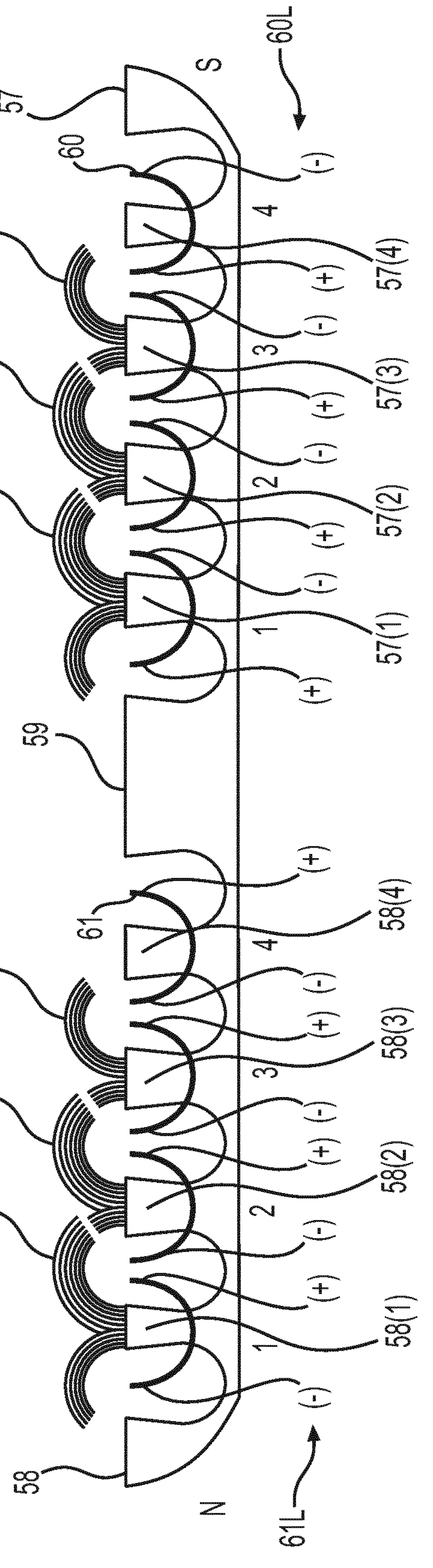

60L
S
57
60
(-)
4
57c
(+)
(+)
57(4)
(-)
3
57b
(+)
(+)
57(3)
(-)
2
57a
(+)
(+)
57(2)
(-)
1
57(1)
(+)
59
(+)
61
58(4)
4
58c
(-)
(-)
(+)
58(3)
3
58b
(-)
(-)
(+)
58(2)
2
58a
(-)
(+)
58(1)
1
(-)
58
N
61L

FIG. 19

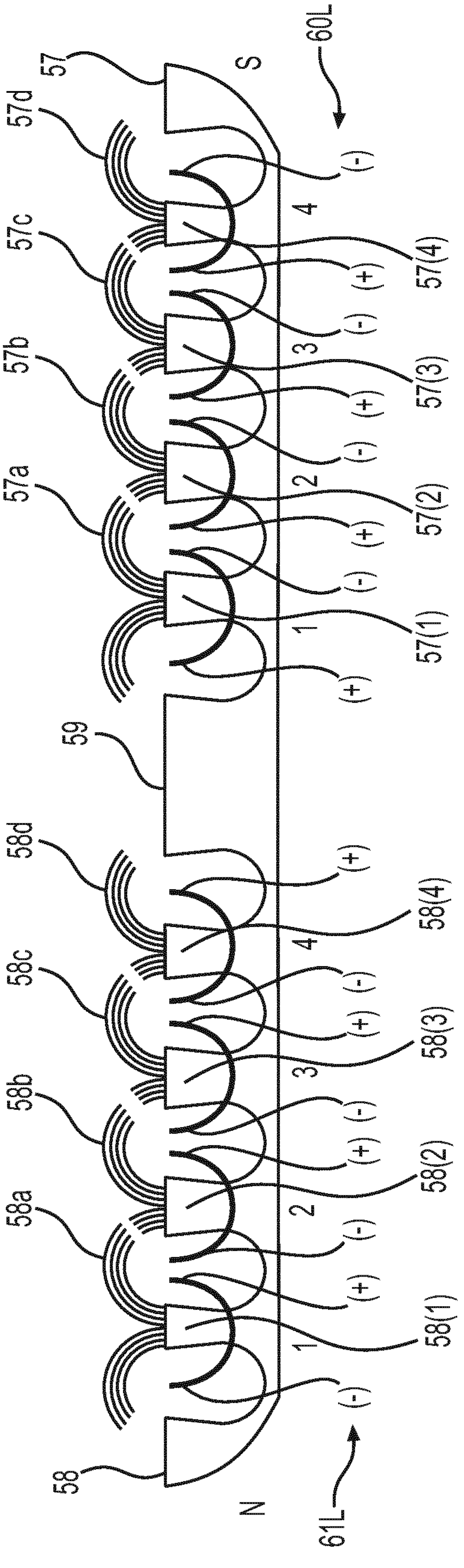

57
57d
57c
57b
57a
S
60L
(-)
4
57(4)
(+)
(+)
(-)
3
57(3)
(+)
(+)
(-)
2
57(2)
(+)
(+)
(-)
1
57(1)
(+)
59
58d
58c
58b
58a
58
(+)
58(4)
4
(-)
(-)
(+)
58(3)
3
(-)
(-)
(+)
58(2)
2
(-)
(+)
58(1)
1
(-)
N
61L

FIG. 20

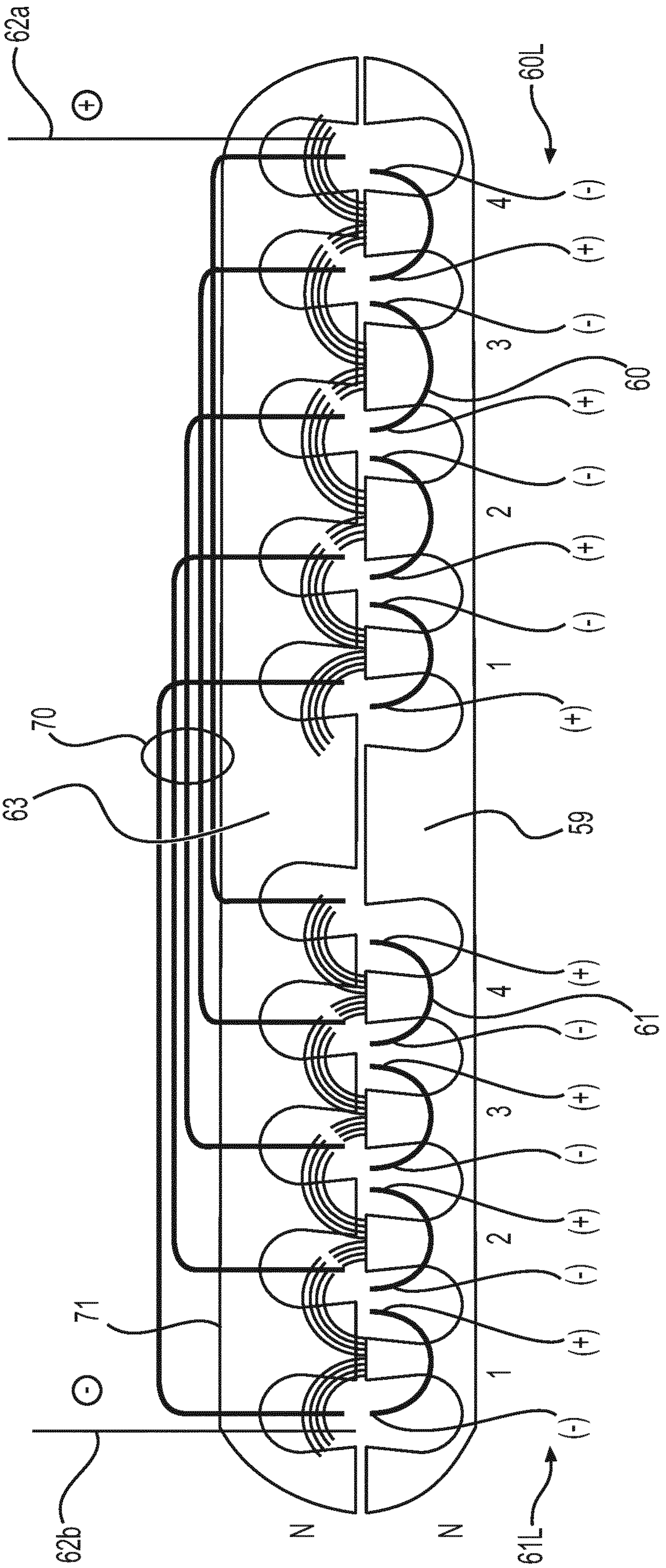


FIG. 21

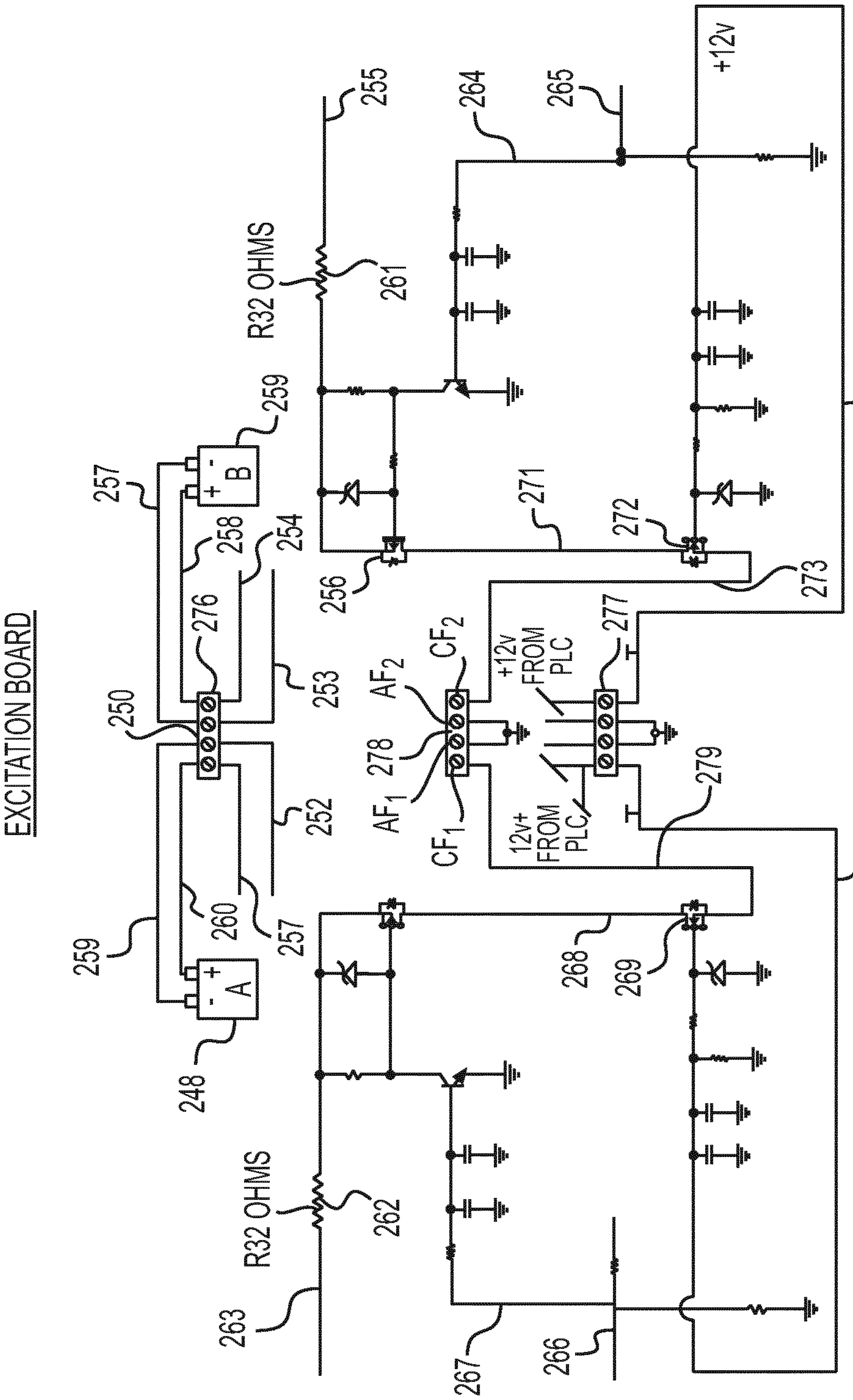
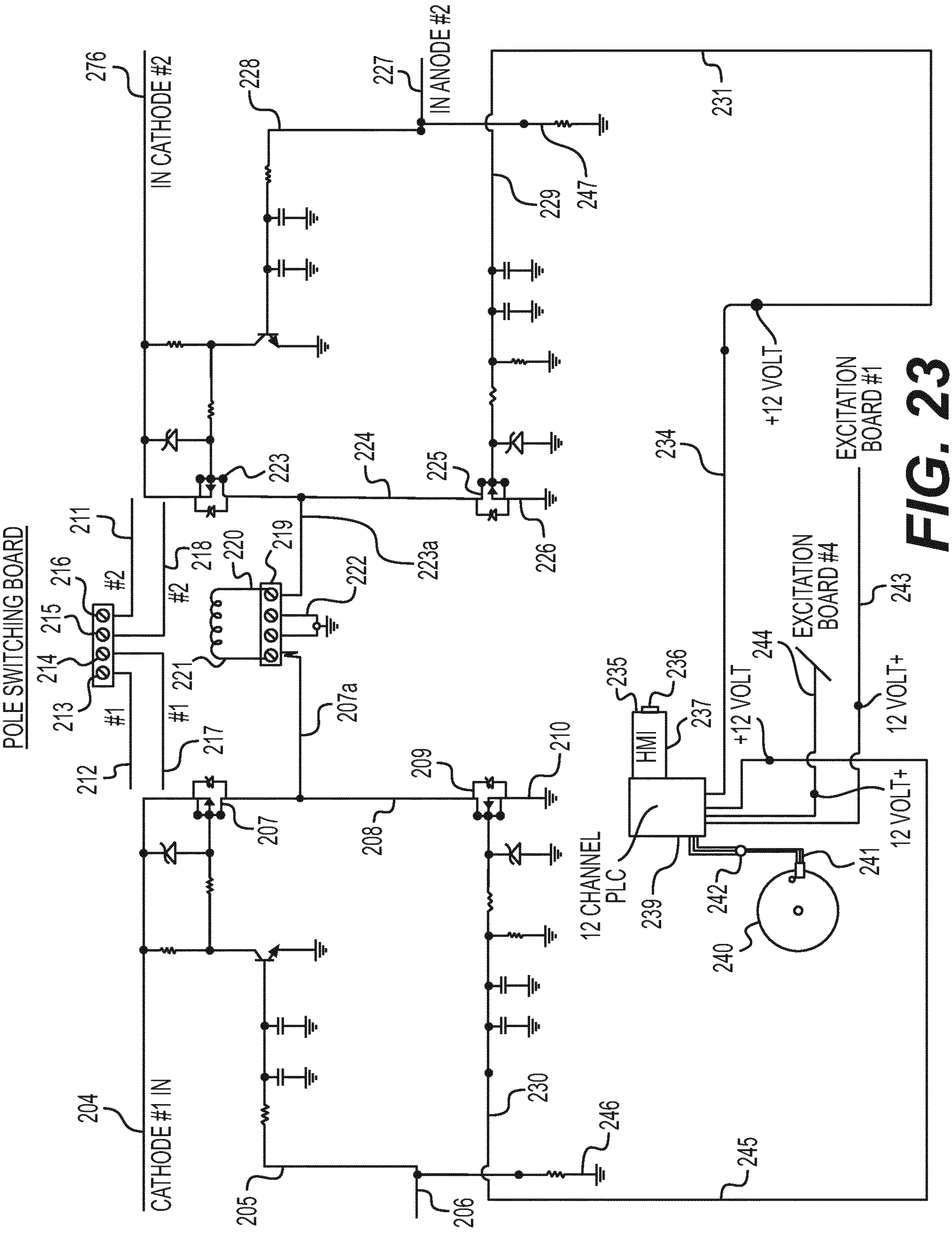

EXCITATION BOARD
250
276
257
258
254
253
252
257
260
259
259
248
A
B
R32 OHMS
261
255
264
265
+12v
274
271
272
273
256
277
+12v FROM PLC
12v+ FROM PLC
AF$_2$
CF$_2$
278
AF$_1$
CF$_1$
279
275
268
269
R32 OHMS
262
263
267
266

FIG. 22


POLE SWITCHING BOARD
CATHODE #1 IN
IN CATHODE #2
IN ANODE #2
#1
#2
#1
#2
HMI
12 CHANNEL PLC
+12 VOLT
+12 VOLT
EXCITATION BOARD #4
EXCITATION BOARD #1
12 VOLT+
12 VOLT+
204
205
206
207
207a
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
223a
224
225
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227
228
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245
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247
276

FIG. 23

# PATENT COOPERATION TREATY

# PCT

## DECLARATION OF NON-ESTABLISHMENT OF INTERNATIONAL SEARCH REPORT

(PCT Article 17(2)(a), Rules 13ter.1(c) and Rule 39)

| | | |
|---|---|---|
| Applicant's or agent's file reference<br>14277 005-00304 | IMPORTANT DECLARATION | Date of mailing *(day/month/year)*<br>9 May 2018 (09-05-2018) |
| International application No.<br>PCT/EP2018/051081 | International filing date *(day/month/year)*<br>17 January 2018 (17-01-2018) | (Earliest) Priority date *(day/month/year)*<br>17 January 2017 (17-01-2017) |
| International Patent Classification (IPC) or both national classification and IPC<br>H02N11/008 | | |
| Applicant<br>HOLCOMB SCIENTIFIC RESEARCH LIMITED | | |

This International Searching Authority hereby declares, according to Article 17(2)(a), that **no international search report will be established** on the international application for the reasons indicated below

1. ☒ The subject matter of the international application relates to:
   - a. ☒ scientific theories.
   - b. ☐ mathematical theories
   - c. ☐ plant varieties.
   - d. ☐ animal varieties.
   - e. ☐ essentially biological processes for the production of plants and animals, other than microbiological processes and the products of such processes.
   - f. ☐ schemes, rules or methods of doing business.
   - g. ☐ schemes, rules or methods of performing purely mental acts.
   - h. ☐ schemes, rules or methods of playing games.
   - i. ☐ methods for treatment of the human body by surgery or therapy.
   - j. ☐ methods for treatment of the animal body by surgery or therapy.
   - k. ☐ diagnostic methods practised on the human or animal body.
   - l. ☐ mere presentations of information.
   - m. ☐ computer programs for which this International Searching Authority is not equipped to search prior art.

2. ☒ The failure of the following parts of the international application to comply with prescribed requirements prevents a meaningful search from being carried out:

   ☒ the description ☒ the claims ☒ the drawings

3. ☐ The failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions prevents a meaningful search from being carried out:

   ☐ the written form has not been furnished or does not comply with the standard.

   ☐ the computer readable form has not been furnished or does not comply with the standard.

4. Further comments:

| | |
|---|---|
| Name and mailing address of the International Searching Authority<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL-2280 HV Rijswijk<br>Tel. (+31-70) 340-2040<br>Fax: (+31-70) 340-3016 | Authorized officer<br>DöRING, Anke<br>Tel: +49 (0)30 25901-215 |

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 203**

The present application and claim 1-56 relate to an alleged perpetual motion machine (perpetuum mobile):
The application relates to a "generator" that can be used as a battery replacement (p.1, l.3). Contrary to the established definition in the art of the term "electric generator" (used in claim 1), the object of the invention does not transform mechanical energy into electrical power as the rotor is stationary with respect to the stator (p.5, l.15-16).
According to the description, the only energy input into the generator is electrical energy used to excite the rotor poles (p.4, l.5-6). This energy represents 10% of the electrical energy generated by the system, 90% being usable for driving a load (p.4, l.12-14). Therefore it appears that the claimed system generates more energy than it consumes.
This is contrary to the law of conservation of energy and to the first law of thermodynamics. Therefore, a meaningful search as well as a meaningful opinion as to novelty and inventive step is not possible.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.