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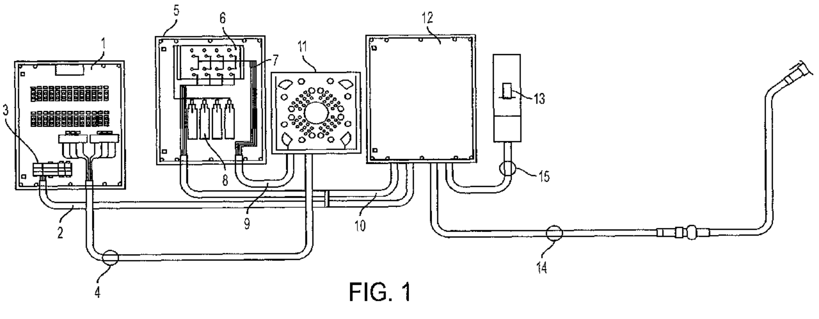

FIG. 1

(57) Abstract: A method and apparatus are disclosed for reducing rotor drag in an electric generator. A first and second stator section are aligned along a lengthwise axis and have aligned longitudinal slots. The slots have a longitudinal opening for accommodating induction windings. First rotors of slot rotor pairs can be distributed along the outer periphery of a first stator section having Induction windings, and can be aligned longitudinally with the lengthwise axis. Second rotors of the slot rotor pairs can be distributed along the outer periphery of the second stator section having induction windings. The first rotors and the second rotors can have least one pair of pole sections of a first and a second magnetic polarity for generating AC current.

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High Efficiency Electric Generator with Electric Motor Forces

Cross-Reference to Related Applications

[0001] The following application claims priority to U.S. Provisional Patent Application Ser. No. 61/630,600, entitled "High Efficiency Electric Generator with Electric Motor Forces," filed 15 December 2011 the contents of which, to the extent permitted by applicable law, incorporated herein by reference.

Background of the Invention

FIELD OF THE INVENTION

[0002] The present disclosure, which can be variously embodied as, for example, a method, apparatus, or the like, relates to the use of kinetic energy for the conversion of energy from electrons in the environment into electrical energy in the form of either alternating current (AC) or direct current (DC) in a manner which reduces electromagnetic drag, thereby greatly improving conversion efficiency. Various exemplary embodiments can provide, for example, a geometric design and electrical excitation sequencing of rotors associated with an electric machine such that significant positive motor effects can be realized in addition to the improved electric generator efficiency, which motor effects can be constructively used.

BACKROUND DISCUSSION

[0003] Rapid consumption of exhaustible energy from the earth, largely in the form of fossil fuels and rapid depletion of associated energy resources and accompanying environmental pollution and climate change drives the clear need for alternative energy supplies. Existing supplies must be used more efficiently.

[0004] In view of these and other issues, the need for sustainable power generation units is self evident. Renewable energy sources such as solar, wind, hydroelectric, electrostatic, temperature differential and geothermal energy have significant problems of availability, reliability and expense. Even gravity, if it could be efficiently harnessed, could provide a most attractive alternative.

[0005] One contribution to increasing consumption efficiency and sustainability is to increase the efficiency of electrical power generation. Increasing the conversion efficiency associated with converting mechanical energy to electrical power can provide potentially large gains. Based on conventional assumptions that 100% working conversion efficiency means, for example, that one horsepower can be used to generate 746 watts, an ordinary electric generator typically converts close to 99% of supplied mechanical power into electric power. The working efficiency factor however is far from an ideal 100% conversion efficiency factor and gains can be made from reducing friction, improving magnetic coupling and the like. Still further gains can be achieved using superconducting technology. For example, a superconducting generator can be around 10-times smaller than a conventional generator f---or the same output.

[0006] While such gains can be attractive, the expenses and challenges of implementing superconducting solutions can be well known. It is therefore also desirable to achieve efficiency gains that can be centered around more conventional structures. For example, if the reaction force or magnetic drag can be reduced or eliminated from the armature of an alternating current (AC) or direct current (DC) generator, the efficiency could be theoretically increased by 400-500%. Under such an increase in efficiency, one horsepower could generate 3,730 watts. Still further, by combining superconductivity with reduced magnetic drag, a greater than 10-fold increase in efficiency may be possible.

[0007] Every atom has a nucleus composed of positively charged protons and uncharged neutrons. Negatively charged electrons orbit the nucleus. In most atoms, the number of electrons is equal to the number of protons in the nucleus, so there is no net charge. If the number of electrons is less than the number of protons, then the atom has a net positive charge. If the number of electrons is greater than the number of protons, then the atom has a net negative charge.

[0008] While on the aggregate scale, the universe is electrically neutral, local concentrations of charge throughout biological and physical systems can be responsible for all electrical activity. Further, not all electrons can be involved in the structure of material. Vast numbers which can be loosely bound “electrons at large” can be in equilibrium with outer shell electrons of atoms in the environment. It is from this pool of electrons in the atmosphere and in the ground, when set into combined motion along a path, than an electric current is generated. Thus if electrical pressure from a generator is applied to an electrical conductor, such as copper wire, and the circuit is closed, electrons will flow along the wire from negative to positive, from atom to atom forming an electric current. The movement of energy associated with electrical current flow occurs at the speed of light, or approximately 186,000 miles per second.

[0009] For conceptual purposes, a wire connected to a DC power source will cause electrons to flow through the wire in a manner approximating water flowing through a pipe. The path of any one electron can be anywhere within the volume of the wire or even at the surface. When an AC voltage is applied across a wire it will cause electrons to vibrate back and forth in such a manner as to generate magnetic fields that push electrons toward the surface of the wire. As the frequency of the applied AC signal increases, the electrons can be pushed farther away from the center and toward the surface.

[00010] An electric power generator contains two main parts: a stator and a rotor. The stator is generally made of laminated iron or other ferro-magnetic material and contains long slots having a certain depth and in which wire coils can be wound in such a fashion to allow electric power to be generated when magnetic fields emanating from the rotor move past the coils. The rotor contains a specific arrangement of magnets, which can be generally wound armature electro-magnets whose strength is governed by the amount of current flowing in the armature windings. When the rotor spins inside the stator, the magnetic fields from the rotor induce a current in the stator windings thus generating what is referred to as electrical power.

[00011] The energy required to spin the rotor is typically supplied by a drive unit of some kind, such as an electrical drive motor, diesel or other fossil fuel motor, steam turbine or the like. At typical efficiencies, only 20% of the energy input by the driver motor is devoted to creating electric power. The remaining 80% is dissipated by magnetic drag, or braking forces, that develop between the rotor and the stator.

[00012] When current is supplied to a load from a conventional generator, a magnetic force or braking force is created by the flow of the load current in the generator conductors that opposes the rotation of the generator armature. If the load current in the generator conductors increase, the drag associated with the reaction force increases. More force must be applied to the armature as the load increases to keep the armature from slowing. Increasing drag and increasing load current leads to decreasing conversion efficiency and can eventually lead to destructive consequences for generator equipment.

SUMMARY

[00013] Various exemplary embodiments can be discusses and described herein involving aspects of an electric machine, such as a generator that produces power with high efficiency and low drag, as well as producing significant usable motor forces.

[00014] In accordance with an aspect, a method is disclosed for reducing drag in an electric generator that includes distributing first rotors of slot rotor pairs along the outer periphery of a first stator section having induction windings accommodated in slots. Second rotors of the slot rotor pairs can be distributed along the outer periphery of a second stator section having induction windings accommodated in slots. The slots of the first stator section and the second stator section can be axially aligned along a lengthwise and depthwise access. The "outer" periphery of the second stator section can also correspond to an "inner circumference" of, for example, the first stator section, where reference is made to a circular or other suitable shape stator embodiment. The inner periphery of the first stator section and the inner periphery of the second stator section can be adjacent to each other. The first rotors and second rotors of the slot rotor pairs include slot rotors having at least one pair of wound armature pole sections of a first and second magnetic polarity. The first and second rotors of the slot rotor pairs can be rotated in a synchronized manner such that a first one of the pole sections of the first rotor having the first magnetic polarity and a second one of the pole sections of the second rotor having the second magnetic polarity can be aligned with the slots to provide maximum flux density in the induction windings to induce a current flow therein. The first rotor and the second rotor of the respective slot rotor pairs can be aligned with the aligned slots of the first stator section and the second stator section along respective lengthwise axis of the first and second rotors and the slots such

that the lengthwise axis of the first and second rotor can be in normal alignment with the depthwise axis of aligned slots.

[00015] The first and second rotors can be magnetically shielded such that flux generated by the first and second rotors is directed into the slots so as to minimize flux leakage and magnetic drag. The first rotors and the second rotors can be inserted into respective openings provided in the first and second stator sections. The respective openings can be arranged in lengthwise alignment with the slots, to partially shield the first and second rotors and can be provided with a longitudinal opening corresponding to a longitudinal opening of the slots in order to provide magnetic communication with the corresponding longitudinal opening of the slots and ultimately to the winding disposed therein.

[00016] The first and second rotors of the slot rotor pairs can be rotated about their axis in opposite directions over the slots such that the net torque generated by the polar force interaction between the first and second rotors is approximately zero and in specific cases can be a high net negative torque and produces usable motor effect. Accordingly, as the first one of the pole sections of the first rotor having the first magnetic polarity is rotated over a slot in a first direction, the second one of the pole sections of the second rotor can be sequenced such that it presents the second magnetic polarity opposite the first magnetic polarity in order to maximize the flux density in the aligned slots. The second one of the pole sections is being rotatable in a second direction opposite the first direction to form a magnetic circuit between the first and second magnetic polarities. The firing angle in certain instances can be timed to yield usable motor effects. The first and second rotors can be driven in a synchronized manner that includes turning on an excitation current in an armature of the first one of the pole sections of the first rotor having the first magnetic polarity at an instant in time when the first one of the pole sections is positioned in a correct proximity to a slot in a first direction. An excitation current in an armature of the first one of the pole sections of the first rotor having the first magnetic polarity at an instant in time when the first one of the pole sections is positioned in correct proximity to a slot in a first direction. An excitation current in an armature of the second one of the pole sections of the second rotor having the second magnetic polarity can be similarly turned on. The first and second rotors can be shielded such that flux generated when an excitation

current is supplied to the armatures of the first and second rotors is directed substantially towards the slot. The induction windings can be connected in a 3 phase, high wye or 3 phase low wye connection, however a delta connection is not prohibited.

[00017] In accordance with another exemplary aspect, an electromagnetic assembly for an electric generator can be provided that includes a dual stator having a first stator section and a second stator section. A first polarity of slots can be arranged on an outer periphery of the second stator section. Again, as noted hereinabove, with respect to a closed geometric arrangement stator the outer periphery of the second stator section can refer to an "inner circumference." Respective inner peripheries of the first and second sections can be disposed in adjacent relation and can include a back iron disposed there between to improve magnetic coupling through the slots. Each of the first and the second polarity of slots can be aligned along a lengthwise and depthwise axis to form slot pairs, each of the polarity of the slots having induction coil windings disposed therein.

[00018] The assembly can further include slot rotor pairs associated with the slot pair. Each of the slot rotor pairs has a first slot rotor disposed in aligned relation with one of the first polarity of slots and a second slot rotor disposed in aligned relation with one of the second polarity of slots corresponding to the slot pair. Each slot rotor has at least a pair of magnetic poles with one of the pair of magnetic poles having a first magnetic polarity and another of the pair of magnetic poles having a second magnetic polarity. Each slot rotor is capable of rotating about a longitudinal axis. The slot rotor pairs can be disposed above the slot pairs such that the induction coil windings disposed in the slot pairs can be exposed to magnetic flux generated by the slot rotor pairs. Each slot rotor can be provided with a shield having an opening positioned over the slots to direct the flux into the slots but minimize external flux leakage. In addition, a shield section can be provided for shielding magnetic coupling of magnetic flux from the first and second slot rotor rotors and end teeth portion of the first stator section and the second stator section. The shielding can be made from mu metal. The first slot rotor and the second slot rotor can be capable of rotating such that when magnetic flux of one of the magnetic poles of the first polarity associated with the first slot rotor is directed to a corresponding first slot of the slot pair, magnetic flux of an associated one of the magnetic poles of the second polarity associated with

the second slot rotor is directed to a corresponding second slot of the slot pair such that induction coil windings disposed in the first and second slots can be exposed to increased magnetic flux and leakage of the magnetic flux is minimized. In one embodiment, the first polarity of slots can include 48 wire slots, and the second polarity of slots can include 48 wire slots. Each of the first stator section and the second stator section can have a substantially circular shape where the first stator section and the second stator section can be concentric about a longitudinal axis of the dual stator. Alternatively, the first stator section and the second stator section can be planar. In another embodiment, the first polarity of slots includes four wire slots and the second polarity of slots can include four wire slots. Each of the first stator section and the second stator section can have a substantially squcan be shape where the first stator section and the second stator section can be concentric about a longitudinal axis of the dual stator.

[00019] An excitation circuit can be provided that applies an excitation current to the first slot rotor and the second slot rotor so as to generate the magnetic flux when the one of magnetic poles of the first polarity associated with the slot rotor is rotated into alignment with a corresponding first slot of the slot pair and to generate the magnetic flux when the associated one of the magnetic poles of the second polarity associated with the second slot rotor is rotated into alignment with a corresponding second slot of the slot pair. The excitation circuit can further remove the excitation current from the first slot rotor and the second slot rotor in order to remove the magnetic flux at an instant when the one of the magnetic poles of the first polarity associated with the first slot rotor is rotated out of alignment with the corresponding first slot of the slot pair, and to remove the magnetic flux at an instant when the associated one of the magnetic poles of the second polarity associated with the second slot rotor is rotated out of alignment with the corresponding second slot of the slot pair. A diode circuit can be provided for transmitting a current generated when the magnetic flux is removed from the first and the second slot rotors to a battery. The excitation circuit can include a commutator circuit associated with the first and second slot rotors, the commutator circuit selectively coupling one of the first and second slot rotors to the excitation current as the ones can be rotated into alignment.

[00020] In accordance with various exemplary embodiments as discussed and described herein, distributed slot rotor pairs can be provided that rotate in a close proximity to aligned wire slots disposed around the circumference of a dual stator of an electric power generator. Accordingly, an intensified magnetic circuit can be completed that places maximum flux into the wire slots using slot rotor pairs. Energy, which would be consumed by drag, is thereby liberated as electric power.

[00021] Further in accordance with various exemplary embodiments, a significant and usable motor force can be produced and in some embodiments, the geometry can be, but is not limited to, a squcan be dual stator arrangement. A correspondence between an exemplary specific geometry of the stator, stator slots and the like, and a controlled energizing or firing angle of the magnetic dual poles of the rotor pairs can generate a significant net negative torque that translates to a significant usable motor force.

Brief Description of the Drawings

[00023] In order that embodiments may be fully and more clearly understood by way of non-limitative examples, the following description is taken in conjunction with accompanying drawings in which like references designate similar or corresponding elements, regions and portions, and in which:

FIG 1 is a diagram illustrating an exemplary power control system that can be associated with a high efficiency decreased drag electric machine in accordance with one or more exemplary embodiments;

FIG 2 is a diagram illustrating a lateral view of an exemplary electric drive motor, support stand, and generator electric machine in accordance with one or more exemplary embodiments;

FIG 3 is a diagram illustrating a superior oblique projection of exemplary stator components with support structures, rotors, slip rings, brushes and transmission in accordance with one or more exemplary embodiments;

FIG 4 is a diagram illustrating a lateral projection of exemplary stator components showing a stator, stator windings, support structure, slip rings, brushes, transmission and end coder sensors in accordance with one or more exemplary embodiments;

FIG 5 is a diagram illustrating an exemplary transmission in accordance with one or more exemplary embodiments;

FIG 6 is a diagram illustrating exemplary transmission gears for rotation of outer rotors in one direction and inner rotors in another direction in accordance with one or more exemplary embodiments;

FIG 7 is a diagram illustrating a superior oblique projection of an exemplary electric machine, frame and driver motor in accordance with one or more exemplary embodiments;

FIG 8 is a diagram illustrating a superior oblique projection of an exemplary sensor end coder and exemplary end portions of a transmission and drive motor in accordance with one or more exemplary embodiments;

FIG 9 is a diagram illustrating a cross section of an exemplary stator and stator laminate in accordance with one or more exemplary embodiments;

FIG 10 is a diagram illustrating a superior and lateral projection of an exemplary unwound stator in accordance with one or more exemplary embodiments;

FIG 11 is a diagram illustrating a cross section of a stator and stator iron, rotor windings, rotors, mu metal shields and mu metal shield covers in accordance with one or more exemplary embodiments;

FIG 12 is a diagram illustrating an exemplary wound dipole rotor and attached slip ring in accordance with one or more exemplary embodiments;

FIG 13A is a diagram illustrating a rotor laminate and slot and shaft structure in accordance with one or more exemplary embodiments;

FIG 13B is a diagram further illustrating a rotor laminate of FIG 13A;

FIG 14 is a diagram illustrating a wound rotor and coil array for a dipole rotor in accordance with one or more exemplary embodiments;

FIG 15 is a diagram illustrating a wound rotor and coil connections for a high magnetic flux density dipole rotor in accordance with one or more exemplary embodiments;

FIG 16 is a diagram illustrating a high efficiency generator coupled in line with a servomotor and a standard generator for removing motor forces from the high efficiency generator in accordance with one or more exemplary embodiments;

FIG 17 is a diagram illustrating an exemplary stator, rotor, frame transmission arrangement of a 3 stator group in which each stator is timed 120° out of sequence to the previous stator timing such that 3 phase power is generated in accordance with one or more exemplary embodiments; and

FIG 18 is a diagram illustrating depiction of a cross section of an embodiment which contains 16 rotors rather than 8 rotors.

Detailed Description of the Drawings

[00025] The structure and mechanism will allow electric energy to be generated by currently available fossil fuel energy sources with a greatly increased efficiency, therefore less fossil fuels will be consumed and therefore less production of greenhouse gases will result. The embodiments described herein can also be run on electric energy.

[00026] The enhancement efficiency is obtained due to removal of electromagnetic drag from the system. This negative motor reaction may be reduced and other problems can be solved in an embodiment whereby a series of rotatable bipolar or quadrapolar electromagnets, electrical armatures, rotors or the like, can be disposed or otherwise inserted on their axis into recesses in a stator. The recesses can be shielded and positioned over each wire slot of the generator. Maximum flux density is obtained in accordance with a novel embodiment whereby wire slots of an inner stator circumference and on an outer stator circumference can be each provided with slot rotors forming an exemplary dual slot rotor, dual stator configuration.

[00027] The following detailed description provides an understanding of embodiments as illustrated and described herein below. Exemplary embodiments can be provided that allow electric energy to be generated based directly or indirectly on conventional fossil fuel sources with greatly increased efficiency resulting in reduced consumption of fossil fuel supplies and reduced output of greenhouse gases. Accordingly, a high efficiency generator is provided that shields or separates the drag creating magnetic forces from one another so that upwards of 80% of the driving energy which conventionally is consumed by magnetic drag is converted into electric power. A mechanism and procedure is presented such that the proper sequencing of bipolar rotors may allow the generation of positive motor effects such than in addition to electric power generation, the high efficiency generator produces a usable mechanical motor force which is absorbed from the system by an in-line dual shaft servomotor and standard 3 phase generator. The standard 3 phase generator, in addition to taking the motor forces out of the system, also produces 3 phase power.

[00028] In accordance with an embodiment as will be described in greater detail in connection with the illustrations below, the classic rotor/armature and stator can be replaced by laminated steel dual stator having a stator section with an outer circumference of a stator section with an inner circumference. Each stator section has, in one example, four wire slots that can be magnetically coupled with individual slot rotors of corresponding slot rotor pairs. The corresponding slots from the inner and outer stator sections can be aligned with each other and ferrous back iron may be disposed between the stator sections to increase the flux coupling. A slot rotor and/or slot rotor transmission support, which can also be any suitable means for support, can also be attached to the stator. The support can be oriented in a variety of manners, such as, four example, in a manner whereby the planes of the support base is parallel with the planes of the end portions of the stator. A slot rotor pair support, including, for example, bearing blocks and the like can also be attached to the base support.

[00029] The slot rotor pair support can support the combined eight slot rotors of the inner and outer stator section circumferences. The slot rotors can be constituted of, for example, two pole or four pole wound armature poles and associated bearing mechanisms and other mechanisms. As will be appreciated, an exemplary apparatus can be configured with a number of slot rotor assemblies such as, for example, but not limited to four slot rotor assemblies for the outer circumference and four slot rotor assemblies on the inner circumference. The slot rotors can be positioned in close proximity to the wire slots in order for each rotor of the slot rotor pair to form a closed magnetic circuit through both slots. In particular, the slot rotors can be positioned adjacent to the slot opening along the periphery of the associated stator section. It should be noted that one of the slot rotors in the slot rotor pair rotates clockwise and the other rotates counterclockwise in order for the proper magnetic flux to be delivered to the wire slots. The exemplary eight armature/rotor mechanism can be contained in magnetically shielded cylinders such as mu metal cylinders with an appropriate opening in the shield that is positioned directly over the opening associated with the stator wire slots. Each slot rotor armature of the slot rotor pair can be energized in the individual rotor assembly and can be rotated to provide alternating fields of north and south pole magnetic flux field energy into the open wire slots of the induction coils in the stator. Each of the slot rotors in the slot rotor pair can be rotated such that a pole of one slot rotor completes a magnetic flux circuit with the corresponding opposite pole of the

other slot rotor of the slot rotor pair thereby directing the maximum amount of magnetic flux into the slots. The magnetic poles can be activated, which can mean, for example, that windings associated with the associated rotors can be energized, with DC current via a brush and commutator and/or slip ring apparatus or other appropriate solid state mechanism such that a magnetic pole is activated only when it passes over the wire slot. Since the opening of the mu metal laminated shield is precisely positioned over the wire slot, the slots of the stator can be exposed to only a small but intense window of magnetic flux. It is important to note that an angle of rotation of the leading edge of a corresponding rotor at the time when activation or excitation begins can be balanced, controlled, synchronized, coordinated or the like, such that the positive and negative motor forces can be balanced. Accordingly, only very minimal electromagnetic drag on the slot rotors is experienced.

[00030] In accordance with an aspect, slots in an outer circumference and inner circumference of a stator, or inner and outer stator portions, can be aligned. The magnetic poles of each individual rotor of the pair of slot rotors rotate in a coordinated fashion respectively over the inner and outer aligned slots such that, for example, as a north pole of one of the pair of rotors rotates over the slot of the inner slot, a south pole of the other pair of rotors rotates over the outer slot. Thus, the dual rotors can be sequenced such that they present opposite poles to corresponding slots in the inner and outer stators respectively making up a magnetic circuit between the north pole and south pole as they rotate past one another. The resulting magnetic circuit generates a very high flux density into the slots on both the inner and outer stators and into the shared back iron.

[00031] In an exemplary bipolar slot rotor, one of the two pole sections is charged as a north pole and the opposite section is charged as a south pole. In an embodiment at, for example, 3,000 rpm, the pre-firing or pre-energization angle can be zero degrees, the north pole section can be constituted with a firing angle of 90 degrees, and a post-firing angle of 90 degrees, and the south pole can then be constituted by an opposite 90 degree firing angle and a 90 degree post-firing angle. The above described sequence constitutes a 360 degree rotational cycle. Pole sections can be shielded with mu metal shielding. Each of the slot rotor arrangement can be contained in a longitudinal cylindrical cavity that is located in close proximity to and extends

lengthwise along the opening of the winding slots. The slot rotor mechanism, including a mu metal shield, can be contained within a steel cylinder or partial cylinder which has an opening that approximately corresponds and in communication with the opening of the stator wire slot. An opening along the length of the steel cylinder can be in alignment with a slot or opening along the length of the mu metal shield to allow magnetic coupling between the slot rotor and the winding slot. The mu metal shield insulation allows the north slot rotor pole of one of the pair of slot rotors to "see" only a narrow segment of the opposing field from the south slot rotor pole of the other of the pair of slot rotors coming through the wire in the wire slots. The degree of magnetic interaction between the slot rotor pairs and the flux coupling from the opposite magnetic poles and the stator through the back iron is minimal due to the effects of the current flow within the windings that occupy the slots. The slots of the first stator section and the second stator section together with the corresponding rotors of the slot rotor pairs, can be preferably closed during the operating phase forming a 360° circumference of mu metal shielding and shield covers. The slots of the first stator and the second stator can be functionally closed by installing mu metal shield covers to form a 360° tunnel around the slots and the rotors and can be placed over the mu metal shields and torqued into a snug fitting position.

[00032] It will be appreciated that in an embodiment, the slot rotor may be fashioned and wound electromagnetic armatures positioned, for example, as four pairs of rotors around the circumference of a dual wound stator. While four pairs can be shown for illustrative purposes, it is by way of example only, and different numbers of slot rotor pairs can be used. An individual slot rotor/armature may be made by fashioning a series of laminated steel pole pieces upon a shaft in a manner similar to that of a conventional generator/armature. The completed pole pieces can be wound in a conventional manner with insulated wire to suitable winding specifications for the operating demand of the generator. The rotor/armature may also be wound in multiple coils making up the face of the coils and connected in parallel in order to reduce the resistance and increase the current flow. Power may be supplied to the rotors/armatures as will be described in detail hereinafter. To drive the shafts of the slot rotor mechanism, a transmission mechanism is provided at one end of the individual slot rotor shafts. As the slot rotor/armature pairs can be rotated on both sides of the stator in a synchronized manner by the gear mechanism, power can

be generated with greatly reduced drag as compared with a single central rotating armature of a conventional generator.

[00033] Power generation in accordance with the reduced electromagnetic drag provided in various embodiments discussed and described herein, can result in, for example, a four-fold or greater increase in electric energy output with the same mechanical or kinetic energy input. With an exemplary mechanical input of, for instance, one horsepower provided by an electric drive motor driving the exemplary gear mechanism, one horsepower of mechanical energy may generate approximate 3,000 watts rather than the more conventional limit of 746 watts. Therefore as the conventional one horsepower electric motor drives the gear mechanism, the generator will consume 746 watts of electric energy and generate 3,000 watts thereby is generating an additional usable 2,254 watts of energy.

[00034] The process of electrical power generation can be thought of as a process by which the input of kinetic energy, for example, is used to move a magnetic field. The resulting moving magnetic field moves across the conductor wires in the stator induction wire slots of the electric generator which causes an electrical current to flow in the coils of the generator. The electrical current flowing in the stator coil creates a magnetic field by virtue of the physical construction of the coils and laminated steel in which they can be wound. The newly created magnetic field in the stator iron increases in strength as electric power is increasingly drawn from the generator and is approximately equal in strength and of opposite polarity to the original source of the magnetic field. The stator field interacts with the original source of the magnetic field in the rotor which ends up dissipating the kinetic energy input to the system. Therefore, it may appear that the kinetic energy is being converted to electrical energy. In fact, the kinetic energy is only eliciting electrical energy which, by virtue of the design of the generator, is dissipating the kinetic energy by acting in the opposite direction of the said original kinetic energy.

[00035] The problem associated with such energy dissipation is a fundamental problem of generator design rather than a partial necessity of the generator process. The change in generator arrangement, as discussed and described herein, has practically eliminated the unwanted

byproduct of back electromotive force (EMF) and subsequent magneto-motive force (MMF) without affecting the generating process. The electrical output of an exemplary generator is no longer strictly limited to the input of kinetic energy by conventional factors. In accordance with various embodiments, an electrical generator system is provided in which a conventional magnetically polarized generator rotor is replaced by a series of distributed slot rotors having magnetic poles affixed over and in close proximity to each wire slot. In order to isolate the magnetic flux and direct it to the slots, the slot rotors can be shielded with, for example, mu metal which can be annealed metal composed of 75% nickel, 15% iron, plus copper and molybdenum.

[00036] A stator, in accordance with embodiments discussed and described herein, can contain wire slots on the inner circumference as well as the outer circumference. It should be noted, however, that by use of the term "inner" and "outer" illustrative reference to a circular shape or other closed shaped stator embodiment. It will be appreciated and should be emphasized that the dual stator need not be circular and can be linear or planer, or can be of semi-circular or other shape and have dual stator sections with the same effect as the embodiments specifically illustrated and described herein. In such an embodiment where the stator is not circular, the terms "inner circumference" and "outer circumference" can be replaced by terms such as "first outer periphery" and "second outer periphery." Further, since an exemplary stator in various embodiments is described herein as dual stator arrangements, the first outer periphery and second outer periphery can include the stator surface containing the slot rotors. The second respective inner peripheries of the second stator section can be adjacent to and can face each other either directly or with intervening members such as back iron or the like.

[00037] The slots in the outer circumference and inner circumference can be aligned. The magnetic poles rotate over both aligned slots such that north pole rotates over one slot, the pole over the aligned slot is sequenced such that it represents a south pole rotating in the opposite direction thereby making up a magnetic circuit between the north pole and the south pole as they rotate past one another. The magnetic circuit generates a very high flux density into the slots on both the inner and outer radius and into the shared back iron. Each of the magnetic bodies in constructed as wound inductive magnetic armatures. The unique design is powered by

a DC current supply which activates pole coils through a brush and slip ring mechanism such that the magnetic poles can be only activated as they can be rotated over the unshielded wire slots. The angle from the middle of the wire slot to the leading edge of the incoming north pole/south pole rotors may be manipulated to control drag forces. It will be appreciated that, in some embodiments, a control algorithm can be used to control the activation of the rotors to monitor various factors such as rotor position, power output and the like, and further improve the efficiency of the effect.

[00038] The armature mechanism can be separated from the back EMF and related to magnetomotive forces by mu metal shield cylinders which completely surround the electromagnetic armature mechanisms except as described hereinafter. The cylinders can be open only to provide magnetic flux coupling to the wire slots of the stator. The shielded electromagnetic poles can be rotated by an exemplary transmission mechanism which effectively exposes the wire slots to a high density moving magnetic field over and through the slots of the induction coils of the stator. The magnetic poles of the armature mechanism can be only activated as they rotate over the wire slots and can be fired or activated at the proper rotational angle. With the proper stator winding and pole activation sequence, clean single-phase or balanced multi-phase alternating current (AC) can be generated. By making the appropriate changes single phase, two-phase, three-phase or other multi phase and direct current (DC) may be generated. In accordance with the principles described herein, generators of practically unlimited size with greatly improved efficiency can be constructed. The efficiency increase when compared to a present day generation technology is significant and can be scalable.

[00039] With reference to the figures, FIG 1 illustrates a basic control system in accordance with an embodiment. Master control panel 12 can house programmable logic centers which can be controlled or “slaved” to a computer having an interface, such as, for example, a human machine interface (HMI). The programmable logic centers receive temperature, speed and rotor pole position, and other data, including data for thermocouples and rotor end coders. The speed and position signals can be routed to excitation controller cards 6 of excitation controller panel 5. The information can be processed by microprocessors within the rotor pole excitation cards 8 allowing current to be directed to the corresponding rotors through slip rings,

commutators, or other mechanisms which can be configured to magnetize the rotor poles at a given time, at a given angle of rotation and for a given duration of rotation. Power output from the high efficiency generator can be made available at generator junction panel 11 where, for example, transformer coils can be made up in series or parallel depending upon the desired end voltage. Power can be fed to a load bank controller panel 1 through a conduit 4. Conduit 2 can carry a supply voltage, such as 240 VAC, to load bank controller panel 1 to power PLC (Programmable Logic Center) 3. Conduit 9 can carry control signals and power supply power to the excitation controller 6 and excitation controller panel 5. Variable Speed Drive (VSD) 13 can receive power and control signals through conduit 15 and thereby control the speed of a drive motor such as driver motor 19 of FIG 2. Electric conduit 14 provides a power supply to the entire system.

[00040] FIG 2 shows driver motor 19, motor support 17 and motor stand 16, the drive shaft coupling 20 and shaft covering 21. The drive shaft (not shown) can be the drive member of the transmission 22 which controls the rotation of the magnetized rotors in the proper sequence for power generation. The generator is supported by generator frame 28 and is covered by cowling 25 and 27. Tie-posts 26 hold the generator structure in alignment. The unit is cooled by vent fans 23. Central drive shaft 41 of FIG 3 enters the transmission housing 22 through support bearings and oil seals as would be appreciated by one of skill in the art. Transmission top cover 40 contains an oil seal and oil cap 39. The transmission gears drive, for example, as shown in the illustrated embodiment, eight rotors 38 which in turn can drive eight additional rotors through spline couplings 42. Support plates 37a, 37 and 29 can be held in place by support tension bars 26. The stators 44 can be wound with insulated copper coils 30. Mu metal shield which surrounds the rotors can be held in place by shield covers 32 and 34. The rotors can be held in bearing rests 31.

[00041] FIG 4 shows an exemplary configuration of an embodiment where two stator components can be mechanically coupled. Additional details are shown including stators, stator windings, support structure, slip rings, brushes, transmission and end coder sensors. The sensor end view reveals the support end plate 29 which can be securely held by tie-support means end cap 52 and compression bolts 53. End plate 29 is supported by support structure 56. End plate 29

retains eight bearing retainers 49 which contain bearings 51 and rotor shaft 50. Pole sensor end coder 54 can be aligned on keyway 55 for pole alignment purposes. A lateral view of transmission 22 is revealed. Drive shaft 45 can function as a driver for all the rotors 38 through the gears of the transmission 22 and can be coupled to central drive shaft 41 of FIG 3. The bipolar magnetic induction rotors generate power as the high density flux sweeps across the stator coils 30. The stator 44 can be formed 0.35mm thick insulated electrical steel laminates and the power is taken off by multi-stranded cables to generate junction panel 11. All rotors 38 can be shielded, such as, for example, being surrounded by 0.62mm thick mu metal shield except for a small opening over the wire slots. The shields can be covered by shield covers 32, and shield covers 79 as shown in FIG 11. Current can be passed through the pole coils of the rotors 38 through brushes and slip rings 46, or in other embodiments, commutators, or other mechanisms or the like. The two stators can be stabilized by support means 26 and tie-rods 53.

[00042] FIG 5 shows an exemplary transmission in an embodiment. Rotor gears 57 can be in contact with drive gears 57a, which can be on the shame shaft as gears 58 and can be driven by central driver gear 59 which is in turn driven by the central drive shaft 45.

[00043] FIG 6 shows meshing gears of an exemplary transmission in accordance with one or more embodiments, which, for example, when taken along with an exemplary transmission as shown in FIG 5, or other drive mechanism, can effect a rotation of the outer rotors which rotate in a clockwise fashion and inner rotors which rotate in a counterclockwise fashion. The keyway 60 of exemplary mesh gear 61 can always be aligned on the north pole of the rotor. The poles alternate north then south as one progresses around the four outer rotors of the device.

[00044] FIG 7 shows an exemplary electric machine, frame, coupling and driver motor. Driver motor 19 can be supported by plate 17 which rests on support 16. The driver motor drives transmission 22 which drives the 16 rotors. The machine is covered by cowling 24 and is vented by vent fans 23. End coder cover 64 is revealed as wire 62.

[00045] FIG 8 shows an exemplary sensor end coder 64 end view along with the transmission and drive motor end. Drive motor 19 is shown supported by fasteners 18 to support frame 16. Drive motor 19 drives transmission 22 which can be covered by cover 21. The end view of end coder end reveals pole position end coder 54 and speed sensor end coder 64.

[00046] FIG 9 shows a cross section of an exemplary stator laminate 44a in accordance with an embodiment. Stator laminate 44a can contains outer rotor cavities 66 and inner rotor cavities 68. Cavities for support post 67 can be shown. Stator torque bolt hole 70 is shown along with eddy current rods retention means 71. It will be appreciated to one of skill in the art that an entire stator can be constructed by a series of stator laminates 44a, which when insulated can be placed next to each other to form the gross structure of a stator.

[00047] As described in connection with FIG 9, a stator can be constructed with a series of stator laminates 44a. FIG 10 shows a non-wound stator in accordance with an embodiment. Stator 44 is constructed of a series of 0.35mm thick insulated steel laminates, such as stator laminates 44a. The steel laminates can be made from oriented steel and oriented in a direction to obtain the best magnetic permeability. The laminates can be pressed under a specific pressure as an example this specified pressure may be 250 – 500 lbs per square inch which may amount to 50 US tons of pressure. While under pressure a weld bead 72a can be placed down the outer circumference in the midline of all four quadrants of the stator. In addition, torsion bolts 72 can be torqued down to, for example, approximately 280 ft. lbs. An eddy current discharge rod 71 is pounded into a receptacle trough. The rotor cavity 66 and 68 can be revealed. Cavity 66 is on the outer circumference of cavity 68 is on the inner circumference.

[00048] FIG 11 shows a cross section of a stator, such as exemplary stator 44, of an embodiment revealing the stator iron, stator windings, rotors, mu metal shields and mu metal shield covers. The illustrated cross section of exemplary stator 44 reveals geometric and shielding configurations allowing operation with low drag forces i.e. low positive torque. It will be noted that at constant speed, a generator shaft torque is the only variable in relation to

horsepower (HP) required to turn the generator shaft at constant speed such that the proper frequency is maintained in accordance with EQ (1).

$$HP = \text{Torque (ft lbs)} \times \text{Speed (rpm)}/5252 \qquad \text{EQ (1)}$$

[00049] A computer model reveals that an exemplary generator in accordance with one or more exemplary embodiments, requires essentially the same torque to turn the shaft in the electrically loaded and unloaded state and/or at various loads. The mechanical forces can be related to mechanical resistance (i.e. torque) to turn the mechanical mechanisms and to compensate for the attraction of the magnetic rotors to the iron in the slots of the stator 66 and 68. Adjustment of the firing rotor angle of the clockwise rotating outer rotors (poles 75, 76) and counterclockwise inner rotors (poles 75a, 76a) along with the proper duration of firing brings about a significant positive motor effect. As south pole rotors 76 of the outer rotors rotate in synchrony with the north pole rotor 75a, north pole 75 is not magnetized nor is south pole 76a magnetized. The pole 76 and 76a can be configured to excite the slot as pole 75 and 75a are rotating into the slot. Adjustment of the angle of rotation, at which south changes to north in the outer rotor and north changes to south in the inner rotor, brings about significant negative torque. Merely switching the north-south alternations will spin the entire generator without a driver motor. The net negative torque is approximately 300 ft lbs. for the two stators of the entire machine. This positive motor force can amount to as high as 170 hp at 3,000 rpm. Manipulation of these positive and negative torque forces allow the desirable low drag to no drag outcome.

[00050] Other dominant forces that can bring about very low electromagnetic drag and that are secondary to stator electric load forces, can be the geometric positioning of the rotors. If the rotors are positioned at a point that is removed from the center, or point of greatest flux concentration of the stator magnetic poles 44a, 44b, 44c and 44d, the rotor magnetic fields can be further isolated. Due to this geometric isolation of the rotor magnets from the stator magnetic field along with mu metal shielding 80 around all rotors, the rotor magnetic forces can be isolated from the stator magnetic forces. The stator coils 1-1a, 2-2a, 3-3a, 4-4a, 5-5a, 6-6a, 7-7a and 8-8a can be lap wound and connected in series or in parallel. It is appcan bent from the

figure that there is an inner stator winding and an outer stator winding. The mu metal shields can be held in place by mu metal shield retainers 32 and 79.

[00051] FIG 12 shows a wound dipole rotor with attached slip rings. Dipole rotor 105 can have 16 slots wound with, for example, 7 wires in parallel (7 in hand) of #20 AWG copper magnet wire. Four (4) coils can be wound in each pole, north pole 110 and south pole 106. The laminates that make up the rotor iron can be made up of 0.35mm thick insulated electrical oriented steel. North pole 110 is wound counterclockwise and south pole 106 is wound clockwise. The laminates can be pressed onto the shaft 114. The coil can be placed in the slots 113 and attached to slip ring 108. Ring #1 on the slip ring arrangement is connected to eddy current grounding rod 107. Ring #2 is north (-) negative, ring #3 is south (-) negative, ring #4 is north (+) positive, ring #5 is south (+) positive. Rings 109 and 109a can be connected internally to north positive and south positive respectively. These rings feed back to a storage battery through a one way diode and collect the current from the collapsing poles as they can be activated and deactivated for each 360 degree cycle. The slip rings can be contacted by carbon brushes which carry current from the excitation boards into the rotor coils.

[00052] FIG 13A shows an exemplary rotor laminate 80 with slot and shaft structure in an embodiment having, for example, 20 slots and 20 coils wound as further illustrated in FIG 14. A series of rotor laminates 80 can be configured together to form a rotor. The resulting rotor can be wound in a lap fashion with #20 AWG copper magnet wire, 7 wires in parallel (or 7 wires in hand). Laminate 80 can be constructed of 0.35mm thick insulated electrical steel with shaft opening 82 containing keyway 83 and wire slot 81.

[00053] FIG 13B is a depiction of a rotor laminate from rotor revealed in FIG 12 showing exemplary sets of four windings making up the north (N) and the south (S) pole. The S pole windings 104 and the N pole windings 105 can be placed in the corresponding slots to provide the ability to energize and magnetize the rotor in the desired manner. The four coils making up the pole winding sets (104, 105) can be wound from the center with #20 AWG copper magnet wire 7 in parallel (7 in hand). For example, for the S pole, coil #1 containing lead 106 in the center slots has 50 turns, coil #2 which is continuous with coil #1 and contains 60 turns, coil #3 is

continuous with coils #1 and #2 and contains 70 turns, and coil #4 is continuous with the previous coils and contains 76 turns and negative lead 107. Similarly, for the N pole, coil #1 with lead 108 in the center has 50 turns, coil #2 has 60 turns, coil #3 has 70 turns and coil #4 has 76 turns and exits through negative lead 109.

[00054] FIG 14 shows a coil array for a dipole rotor in accordance with an embodiment. In the illustrated embodiment, four groups of five coils per group can be laid down in a lap fashion. There can be 25 turns of #20 AWG copper magnet wire wound 7 wires in parallel (7 in hand). The "in" an "out" leads for each coil are labeled 1 and 2. The rotor iron 80 contains slots 81 and eddy current rods 8. The coils can be connected in parallel to form a magnetic dipole as seen in FIG 15.

[00055] FIG 15 shows a wound rotor of FIG 14 having coil connections needed to construct a high magnetic flux density dipole rotor. North pole neutral lead 90 is connected to all #2 leads and in one half of the rotor. North pole positive 88 is connected #1 leads on the same path of the rotor. South pole neutral 89 is connected to #1 leads on the opposite side of the rotor and south pole positive 91 is connected to the remaining #2 leads.

[00056] FIG 16 shows an exemplary high efficiency generator that can generate motor effects as described herein, in line with a servomotor and standard generator for removing and utilizing the motor forces. Generator 22 is presented with a motor stand 16 which supports a double shaft electric servomotor 94 and a standard efficiency generator 92 for the purpose of removing and utilizing the positive motor forces of the high efficiency generator.

[00057] FIG 17, in accordance with exemplary and alternative exemplary embodiments, shows stator, rotor, frame and transmission arrangement of a three stator group in which each stator of the group is timed 120 degrees out of sequence to the previous stator timing such that three phase power is generated. The numbered items can be consistent with the items in other figures.

[00058] FIG 18, in accordance with exemplary and alternative exemplary embodiments, shows a cross section of an exemplary generator, which may be constructed to contain 16 rotors rather than 8 rotors.

Claims

1. A method for reducing rotor drag in an electric generator having a first stator section and a second stator section, the first and the second stator section aligned along a lengthwise axis, the first and the second stator sections having longitudinal slots aligned with the lengthwise axis, the slots having a longitudinal opening for accommodating induction windings, the method comprising:

distributing first rotors of slot rotor pairs along the outer periphery of a first stator section having induction windings, the first rotors aligned longitudinally with the lengthwise axis;

distributing second rotors of the slot rotor pairs along the outer periphery of the second stator section having induction windings, the first rotors and the second rotors of the slot rotor pairs having:

at least one pair of pole sections of a first and a second magnetic polarity for generating AC current; and

a constant first magnetic polarity associated with the first rotors and a constant second magnetic polarity associated with the second rotors, or both the first rotors and the second rotors have a constant first magnetic polarity and a constant second magnetic polarity;

isolating the first rotors and the second rotors from at least a portion of an area of the induction windings associated with a concentration of magnetic flux by positioning the first rotors and second rotors away from a geometric center of poles associated with the induction windings of the first stator section;

shielding the slot rotor pairs around the complete cross sectional

circumference thereof, except in an can be of the longitudinal opening of the slots using mu metal cylindrical shields;

synchronizing the rotation of the first and second rotors of the slot rotor pairs such that a first one of the pole sections of the first rotor having the first magnetic polarity and the second one of the pole sections of the second rotor having a second magnetic polarity can be aligned with the slots to provide maximum flux density in the induction windings to induce a current flow therein and to reduce a drag on the rotor of both the first and second rotors.

wherein:

the inner periphery of the first stator section and the inner periphery of the second stator section can be adjacent to each other;

the slots of the first stator section and the second stator section can be axially aligned in a lengthwise direction and radially aligned in a depthwise direction;

the first rotor and the second rotor of the respective slot rotor pairs can be axially aligned with the aligned slots of the first stator section and the second stator section in the lengthwise direction such that the lengthwise axis of the first and second rotors can be in normal alignment with the depthwise direction of the aligned slots;

2. The method of claim 1, further comprising magnetically shielding the first and second rotors such that flux generated by the first rotor and the second rotor is directed into the slots so as to reduce flux leakage and therefore reduce magnetic flux linkage with the stator, thereby reducing electromagnetic drag.

3. The method of claim 1, wherein the distributing the first rotor and distributing the second rotor further includes inserting the first and the second rotors into respective shielded cavities provided in the first and second stator sections, the respective cavities arranged in lengthwise alignments with the slots to partially shield the first and second rotors, the cavities having a longitudinal opening corresponding to a longitudinal opening in the slots, to provide magnetic communication with the corresponding longitudinal opening.

4. The method of claim 1, wherein, when the first and the second rotors have the at least one pair of pole sections of a first and a second magnetic polarity, the synchronizing the rotation of the first and second rotor of the slot rotor pairs further includes rotating the first and second rotors of the slot pairs about respective axes in opposite directions over the stator induction wire slots, such that the net torque generated by the force interaction of the poles through magnetic coupling between the first and second rotors is approximately zero.

5. The method of claim 1, wherein, when the first and the second rotors have the constant first magnetic polarity associated with the first rotors and the constant second magnetic polarity

associated with the second rotors, or the both the first rotors and the second rotors have the constant first magnetic polarity and the constant second magnetic polarity, the synchronizing the rotation the first and second rotors of the slot rotor pairs further includes rotating the first and second rotors of the slot pairs about their axes in opposite directions over the stator induction wire slots such that the net torque generated by the force interaction of the pole through magnetic coupling between the first and second rotors is approximately zero.

6. The method of claim 1, wherein, when the first and the second rotors have the at least one pair of pole sections of a first and a second magnetic polarity, the synchronizing the rotation of the first and second rotors of the slot rotor pairs about their axes in opposite direction over the slots further includes rotating the first one of the pole sections of a first rotor having the first magnetic polarity over a slot in a first direction, the second one of the pole sections of a second rotor being sequenced such that it presents the second magnetic polarity opposite the first magnetic polarity, the second one being rotatable in a second direction opposite the first direction to form a magnetic circuit i.e. magnetic coupling between the first and second magnetic polarities.

7. The method of claim 1, further comprising, when the first and the second rotors have the at least one pair of pole sections of a first and a second magnetic polarity, driving the first rotor and second rotor in a synchronized manner including turning on an excitation current in an armature of the first one of the pole sections of the first rotor having the first magnetic polarity when the first one is positioned over a slot in a first direction and turning on an excitation current in an armature of a second one of the pole sections of the second rotor having the second magnetic polarity when the one is positioned over a corresponding aligned slot in a second direction.

8. The method of claim 1, further comprising shielding the first and second rotors, such that flux generated when an excitation current is supplied to the armature of the first and second rotors is directed substantially toward the stator wire slots, with magnetic shielding of the armature magnetic poles from the stator magnetic poles.

9. The method of claim 1, wherein each electric power phase is generated by a separate stator, and wherein the coils of each stator can be connected in series or in parallel to give the desired single-phase voltage and resultant power generating capacity.

10. The method of claim 1 and 9, wherein the neutral lead from each of three stators associated with 3-phase power generation generates power 120° out of phase with respect to each other, may be connected such that the 3-phase power may be produced from the resultant connection of the three neutral power leads in one of: a "wye" connection, a "star" connection, and a "delta" connection.

11. The method of claim 1, 9 and 10, wherein the neutral lead from each of two stators which are capable generating power 120°, or other angle, out of phase with each other, are connected such that two-phase power is produced.

12. The method of claim 1, wherein three phases of 3-phase power are capable of being generated from each of three stators, the method further comprising connecting the induction windings in a 3-phase configuration by connecting all coils of each phase in one of: a "high-wye" connection, a "star" connection, or a "delta" connection.

13. The method of claim 1, wherein three phases of 3-phase power are capable of being generated from each of three stator-type structures, the method further comprising connecting induction windings in a 3-phase configuration by connecting half of the coils of each phase in series, and connecting the resulting two series groups in parallel and subsequently connecting all neutral leads from the generator sections forming a "low-wye" connection.

14. The method of claim 1, further comprising driving the first and second rotors in a synchronous fashion using a transmission mechanism.

15. The method of claim 1, wherein the isolating further includes positioning the first rotors and the second rotors at a greatest possible distance from the center of the corresponding stator magnetic poles.

16. An electromagnetic assembly for an electric generator comprising:

a dual stator having a first stator section and a second stator section, a plurality of slots arranged on an outer periphery of the first stator section and a second plurality of slots arranged on an outer periphery of a second stator section, respective inner peripheries of the first and second stator section disposed in adjacent relation, each of the first and second pluralities of slots aligned along a lengthwise and depthwise axis to form slot pairs, each of plurality of slots having induction coil windings disposed therein; and

slot rotor pairs associated with the slot pairs, each of the slot rotor pairs having a first slot rotor disposed in alignment relationship with one of the first plurality of slots and a second slot rotor disposed in alignment relation with one of the second plurality of slots corresponding to the slot pairs, each rotor having at least of pair of magnetic poles, one of the pair of magnetic poles having a first magnetic polarity and another of the pair magnetic poles having a second magnetic polarity, each slot rotor being capable of rotating about a longitudinal axis, the slot rotor pairs disposed along the slot pairs such that the induction coil windings disposed in the slot pairs can be exposed to magnetic flux generated by the slot rotor pairs;

wherein the first slot rotor and the second slot rotor are capable of rotating such that when magnetic flux of one of the magnetic poles of the first polarity associated with the first slot rotor is directed to a corresponding first slot of the slot pair, magnetic flux of an associated one of the magnetic poles of the second polarity associated with the second slot rotor is directed to a corresponding second slot of the second slot pair such that the induction coil winding disposed in the first and second slots exposed to increased magnetic flux moving across the induction coils thereby pushing electrons through the induction coils to produce voltage and current when the induction coils can be closed to an electrical load;

wherein the slot rotor pairs are configured to be geometrically isolated from at least an area of the stator power induction coil magnetic poles associated with a high flux concentration, the slot rotors having magnetic shielding such that a portion of side iron, back iron and induction coil slots are exposed to the magnetic flux of the slot rotor pairs, so as to avoid magnetic coupling between the rotor magnetic poles and the power induction poles of the stator.

17. The electromagnetic assembly of claim 16, further comprising a back iron and side iron disposed between the first stator section and the second stator section.

18. The electromagnetic assembly of claim 16, wherein each slot rotor pair is geometrically isolated from the center of the stator induction magnetic poles.

19. The electromagnetic assembly of claim 16, wherein the magnetic shielding includes mu metal shielding for each slot rotor, the shielding having an opening positioned over the stator induction wire slots.

20. The electromagnetic assembly of claim 16 and any of the preceding claims, wherein the first plurality of slots includes four wire slots and the second plurality of slots includes four wire slots.

21. The electromagnetic assembly of any of claims 16-19, wherein the first plurality of slots includes eight wire slots and the second plurality of slots includes eight wire slots.

22. The electromagnetic assembly of any of claims 16-19, wherein the first plurality of slots includes twelve wire slots and the second plurality of slots includes twelve wire slots.

23. The electromagnetic assembly of any of claims 16-19, wherein the first plurality of slots includes twenty-four wire slots and the second plurality of slots includes twenty-four wire slots.

24. The electomagnetic assembly of any of claims 16-19, wherein the first plurality of slots includes forty-eight wire slots and the second plurality of slots includes forty-eight wire slots.

25. The electromagnetic assembly of any of the preceding claims, wherein the first slot rotor and the second slot rotor are configured as an alternating dipole rotor of the first magnetic polarity and the second magnetic polarity, the alternating dipole rotor being approximately twelve inches in diameter and wherein the first stator plurality of slots includes twelve wire slots and the second plurality of stator slots includes twelve wire slots.

26. The electromagnetic assembly of any of claims 16-24, wherein the first rotor and the second rotor are configured as a dipole rotor approximately 6" in diameter wherein the first plurality of stator slots includes twelve wire slots and the second plurality of slots includes twelve wire slots.

27. The electromagnetic assembly of any of the preceding claims, wherein each of the first stator section and the second stator section includes a substantially circular shape.

28. The electromagnetic assembly of any of the preceding claims, wherein the first stator section and the second stator section includes a planar shape.

29. The electromagnetic assembly of claim 16 and any of the preceding claims, further comprising an excitation circuit that applies a rotor excitation current when triggered by a rotor sensor signal, the excitation current applied to first slot rotor poles of a first polarity and second slot rotor poles of a second polarity to generate the magnetic flux and magnetic coupling when one of the first slot rotor poles of the first polarity associated with the first slot rotor is rotated into alignment over a corresponding first slot of the slot pair and to generate the magnetic flux coupling when the associated one of the second slot rotor poles of the second polarity associated with the second slot rotor is rotated into alignment over a corresponding second slot of the slot rotor pair.

30. The electromagnetic assembly of claim 16, further comprising an excitation system, the excitation system being computer controlled.

31. The electromagnetic assembly of claim 16, further comprising an excitation system, the excitation system being controlled by a PLC (Programmable Logic Center).

32. The electromagnetic assembly of claim 29, wherein the excitation circuit is configured to remove the residual excitation current from the collapsing field of the slot rotor poles as the current of excitation is periodically discontinued, the residual excitation current being routed by the excitation system to a battery storage to be utilized in the excitation of the slot rotor poles.

33. The electromagnetic assembly of claims 29, wherein the excitation circuit includes a commutator circuit associated with the first and second slot rotor rotors, the commutator circuit selectively coupling ones of the first and second slot rotors to the excitation current as the ones can be rotated into alignment.

34. The electromagnetic assembly of any of the preceding claims further comprising a frame and support structure.

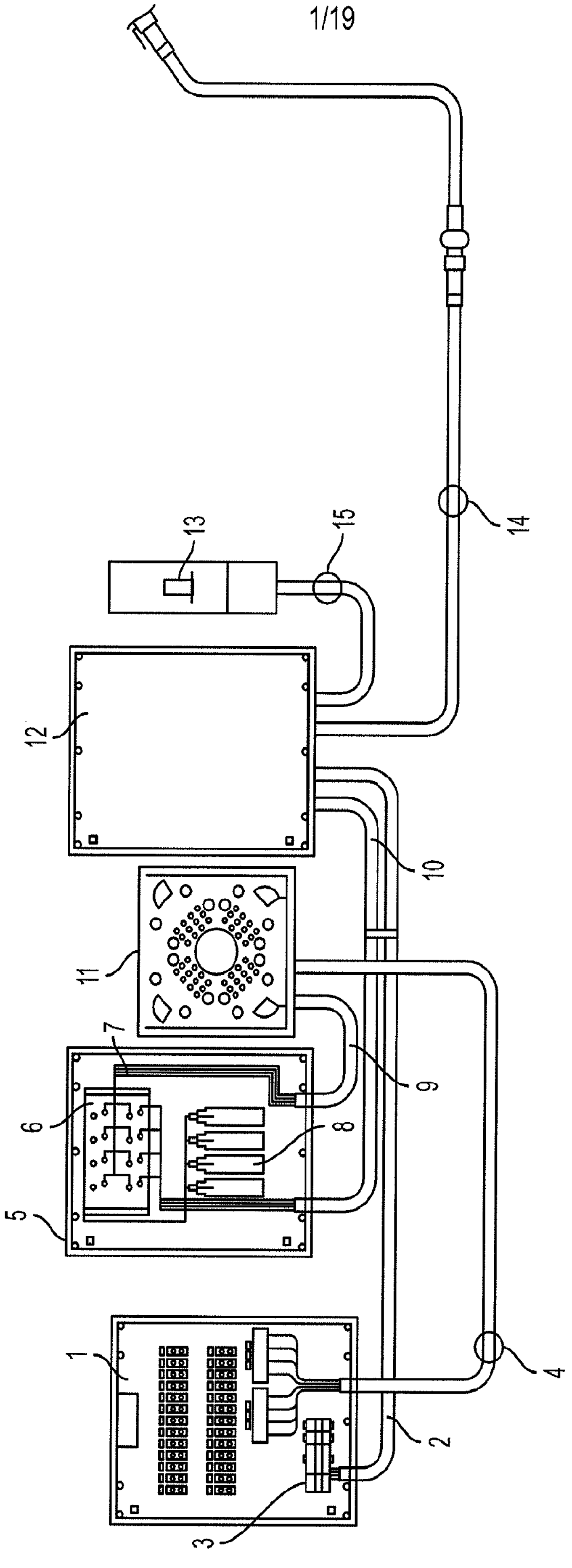

FIG. 1

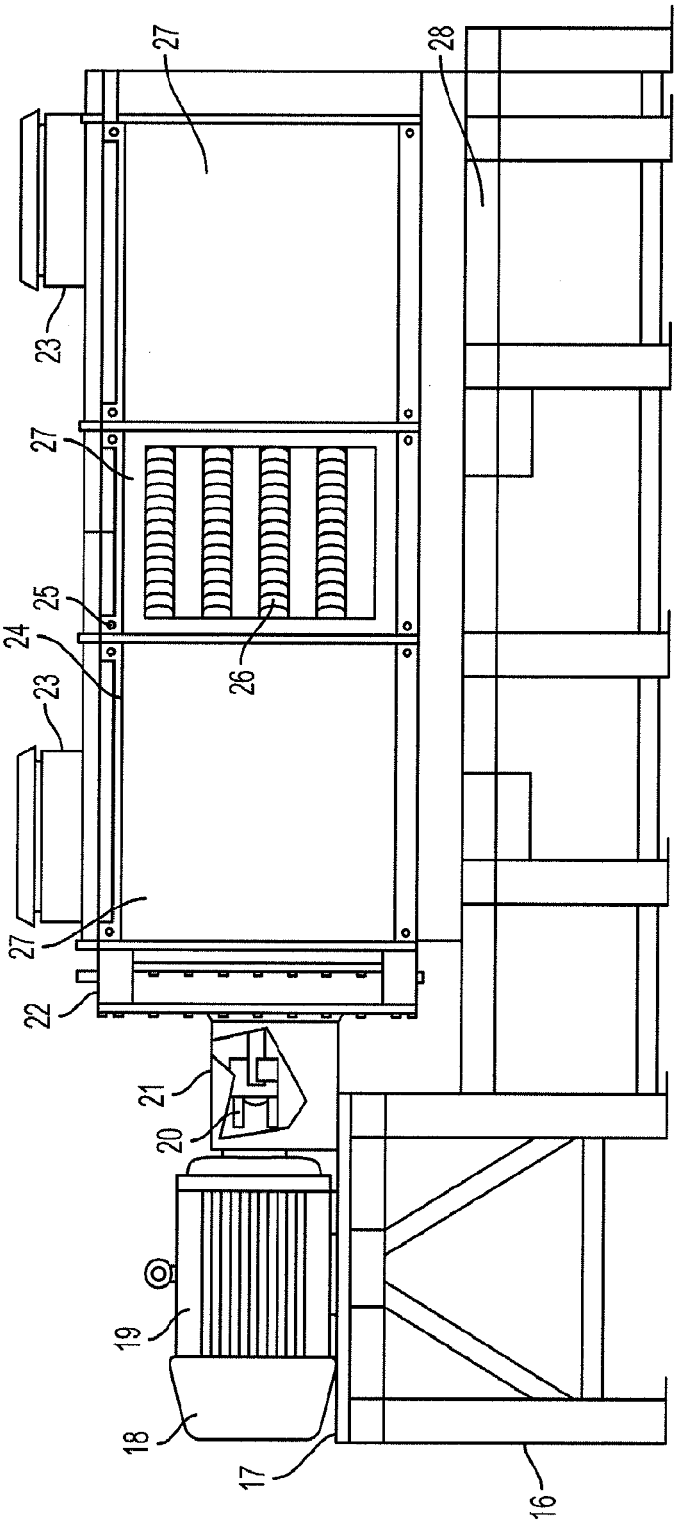

FIG. 2

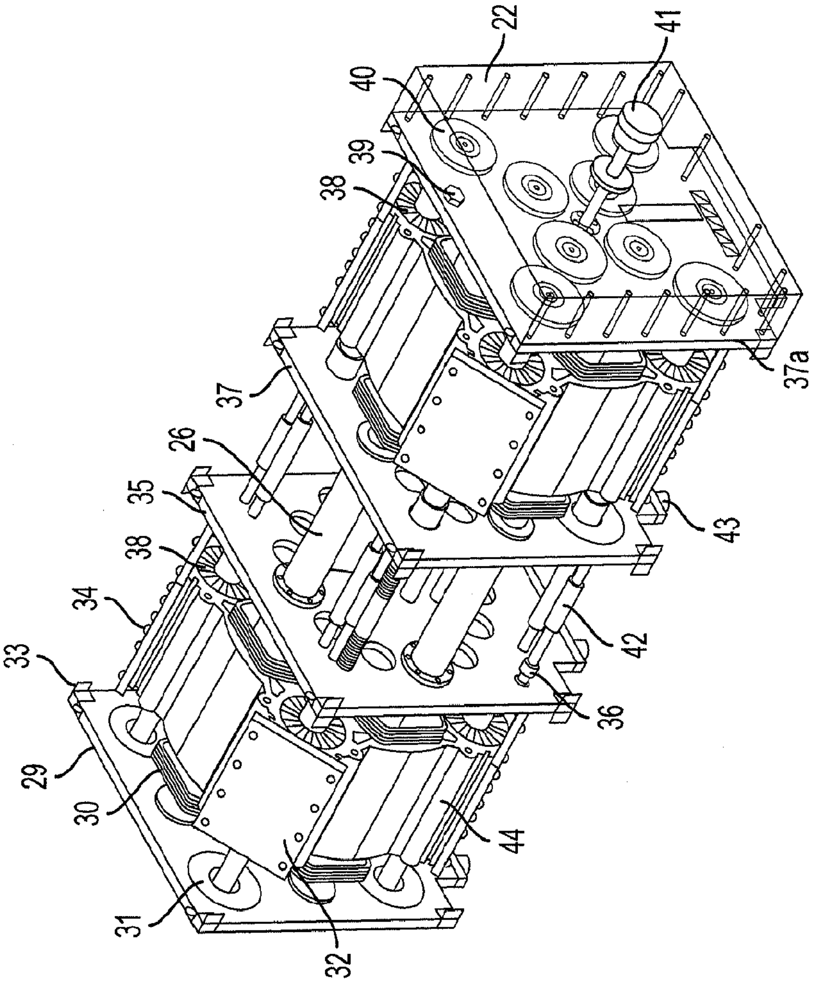

FIG. 3

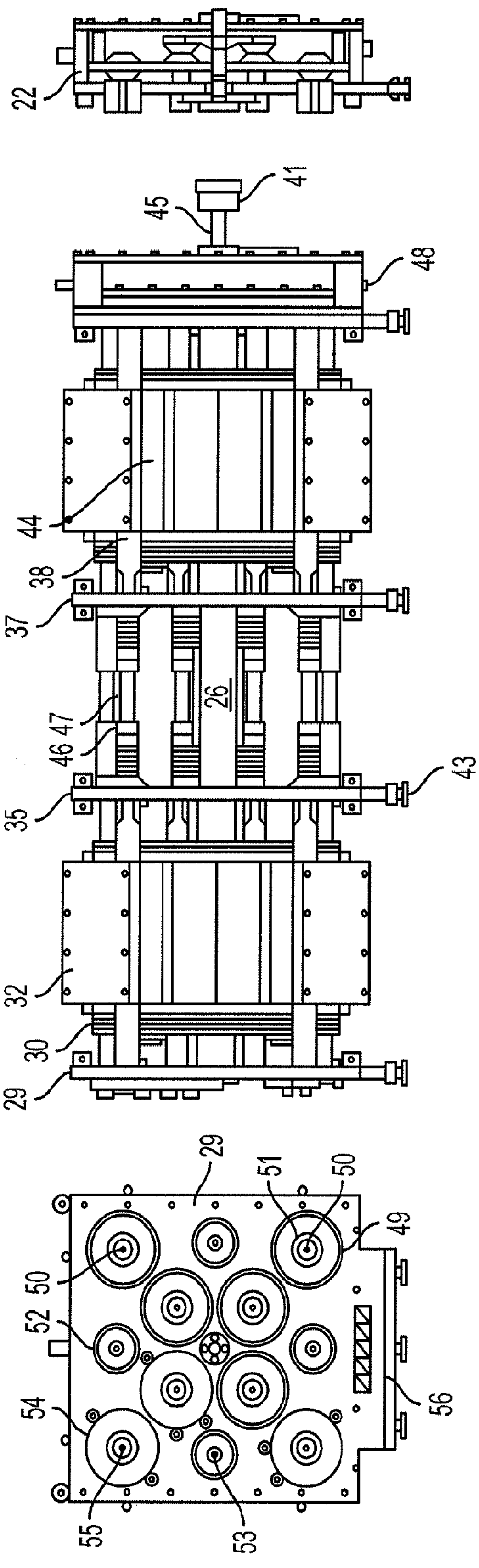
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FIG. 4

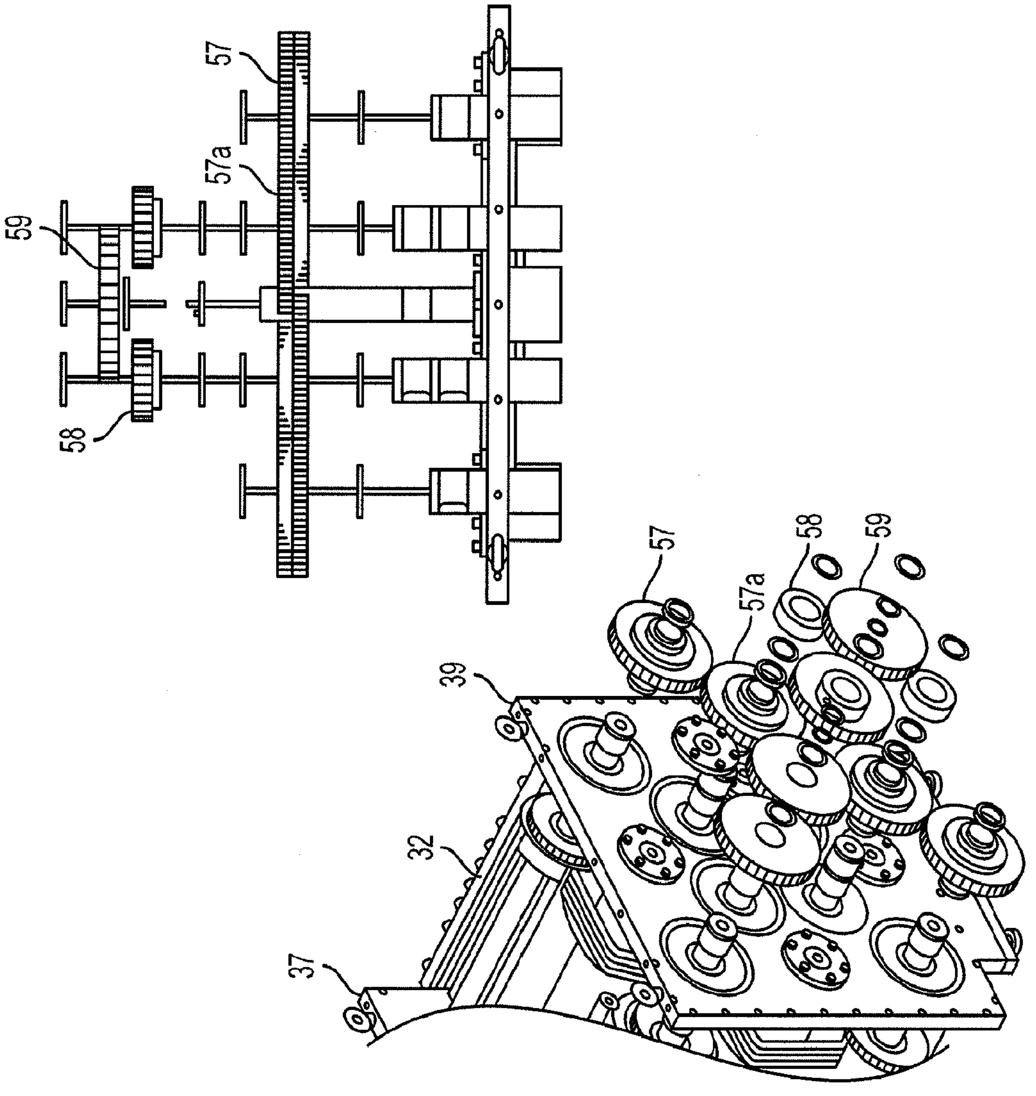


FIG. 5

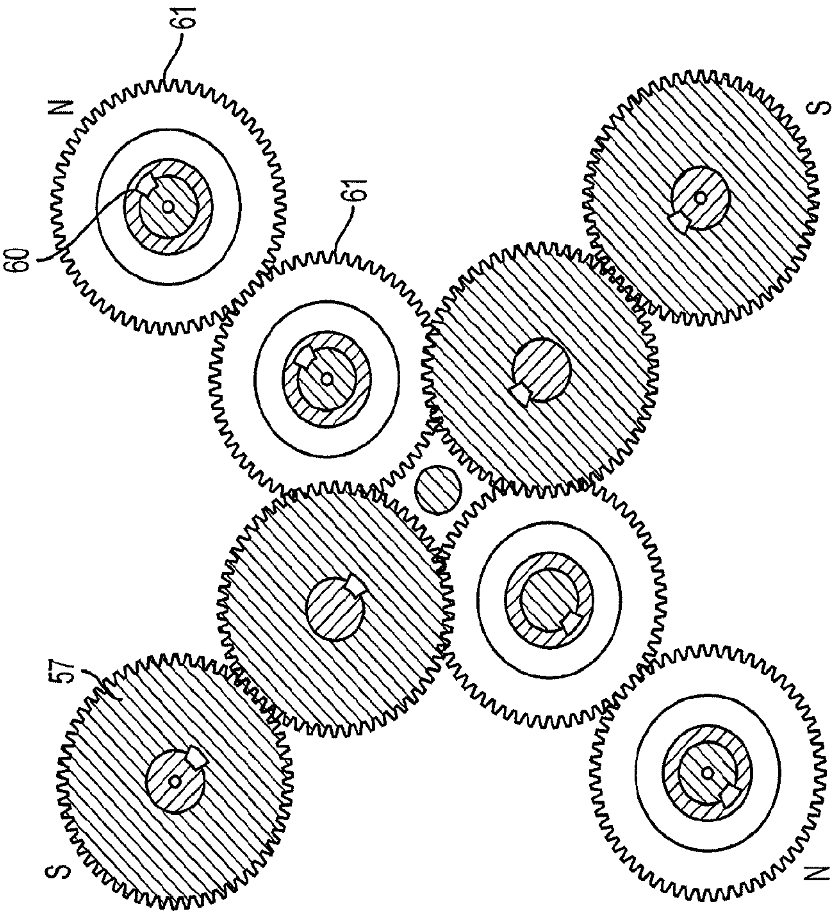


FIG. 6

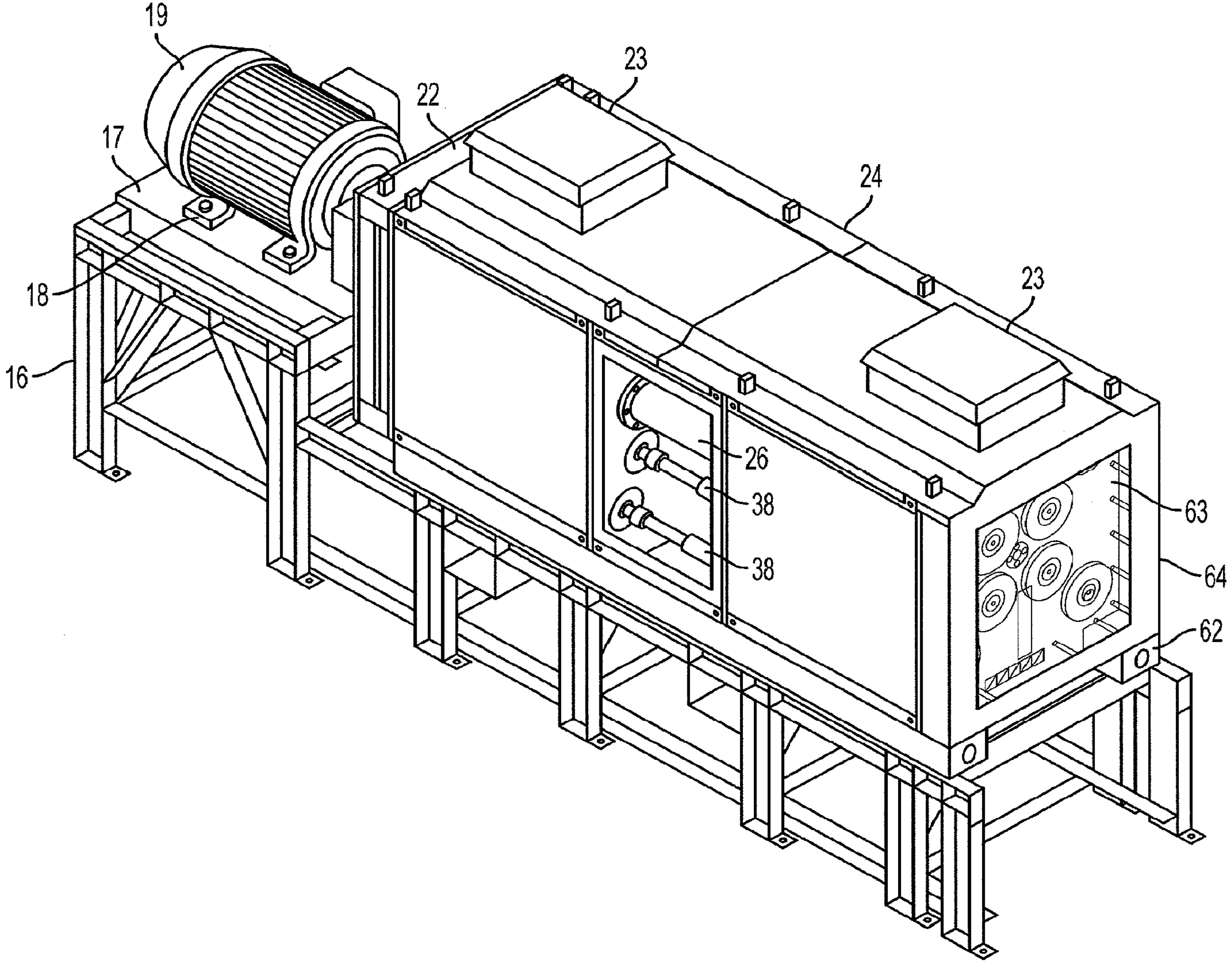


FIG. 7

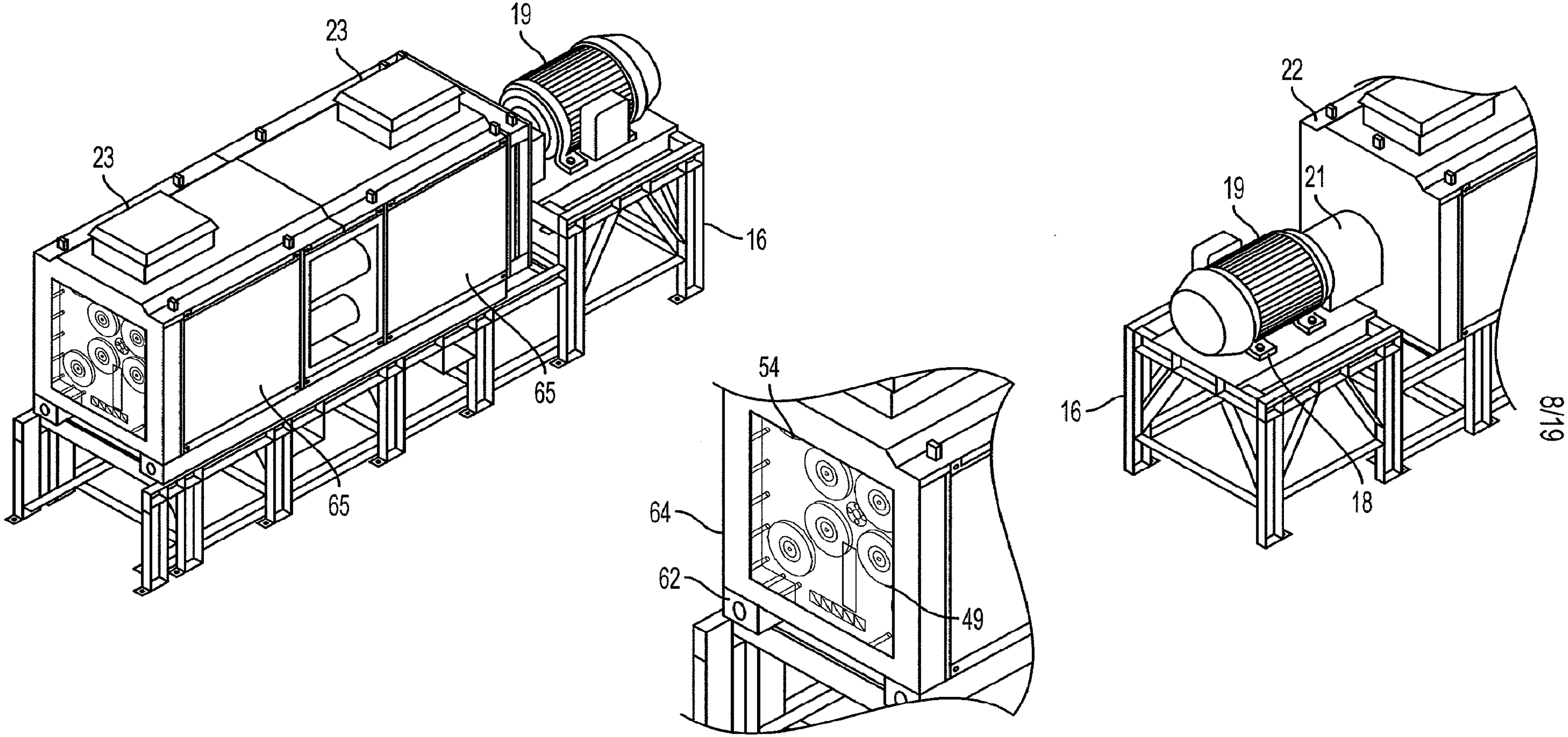


FIG. 8

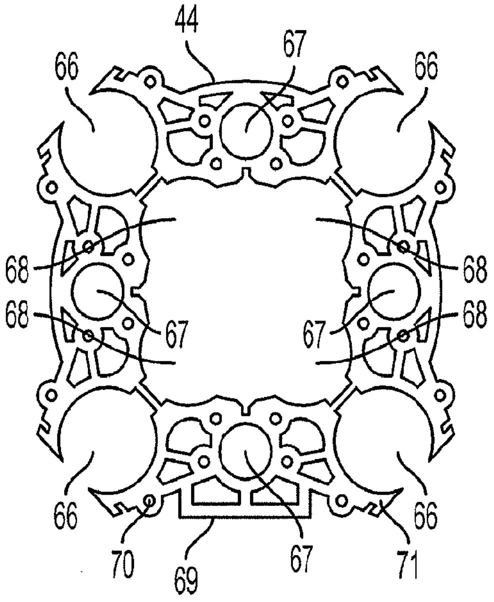


FIG. 9

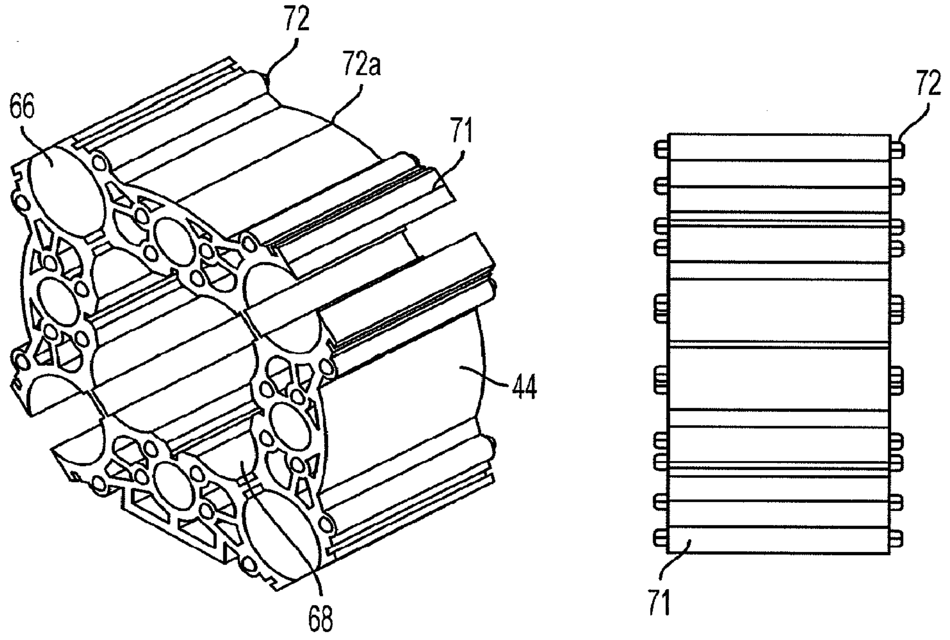
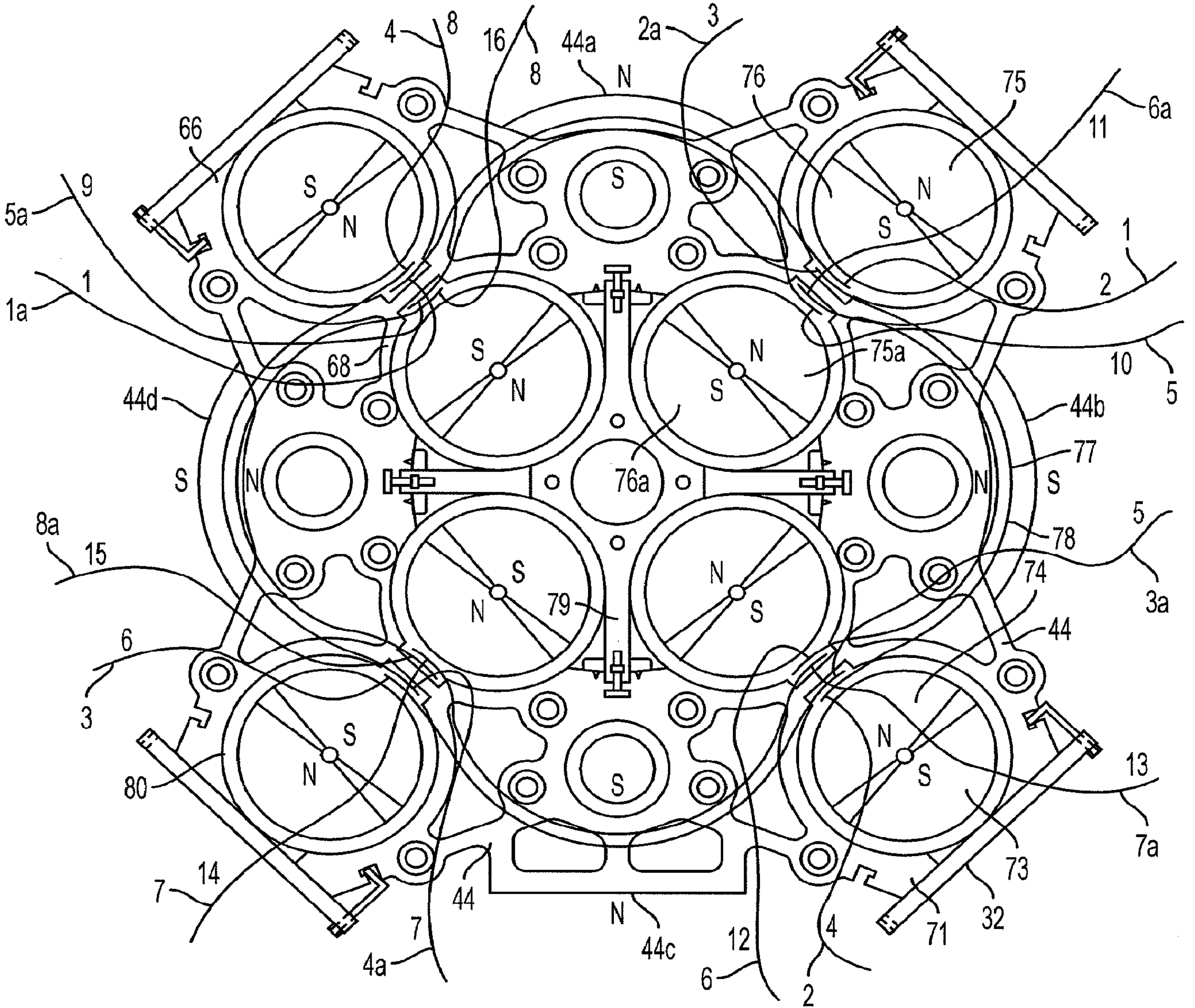


FIG. 10


4
8
16
8
44a
N
2a
3
76
75
6a
11
66
S
N
S
N
S
N
S
N
S
N
S
S
5a
9
1a
1
1
2
68
75a
10
5
44d
44b
77
S
N
N
S
76a
8a
15
S
N
79
N
S
78
5
74
3a
44
6
3
S
N
N
S
80
S
13
7a
73
7
14
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7
4a
N
44c
12
6
2
4
71
32

FIG. 11

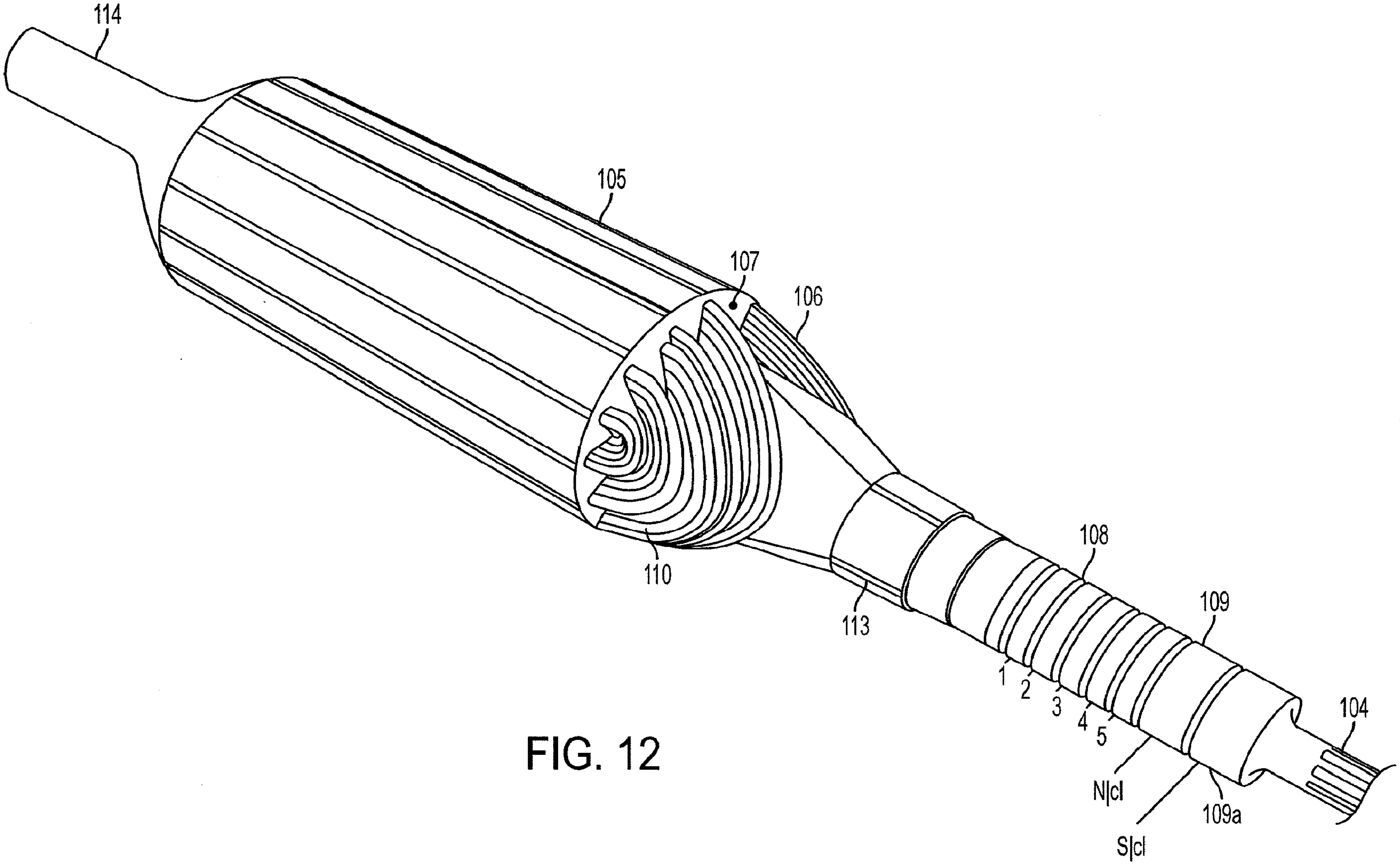


FIG. 12

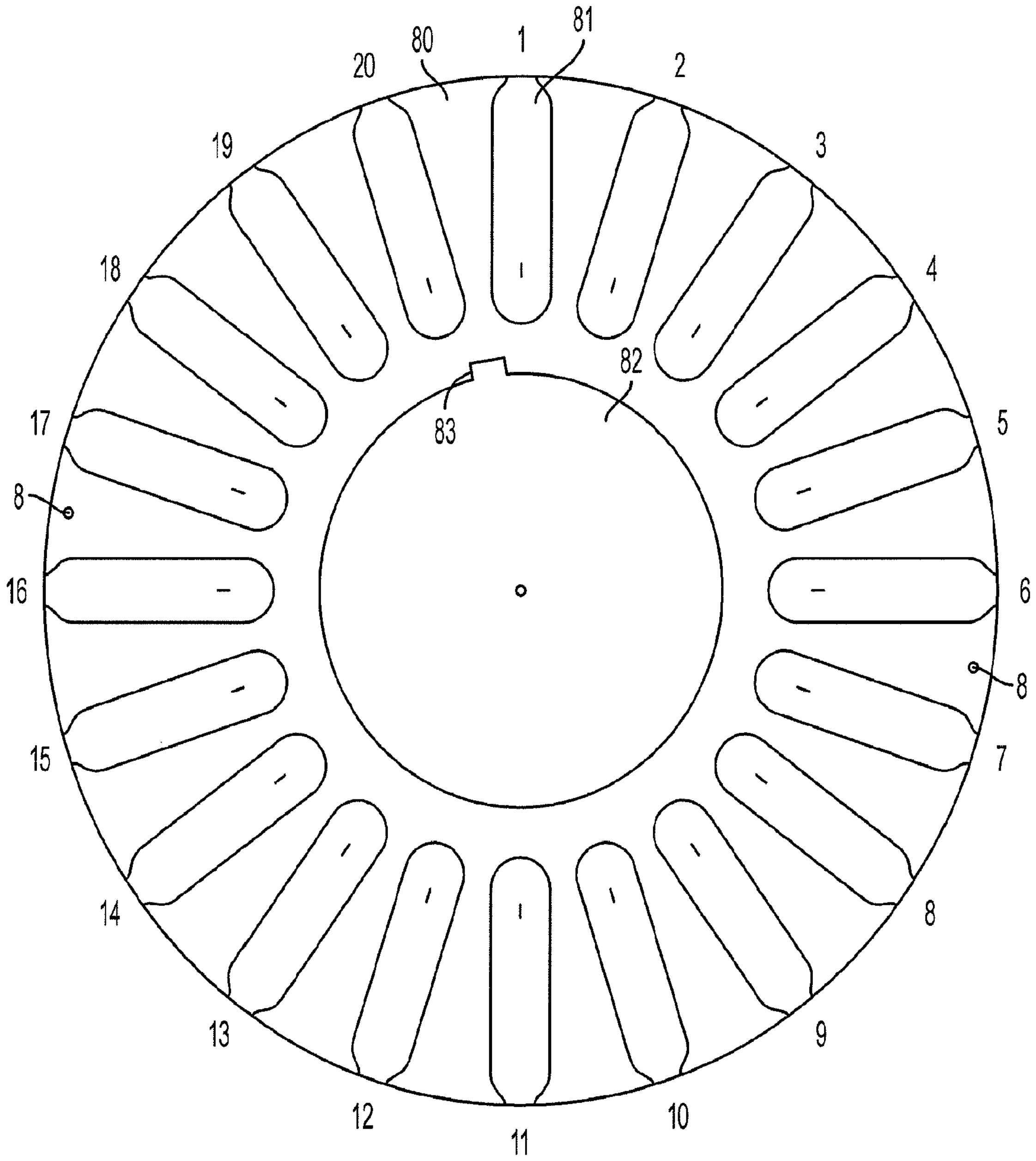


FIG. 13A

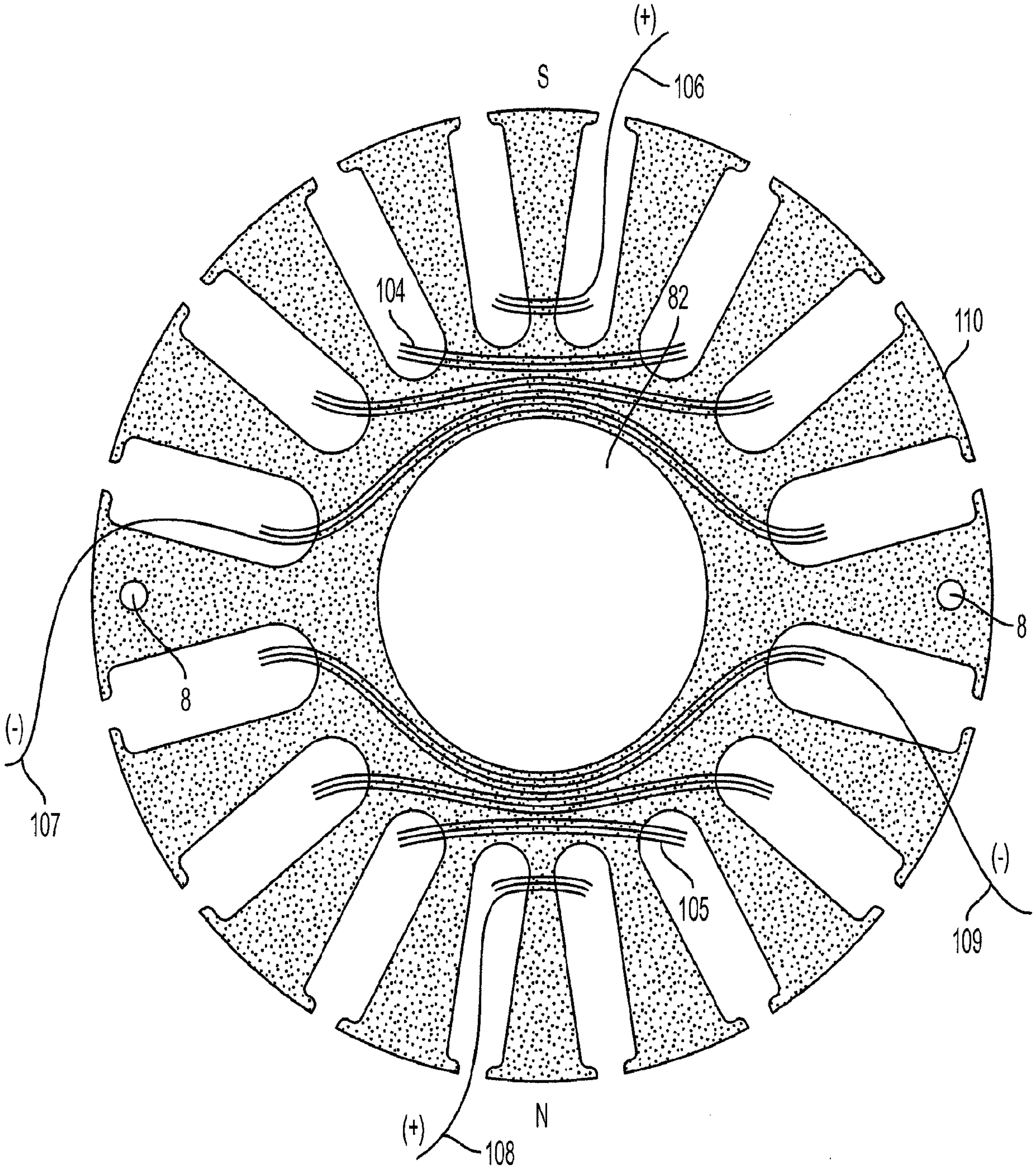
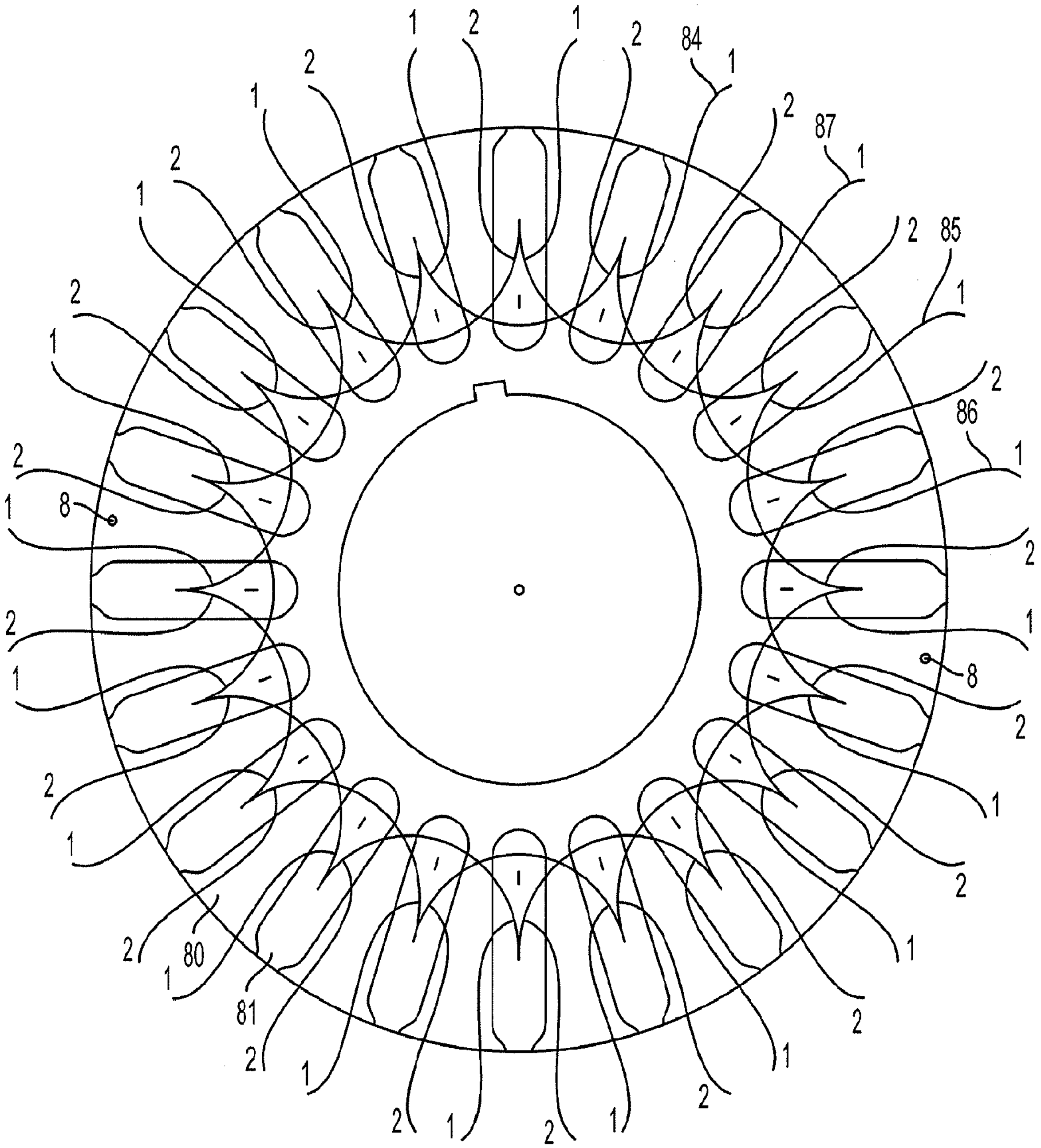


FIG. 13B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1
2
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2
1
2
2
1
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8
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80
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81
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1
2
1
2
1

FIG. 14

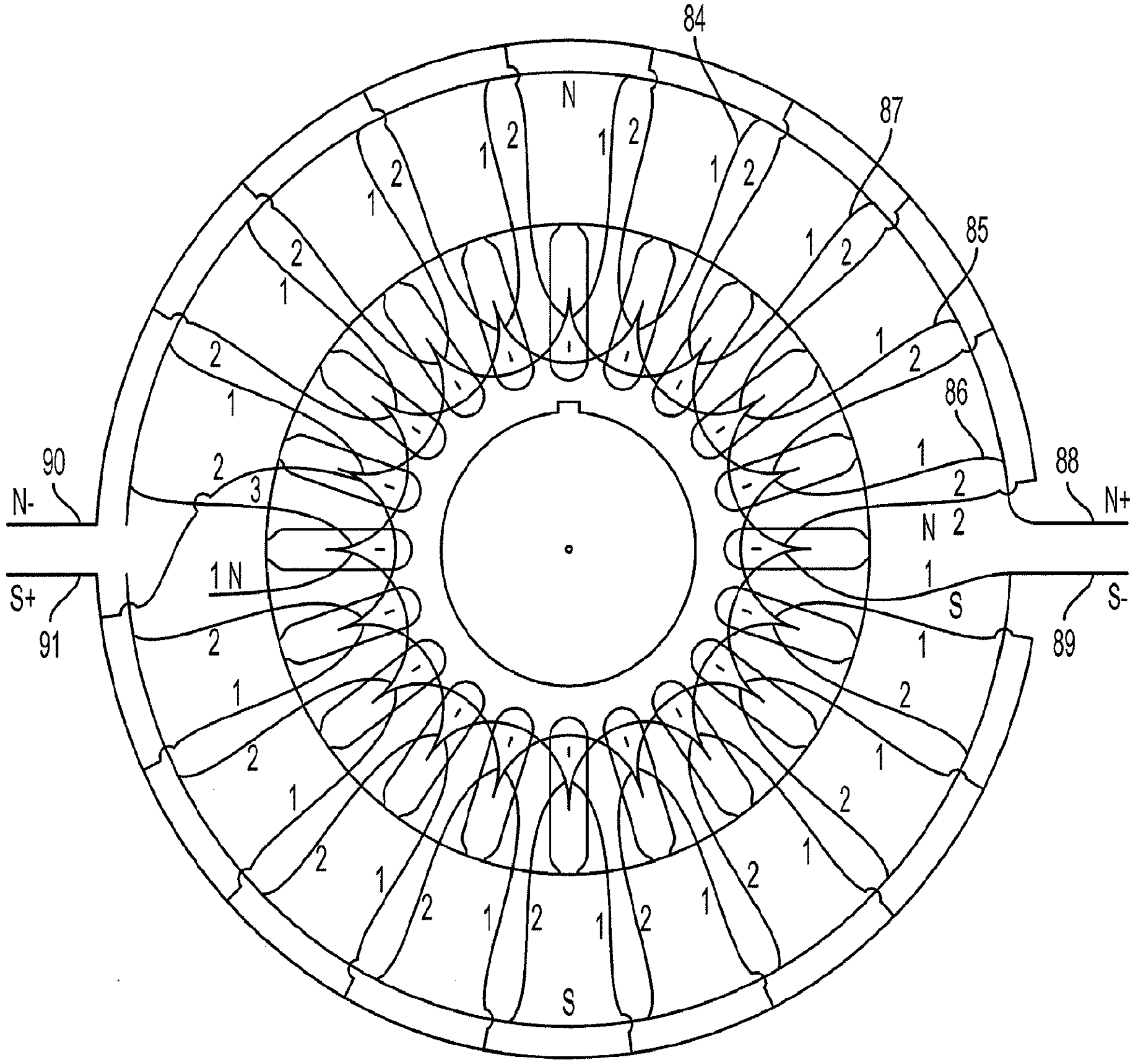

FIG. 15

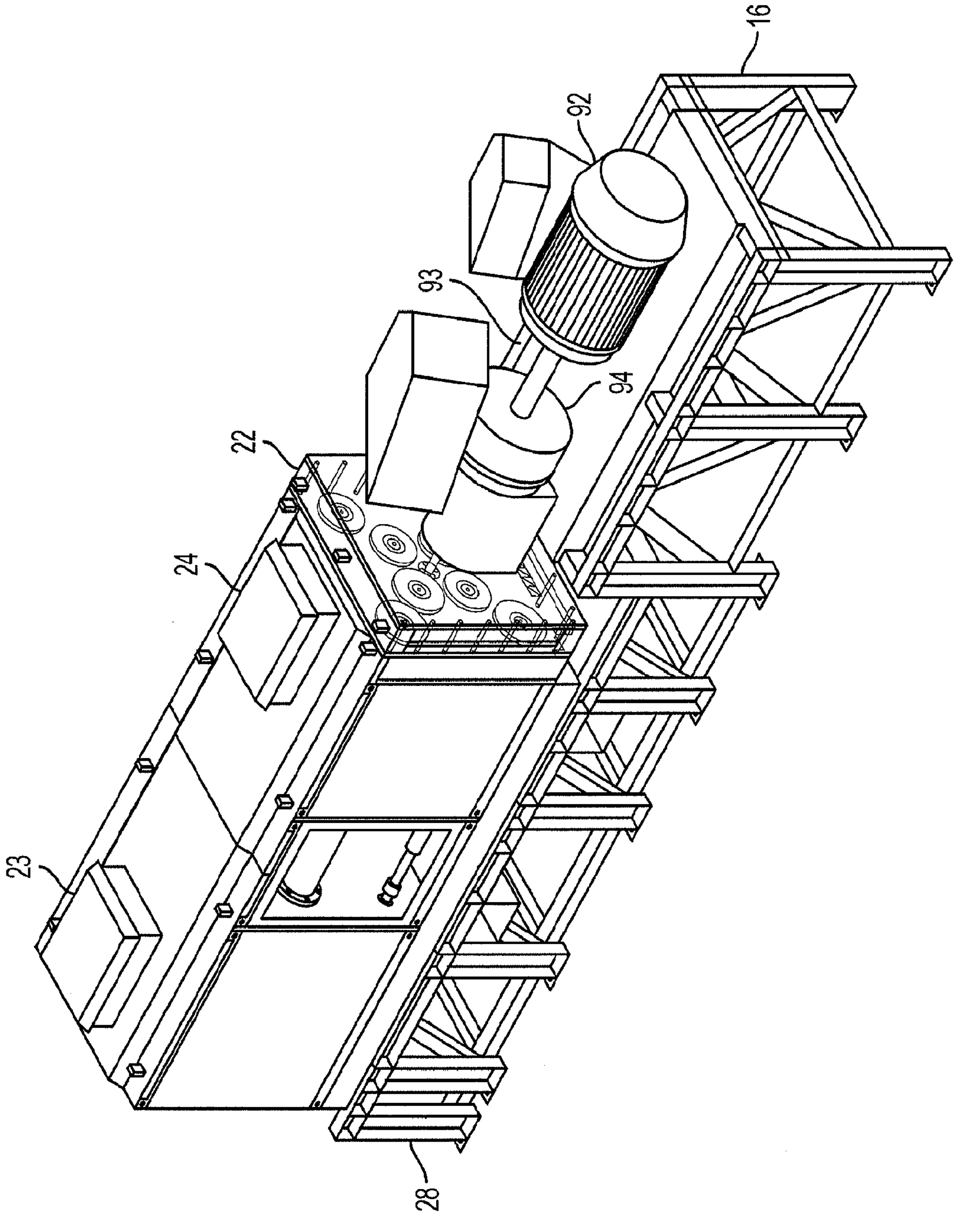

FIG. 16

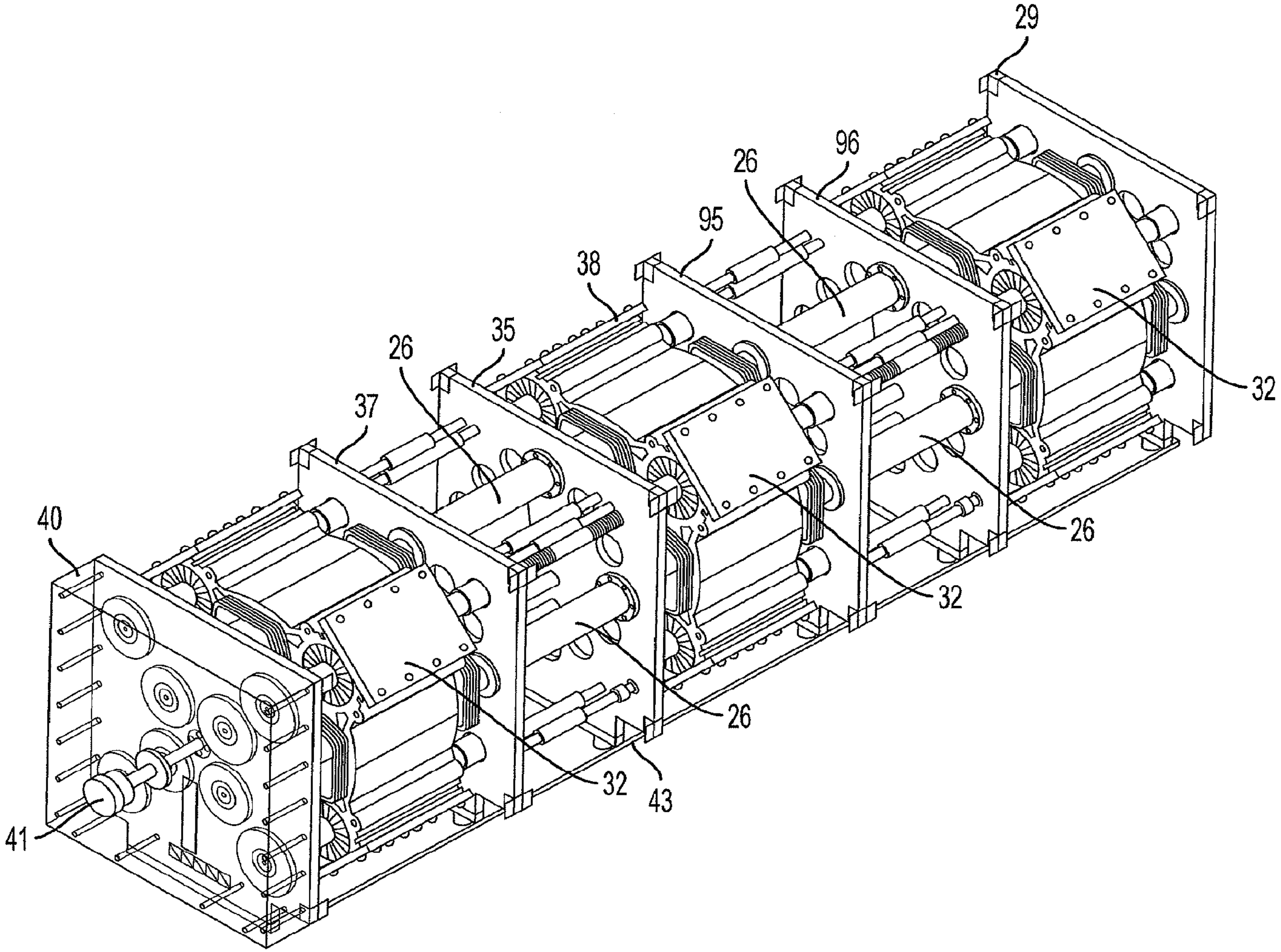

FIG. 17

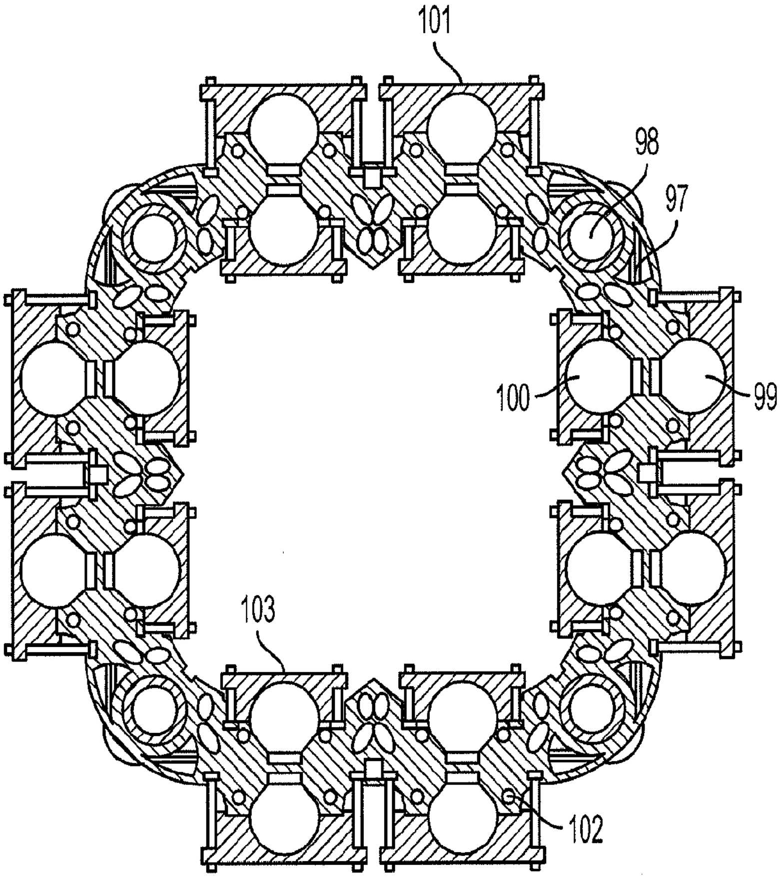

FIG. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/069449

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H02K 47/14 (2013.01)
USPC - 310/113
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)
IPC(8) - H02K 16/02, 47/14, 53/00 (2013.01)
USPC - 74/DIG.9; 310/113, 114

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - F03G 3/00; H02K 16/02, 47/20

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
MicroPatent, Google Patents, Google Scholar, PatBase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2011/098859 A1 (HOLCOMB) 18 August 2011 (18.08.2011) entire document	1-9, 12-19, 21-24, 30, 31
Y	US 2011/0221298 A1 (CALLEY et al) 15 September 2011 (15.09.2011) entire document	1-9, 12-19, 21-24, 30, 31
Y	US 7,608,967 B2 (DURHAM et al) 27 October 2009 (27.10.2009) entire document	1-9, 12-15
Y	US 2009/0102413 A1 (HANLON et al) 23 April 2009 (23.04.2009) entire document	9, 12
Y	US 2009/0296777 A1 (FISH) 03 December 2009 (03.12.2009) entire document	31
A	US 5,260,620 A (MORRILL) 09 November 1993 (09.11.1993) entire document	1-9, 12-19, 21-24, 30, 31

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 05 February 2013	Date of mailing of the international search report 20 FEB 2013
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/069449

Box No. II **Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 10-11, 20, 25-29, 32-34
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III **Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.