

**DEVICES, SYSTEMS, AND METHODS FOR ENHANCING THE
PROVISION OF ELECTRICAL ENERGY**CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is related to U.S. Provisional Patent Application No. 63/583,060, titled DEVICES, SYSTEMS, AND METHODS FOR ENHANCING THE PROVISION OF ELECTRICAL ENERGY, filed September 15, 2023, the disclosure of which is incorporated by reference in its entirety herein.

FIELD

[0002] The present disclosure is generally related to devices, systems, and methods configured to improve the quality and reduce the quantity of electrical energy needed for any residential, commercial, or industrial application and, more specifically, to specifically configured devices that improve an electrical input and provide an electrical output that enables consuming devices to function without issue on less electrical energy.

SUMMARY

[0003] In one aspect, the present disclosure provides a device for enhancing the provision of electrical energy is disclosed. The device can include an inductive core configured to receive an electrical input from an energy source and magnetically annul a peak in the electrical input that results from an inductive load and a resistive load associated with the electrical input, a capacitor configured to balance the inductive load with a capacitive load and generate an electrical output based on the balancing, wherein the generated electrical output includes less electrical power than the electrical input.

[0004] In another aspect, the present disclosure provides a system for enhancing the provision of electrical energy is disclosed. The system can include a processing device including an inductive core configured to receive an electrical input from an energy source and magnetically annul a peak in the electrical input that results from an inductive load and a resistive load associated with the electrical input, a capacitor configured to balance the inductive load with a capacitive load and generate an electrical output based on the balancing, wherein the electrical output includes less electrical power than the electrical input, and a connectivity circuit electrically coupled to the inductive core and the capacitor, and a host server communicably coupled to the connectivity circuit of the processing device, wherein the host server includes a control circuit configured to receive data associated with the electrical output from the connectivity circuit of the processing device, process the received data

associated with the electrical output, generate a carbon credit based on the processing of data associated with the electrical output, and traceably store the generated carbon credit.

[0005] In still another aspect, a computer-implemented method of enhancing the provision of electrical energy, the method including is disclosed. The method can include a receiving, via a processing device, an electrical input from an energy source, generating, via an inductive core and a capacitor of the processing device, an electrical output based on the received electrical input, transmitting, via a connectivity circuit of the processing device, data associated with the electrical output to a host server, processing, via a control circuit of the host server, the data associated with the electrical output to a host server, generating, via the control circuit of the host server, a carbon credit based on the processing of data associated with the electrical output, and traceably storing the generated carbon credit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Various features of the aspects described herein are set forth with particularity in the appended claims. The various aspects, however, both as to organization and methods of operation, together with advantages thereof, may be understood in accordance with the following description taken in conjunction with the accompanying drawings as follows:

[0007] FIG. 1 illustrates a system for enhancing the provision of electrical energy, in accordance with at least one non-limiting aspect of the present disclosure;

[0008] FIG. 2 illustrates the processing device of the system of FIG. 1, in accordance with at least one non-limiting aspect of the present disclosure;

[0009] FIGS. 3A and 3B illustrate an atomic structures for a material that can be implemented via the enclosure of the inductive core of the processing device of FIG. 2, in accordance with at least one non-limiting aspect of the present disclosure;

[0010] FIGS. 4A and 4B illustrate several several lamination approaches that can be implemented via the enclosure of the inductive core of the processing device of FIG. 2, in accordance with at least one non-limiting aspect of the present disclosure;

[0011] FIG. 5 illustrates another atomic structure for a material that can be implemented via the enclosure of the inductive core of the processing device of FIG. 2, in accordance with at least one non-limiting aspect of the present disclosure;

[0012] FIG. 6 illustrates a conductive path for a conductive winding implemented via the enclosure of the inductive core of the processing device of FIG. 2, in accordance with at least one non-limiting aspect of the present disclosure;

[0013] FIG. 7 illustrates several magnetic fields generated by the inductive core of the processing device of FIG. 2, in accordance with at least one non-limiting aspect of the present disclosure;

[0014] FIG. 8 illustrates several particle paths generated by the inductive core of the processing device of FIG. 2, in accordance with at least one non-limiting aspect of the present disclosure;

[0015] FIG. 9 illustrates a top view of the inductive core of the processing device of FIG. 2, in accordance with at least one non-limiting aspect of the present disclosure;

[0016] FIG. 10 illustrates a circuit board configured to be installed within the housing of the processing device of FIG. 2, in accordance with at least one non-limiting aspect of the present disclosure; and

[0017] FIG. 11 illustrates a method for enhancing the provision of electrical energy, in accordance with at least one non-limiting aspect of the present disclosure.

[0018] Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate various aspects of the invention, in one form, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION

[0019] Numerous specific details are set forth to provide a thorough understanding of the overall structure, function, manufacture, and use of the aspects as described in the disclosure and illustrated in the accompanying drawings. Well-known operations, components, and elements have not been described in detail so as not to obscure the aspects described in the specification. The reader will understand that the aspects described and illustrated herein are non-limiting examples, and thus it can be appreciated that the specific structural and functional details disclosed herein may be representative and illustrative. Variations and changes thereto may be made without departing from the scope of the claims. Furthermore, it is to be understood that such terms as "forward", "rearward", "left", "right", "upwardly", "downwardly", and the like are words of convenience and are not to be construed as limiting terms. Furthermore, it is to be understood that such terms as "forward", "rearward", "left", "right", "upwardly", "downwardly", and the like are words of convenience and are not to be construed as limiting terms.

[0020] In the description, for purposes of explanation and not limitation, specific details are set forth, such as particular embodiments, procedures, techniques, etc. to provide a thorough understanding of the present technology. However, it will be apparent to one skilled in the art that the present technology may be practiced in other embodiments that depart from these specific details.

[0021] As used in any aspect herein, the term "control circuit" may refer to, for example, hardwired circuitry, programmable circuitry (e.g., a computer processor including one or more individual instruction processing cores, processing unit, processor, microcontroller,

microcontroller unit, controller, digital signal processor ("DSP"), programmable logic device ("PLD"), programmable logic array ("PLA"), or field programmable gate array ("FPGA"), state machine circuitry, firmware that stores instructions executed by programmable circuitry, and any combination thereof. The control circuit may, collectively or individually, be embodied as circuitry that forms part of a larger system, for example, an integrated circuit ("IC"), an application-specific integrated circuit ("ASIC"), a system on-chip ("SoC"), desktop computers, laptop computers, tablet computers, servers, smart phones, etc. Accordingly, as used herein "control circuit" includes, but is not limited to, electrical circuitry having at least one discrete electrical circuit, electrical circuitry having at least one integrated circuit, electrical circuitry having at least one application specific integrated circuit, electrical circuitry forming a general purpose computing device configured by a computer program (e.g., a general purpose computer configured by a computer program which at least partially carries out processes and/or devices described herein, or a microprocessor configured by a computer program which at least partially carries out processes and/or devices described herein), electrical circuitry forming a memory device (e.g., forms of random access memory), and/or electrical circuitry forming a communications device (e.g., a modem, communications switch, or optical-electrical equipment). Those having skill in the art will recognize that the subject matter described herein may be implemented in an analog or digital fashion or some combination thereof. Additionally, it shall be appreciated that, as referenced herein, any specific type of control circuit can be effectively interchanged with any of the control circuits described above.

[0022] As used in any aspect herein, the term "logic" may refer to an app, software, firmware and/or circuitry configured to perform any of the aforementioned operations. Software may be embodied as a software package, code, instructions, instruction sets and/or data recorded on non-transitory computer readable storage medium. Firmware may be embodied as code, instructions or instruction sets and/or data that are hard-coded (e.g., non-volatile) in memory devices.

[0023] As used in any aspect herein, the terms "component," "system," "module" and the like can refer to a computer-related entity, either hardware, a combination of hardware and software, software, or software in execution.

[0024] As used in any aspect herein, an "algorithm" refers to a self-consistent sequence of steps leading to a desired result, where a "step" refers to a manipulation of physical quantities and/or logic states which may, though need not necessarily, take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It is common usage to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like. These and similar terms may be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities and/or states.

[0025] Residential and industrial energy consumption is on the rise. As daily routines become increasingly reliant on computers, robotics, internet connectivity, and electronic devices, there is no indication that the demand for electricity will slow down. Other factors, including a post-pandemic economic rebound, and extreme weather conditions, have increased the global electricity demand by large percentages. Aside from the considerable expense associated with the mounting increase in electricity consumption, most electricity is generated via coal or natural gas, which produces harmful carbon dioxide emissions that pollute our environment. Although nuclear sources of electricity are generally cleaner, they include risks that can lead to a general sense of public distrust that has hindered wide scale adoption. Cleaner, more sustainable sources of electricity—including wind turbines or solar powers—may be difficult to scale due to inefficiency and unreliability. Even electric vehicles, which are being introduced to the market to reduce gasoline-generated carbon emissions, rely on electricity that may be generated via unclean sources to charge their batteries, thereby reducing but not completely eliminating the problem such technologies were introduced to solve.

[0026] Additionally, migrating to alternate sources of energy may implicate large infrastructure enhancements and investments that will delay—if not impede—a widespread adoption of alternate energy sources. Thus, although much energy has been committed to the development of alternate, cleaner sources of electricity, there is an opportunity to reduce the amount of electricity being consumed from traditional sources. Indeed, reducing the amount of energy required to operate a household, office, and/or factory, for example, could enable users to reducing the costs associated with electricity consumption as well as the amount electricity that needs to be generated by any energy source, conventional or new. Conventional devices implemented to provide electricity for residential and industrial uses are generally inefficient, meaning they draw more power than what is actually required by the end user. Accordingly, there is a need for devices, systems, and methods for a more efficient provision of electricity.

[0027] Referring now to FIG. 1, a system 100 for enhancing the provision of electrical energy is depicted in accordance with at least one non-limiting aspect of the present disclosure. According to the non-limiting aspect of FIG. 1, the system 100 can include an energy source 102, a processing device 104, and a consuming device 107. As will be described in further detail with reference to FIG. 2, the processing device 104 can be configured to receive an electrical input 103 from the energy source 102 and provide an electrical output 105 to the consuming device 107. It shall be appreciated that, according to some non-limiting aspects, the energy source 102 can include an electrical panel or other interface to a grid that may provide electricity generated by any number of sources (e.g., coal, gas, nuclear, solar, wind, battery, capacitor, water, etc.). However, the energy source 102 does not necessarily have to

interface the system 100 of FIG. 1 to an external system (e.g., a grid maintained by a third party). Rather, according to some non-limiting aspects, the energy source 102 can be directly controlled by a user of the system 100 (e.g., a residential user may have solar panels installed on their house). Thus, it shall be appreciated that, according to such non-limiting aspects, the system 100 can be directly coupled the power source 102 or indirectly coupled to the power source 102 (e.g., the solar panels, etc.) a capacitor, battery, transformer, or other intermediate components directly controlled by a user of the system 100.

[0028] According to still other non-limiting aspects, it shall be appreciated that the processing device 104 can be integrated into the energy source 102 and not necessarily exist as a standalone unit. For example, the processing device 104 can be integrated into an interface of the energy source 102, such as a panel, thereby creating an energy consumption reducing “smart” panel. According to such aspects, the processing device 104 can be built-in and connected to both line and load sides of a ground circuit and a neutral circuit within the panel. Additionally, the processing device 104 can be configured to function for additional passive, active, line reactor, and/or isolated transformer devices deployed within a given electrical architecture where the generated electrical output comprises less electrical power than the electrical input.

[0029] In further reference to FIG. 1, as will be described in further detail herein, the processing device 104 can be specifically configured to mitigate electrical losses provided by the energy source 102 via the electrical input 103, which would otherwise be incurred by the system 100. Specifically, the processing device 104 is particularly configured to filter the electrical input 103 and generates a more efficient electrical output 105, such that the consuming device 107 requires less electrical energy from the energy source 102 to perform the same tasks. This is because the electrical energy provided via the electrical output 105 is of a higher quality, meaning the system 100 enables the consuming device 107 to accomplish more with less electrical energy than what would otherwise be required from the energy source 102.

[0030] Still referring to FIG. 1, the consuming device 107 of the system 100 can include any device a user of the system 100 aspires to power via electricity provided via the energy source 102. It shall be appreciated that the consuming device 107 can include any residential or industrial device, as the system 100 of FIG. 1 can be implemented for personal or commercial uses. For example, according to some non-limiting aspects, the consuming device 107 can include at least one of a refrigerator, an air conditioner, a heater, a computer, or a hot water heater, or combinations thereof. However, according to other non-limiting aspects, the consuming device 107 can include an office appliance, an industrial machine, a tool, or a robot, or combinations thereof. In other words, as described in further detail herein, the system 100—and more specifically, an inductive core 112 (FIG. 2) of the processing device 104—can

be scalable and configured such that the system 100 can be implemented for a wide variety of applications.

[0031] Furthermore, according to some non-limiting aspects, the processing device 104 of the system 100 of FIG. 1 can be communicably coupled to a computing device 108 and a host server 110 via a communications network 106. The communication network 106, for example, can include any known wired or wireless connection, including a number of conventional infrastructure networks (e.g., WiFi, cellular, etc.) and/or *ad hoc* wireless networks (e.g., Bluetooth, near-field communication, Zigbee, etc.). Although, according to some non-limiting aspects, the processing device 104 can include an on-board control circuit configured to perform the methods disclosed in further detail herein, according to other non-limiting aspects, the processing device 104 can send signals to a local or remote computing device 108 or host server 110, either of which can include a control circuit configured to analyze the performance of the processing device 104 or, according to some non-limiting aspects, control the processing device. The computing device 108 and host server 110, for example, can be controlled by a user of the system 100 or a third-party who has commissioned the processing device 104 to the user of the system 100. Regardless, it shall be appreciated that the processing device 104 is communicably enabled and thus, can function as an internet-of-things device that can be scheduled, programmed, and monitored via wired and/or wireless connections to the computing device 108 and/or host server 110.

[0032] Referring now to FIG. 2, the processing device 104 of the system 100 of FIG. 1 is depicted in accordance with at least one non-limiting aspect of the present disclosure. According to the non-limiting aspect of FIG. 2, the processing device 104 can include a housing 111, within which an inductive core 112 and a capacitor 114 can be placed. As will be described in further detail with reference to FIG. 3, the inductive core 112 can include a three-dimensional geometry configured to function as a choke filter for electrical inputs 103 (FIG. 1) received from the energy source 102 (FIG. 1). The inductive core 112, for example, can be configured as an inductor, a filter, a choke, a line reactor, an antenna, and/or an exciter coil, or any configuration that similarly relies on the principles of inductance and impedance. As explained herein, the inductive core 112 can include a particularly configured three-dimensional geometry for passive and/or active power transformation of the electrical input 103 (FIG. 1). It shall be appreciated that the inductive core 112 can function as a common mode choke pass filter that magnetically annuls peaks that result from the inductive and resistive loads of the electrical input 103 (FIG. 1) and that the particular geometric configurations disclosed herein provide significant enhancements to this benefit. Accordingly, the electrical output 105 of the processing device 104 is filtered and thus leaner than the electrical input 103 provided to the processing device 104 by the energy source 102. It shall be appreciated, therefore, that the processing device 104 of FIG. 2 enables the consuming

device 107 to use less electrical energy from the energy source 102 to perform the same tasks.

[0033] The capacitor 114 of the processing device 104 of FIG. 2 can include, according to some non-limiting aspects, a power factor correction capacitor, which can help to improve the power factor of the overall electrical circuit provided via the system 100 of FIG. 1. For example, lagging currents within the circuit may otherwise require additional power from the supply, as is true when there is a leading current within the circuit, wherein the voltage waveform is slightly behind the current waveform. Accordingly, the capacitor 114 balances the inductive load of the inductive core 112 with a capacitive load, which can then cancel out the extra power requirement from the supply. The capacitor can further be configured to provide a leading current to help bring the measure closer to unity (e.g., a power factor of 1). At unity, the voltage waveform and the current waveform have been effectively balanced by the processing device 104. Thus, the capacitor 114 of the processing device 104 can reduce energy costs by avoiding the premium rates that a utility, or owner of the energy source 102, might charge when power factor falls below a specified value.

[0034] As will be described in further detail with reference to FIG. 10, the inductive core 112 and the capacitor 114 can be components of a circuit board 113 installed within the housing 111 of the processing device 104. According to some non-limiting aspects, the inductive core 112 of the processing device 104 of FIG. 2 can be electrically coupled to the capacitor 114 such that the resulting circuit produces a low resistance (e.g., a direct current, or DC, resistance) and a high reactance (e.g., an alternating current, or AC, reactance). Thus, the processing device 104 takes the electrical input 103 and generates ripples, which can be filtered through a conductive coil of the inductive core 112, as will be described in further detail with reference to FIG. 3. Residual ripples coming out of the inductive core 112 will get filtered by the capacitor 114, as the capacitor 114 allows AC and blocks DC voltages. According to some non-limiting aspects, the inductive core 112 and the capacitor 114 can be used in conjunction with a rectifier circuit, such that pulsating voltage from the rectifier passes through the inductive core 112.

[0035] In further reference to FIG. 2, the inductive core 112 of the processing device 104 can be formed from a variety of materials in a variety of ways depending on user preference and/or intended application. For example, according to non-limiting aspects wherein the inductive core 112 is configured as an inductor transformer, the inductive core 112 may be formed by a laser sintering process, using Metglas® (e.g., Metglas® 2605HBIM, etc.) powders, or other amorphous metal alloys with a high electromagnetic conversion rate, to obtain an enclosure 118 with a core geometry of specific and/or desired proportions. For example, the material can include an amorphous foil with an irregular atomic arrangement, such as the atomic arrangements of FIGS. 3A and 3B. Such atomic arrangements result in a

magnetic crystalline anisotropy that essentially disappears. Furthermore, it may be desirable for the material to have a low degree of hysteresis loss, a high electrical resistivity (e.g., $1.3\mu\Omega\text{m}$), a thinner strip (e.g., $25\mu\text{m}$), and/or a low eddy current loss. Furthermore, the material should include a large internal stress due to rapid solidification, which may provide stress relief annealing that imbues the inductive core 112 with enhanced magnetic properties.

[0036] In this regard, the inductive core 112 of FIG. 2 can further mitigate losses from the electrical input 103 (FIG. 1) by reducing losses resulting from eddy currents. As such, the inductive core 112 of FIG. 2 can be laminated so it possesses a geometric structure composed of “thinner strips,” such as those depicted in FIG. 4B. The geometry of FIG. 4B, for example, can be beneficial to reduce losses from the electrical input 103 (FIG. 1) because the series of thin, discontinuous laminations can be implemented to complicate the inductive path for eddy currents resulting from the electrical input 103 (FIG. 1). These interruptions are not possible in a construction that includes a more solid block of material, as depicted in FIG. 4A, because eddy currents resulting from the electrical input 103 (FIG. 1) would have an easier conductive path and thus, could propagate more easily.

[0037] However, according to non-limiting aspects wherein the inductive core 112 of FIG. 2 is configured as an inductor filter and/or suppressor, the inductive core 112 may include a crystalline alloy, such as the structure depicted in FIG. 5. For example, the material can include a non-oriented electrical steel, which has a regular atomic arrangement. This could have a large effect on the resulting magnetic crystalline anisotropy, causing an increased hysteresis loss, a low electrical resistivity, and a “thicker strip” construction compared to the inductor transformer construction, which can cause larger eddy current losses. Thus, such a structure may be better for non-limiting aspects wherein the inductive core 112 is configured to function as an inductor or suppressor of losses for the electrical input 103.

[0038] Still referring to FIG. 2, according to some non-limiting aspects, the enclosure 118 of the inductive core 112 can include a three-dimensional Hopfion geometry. The electrical input 103 (FIG. 1) from an energy source 102 (FIG. 1) can traverse a conductive path 116 (e.g., composed of any suitable conductive material, such as copper, etc.) within the enclosure 118 of the inductive core. According to some non-limiting aspects, the conductive path 116 can include a bifilar coil, or an electromagnetic coil that contains two closely spaced, parallel windings. The geometry of the conductive path 116, for example, can be determined via a fast Fourier transform (“FFT”) algorithm. According to some non-limiting aspects, the conductive path 116 can establish coverage angles that are divisibly by three. For example, as depicted in FIG. 6, a conductor (e.g., copper) has been placed within the conductive path 116 such that conductor winds about the enclosure 118, appearing three times about the three-hundred and sixty degree circumference of the circular enclosure 118, when viewed from above or below. As such, it shall be appreciated FIG. 6 depicts a one-hundred and twenty degree coverage

angles (e.g., three-hundred and sixty divided by three). However, according to other non-limiting aspects, it may be preferable to utilize a coverage angle generated by any other multiple of three. For example, the coverage angle can be sixty (e.g., three-hundred and sixty divided by six), forty (e.g., three-hundred and sixty divided by nine), thirty (e.g., three-hundred and sixty divided by twelve), etc. The coverage angle can be selected to optimize and increase the inductive capacity of the inductive core 112. Additionally, according to some non-limiting aspects, the conductive path 116 can be particularly configured relative to the enclosure 118. For example, according to the non-limiting aspect of FIG. 6, the conductive path 116 can be wound about the enclosure 118 approximately one hundred and twenty degrees out of phase, for preferred results and loss mitigations.

[0039] It shall be appreciated that the Larmor frequency describes an angle of precession of the magnetic moment generated by the inductive core 112 as the electrical input 103 (FIG. 1) traverses through the conductive path 116. For example, according to some non-limiting aspects, the angle described by the Larmor frequency may be between 40 and 45 degrees and, in some cases, 42.5 degrees. Such a Larmor angle can be used as the winding angle, mimicking through a copper material deposited in the conductive path 116 that works as a magnetic rail, preventing electrons from “skidding” and losing momentum while accelerating or during the induction process. This enhances the efficiency of the electrical output 105 (FIG. 1).

[0040] Furthermore, it shall be appreciated that the conductive path 116 defined by the enclosure 118 of the inductive core 112 creates a contact surface between the magnetic material of the enclosure 118 and the conductive material (e.g., copper) deposited within the conductive path 116. Moreover, the conductive path 116 enables the the conductive material to be surrounded by the magnetic structure of the enclosure 118, which avoids losses due to skin effects and allows for greater confinement of the magnetic fields generated by the inductive core 112 and thus, improved efficiency and reduced losses in the electrical output 105 (FIG. 1). This is only possible due to the smooth, curvilinear surface of the inductive core 112, as the position of the conductive material on the next turn around the torus will be one-hundred and twenty degrees away from the initial position (e.g., the coverage angle). Similar to a motor winding in which the three phases are separated by one-hundred and twenty degrees, the coverage angle enables the magnetic core, or enclosure 118, to function as a rotor that alternates its polarity as the electrical input 103 (FIG. 1) traverses the conductive path 116 (e.g., north, south, north).

[0041] It shall be appreciated that, according to some non-limiting aspects (e.g., northern hemisphere), the direction taken by the winding (e.g., conductor deposited within the conductive path 116) will be in a counterclockwise direction. According to other non-limiting aspects (e.g., southern hemisphere), the direction taken by the winding will be in a clockwise

direction. The windings also have an upward direction from the surface of the toroidal core formed by the enclosure 118, towards the center of the winding. The direction relates to the direction of low pressure in both hemispheres. Additionally, according to some non-limiting aspects, it may be preferential to configure the volumetric ratio of the core to be two inches inner diameter, three inches outer diameter, with eight inches in height. This proportion can be fixed for all nucleus sizes, and is scalable in either direction.

[0042] Finally, the Hopfion geometry of the inductive core 112 enables fibrillation that describes the movement and angles defined by electrons and a resulting magnetic field generated via induction. The conductive path 116 followed by the winding is intended to mimic the preferred path of the electron itself as the electrical input 103 (FIG. 1) traverses the inductive core 112, such that the magnetic fields are aligned as desired and depicted in FIG. 7. These fields generate an electrical output 105 (FIG. 1) that is more efficient and has less loss due to the Hopfion design.

[0043] Referring now to FIG. 7, a three-dimensional schematic of magnetic fields generated by the electrical input 103 as it traverses the conductive path 116 of the inductive core 112 is depicted in accordance with at least one non-limiting aspect of the present disclosure. Referring now to FIG. 8, a three-dimensional schematic of a particle trajectory generated by the electrical input 103 as it traverses the conductive path 116 of the inductive core 112 is depicted in accordance with at least one non-limiting aspect of the present disclosure.

[0044] Referring now to FIG. 9, the enclosure 118 of the inductive core 212 of the processing device 104 of FIG. 2 is depicted in accordance with at least one non-limiting aspect of the present disclosure. For example, accord to the non-limiting aspect of FIG. 8, the enclosure 118 of the inductive core 212 can be produced using a three-dimensional printing process, which might make it easier to achieve the Hopfion geometry, or any other non-planar geometry selected to achieve the benefits disclosed herein. Moreover, the enclosure 118 of FIG. 8 can be said to have a "three-dimensional plus" Hopfion geometry, because the enclosure 118 is particularly configured to address and control the three-dimensional characteristics of the resulting electromagnetic fields. Conventional devices, systems, and methods, generally only consider two-dimensions of a resulting magnetic field, driven by the north and south poles. The three-dimensional nature of the resulting magnetic field is depicted in FIG. 7.

[0045] Referring now to FIG. 10, a circuit board 113 installed within the housing 111 of the processing device 104 is depicted in accordance with at least one non-limiting aspect of the present disclosure. According to the non-limiting aspect of FIG. 10, the circuit board 113 can include the inductive core 112, the capacitor 114, and a connectivity circuit 120, as well as a substrate 122 upon which the components are installed. As previously established, the processing device 104 can be communicably coupled to a computing device 108 or a host server 110 via a communications network 106. As such, it shall be appreciated that

performance of the processing device 104 can be remotely monitored, and reports can be generated based on its performance. For example, according to some non-limiting aspects, the connectivity circuit 120 can include a three-phase and a neutral sensor array along with an wireless communication circuit or transceiver to facilitate such communications. Signals generated and transmitted by the connectivity circuit 120 can be evaluated for real-time validation within less than a single percent margin of error. The connectivity circuit 120 can further enable encryption protocols such that savings (kWh) generated by the processing device 104 can be incorporated into customer statements and/or reports, supported by high-quality data backed analyses. According to still other non-limiting aspects, data generated and transmitted by the connectivity circuit 120 can be tokenized and stored on a blockchain network. This can be particularly beneficial for a commodification of results produced by the processing device 104, as will be described in further detail herein. For example, according to such non-limiting aspects, the processing device 104 can be used to generate carbon credit derivative assets, which can be openly exchanged via the devices, systems, and methods disclosed herein. According to some non-limiting aspects, the connectivity circuit 120 can further include control circuit (e.g., a microprocessor) and/or memory such that the processing device 104 can perform a certain degree of edge computing in monitoring, characterizing, and controlling its own performance, including the storage and execution of an artificial intelligence model.

[0046] Further still, according to some non-limiting aspects, either a control circuit of the connectivity circuit 120, the computing device 108 (FIG. 1), and/or the host server 110 (FIG. 1) can implement an artificial intelligence model to process signals generated by the processing device 104. For example, an artificial intelligence managed electrical processor and a sensor array can monitor and control voltage and current levels, ensuring they not only harmonize within predefined boundaries but also selectively activating power factor correction to optimize energy efficiency. The artificial intelligence model, for example, can be used implemented to autonomously asses performance of the processing device 104 and attenuate its control to hone in on a desired result. As a result, mitigating voltage irregularities, surges, harmonics, and assorted disturbances while enhancing sag/lag alignment can be automated, thus ensuring the smooth, reliable, and highly efficient performance of electrical circuits. Thus, power factor correction can be achieved via the inductive core 112 and capacitor 114, thereby reducing overall interference in the system 100 (FIG. 1) This can allow the fundamental harmonic 60Hz or 50Hz to remain undisturbed.

[0047] Referring now to FIG. 11, a method 200 for enhancing the provision of electrical energy, in accordance with at least one non-limiting aspect of the present disclosure. It shall be appreciated that the method 200 can be performed via a control circuit of the processing device 104 (FIG. 1), the computing device 108 (FIG. 1), and/or the host server 110 (FIG. 1).

According to the non-limiting aspect of FIG. 11, the method 200 can include generating 202 data associated with the electrical performance of a processing device 104 (FIG. 2). For example, as previously described, the processing device 104 can include sensors and can transmit signals associated with its performance transforming the electrical input 103 (FIG. 1) into the electrical output 105 (FIG. 1) for provision to the consuming device 107 (FIG. 1). This can include characteristics of the electrical currents and voltages processed via the inductive core 112 (FIG. 2) and/or capacitor 114 (FIG. 2), including harmonic and power factor data. Generation and subsequent collection can be performed in real-time and may be based on quality metrics and/or other predefined electrical data, perhaps provided via the host server 110 (FIG. 1).

[0048] Still referring to FIG. 11, the method 200 can further include processing 204 data associated with the electrical performance of the processing device. As previously described, according to some non-limiting aspects, the processing 204 can be performed by an artificial intelligence model stored in the processing device 104 (FIG. 2), the computing device 108 (FIG. 1), and/or the host server 110 (FIG. 1). The processing 204 can further include an analysis of the power quality and calculation of a resulting power (e.g., kWh, etc.) reduction, as well as a correlated carbon dioxide reduction based on this reduction. According to some non-limiting aspects, such calculations can be performed in compliance to user preferences, corporate policies, and/or governmental regulations. For example, according to some non-limiting aspects, the processing 204 can be dictated by a tax code, for auditing, insight, and reporting. The method 200 can further include generating 206 a carbon credit based on the processing of data associated with the electrical performance of the processing device. Such generation can employ a data-backed methodology that converts calculated carbon dioxide reductions into a quantifiable measure that may be utilized as a commodity. For example, the validated carbon credit measures can be used to create carbon credit derivative assets based on past data associated with electricity historically used by the consuming device 107 (FIG. 1). In other words, the electrical output 105 (FIG. 1) can be compared to historical data to generate the carbon credit derivative. Alternately and/or additionally, a comparison of the electrical input 103 (FIG. 1) and the electrical output 105 (FIG. 1) can be used to generate the carbon credit derivative. According to non-limiting aspects wherein the processing device 104 (FIG. 2) includes one or more sensors, sensor data can be used to generate the carbon credit derivative.

[0049] In further reference to FIG. 11, the method 200 can further include traceably storing 208 the generated carbon credit asset. For example, the generated carbon credit asset can be tokenized and stored on a blockchain network, a private server, or in a data lake, for example. Moreover, the generated carbon credit asset as well as associated data may be stored by the host server 110 (FIG. 1) for internal processing and improvement. For example,

according to some non-limiting aspects, the generated carbon credit asset and associated data can be used as training data for the artificial intelligence model, thereby improving the accuracy of energy and carbon dioxide reduction calculations. Finally, the method 200 can further include exchanging 210 the generated carbon credit via a swap exchange facility where carbon credits can be purchased and sold.

[0050] Examples of the method according to various aspects of the present disclosure are provided below in the following numbered clauses. An aspect of the method may include any one or more than one, and any combination of, the numbered clauses described below.

[0051] Clause 1. A device for enhancing the provision of electrical energy, the device including an inductive core configured to receive an electrical input from an energy source and magnetically annul a peak in the electrical input that results from an inductive load and a resistive load associated with the electrical input, a capacitor configured to balance the inductive load with a capacitive load and generate an electrical output based on the balancing, wherein the generated electrical output includes less electrical power than the electrical input.

[0052] Clause 2. The device according to clause 1, wherein the inductive core includes an enclosure and a conductive path configured to traverse through the enclosure.

[0053] Clause 3. The device according to either of clauses 1 or 2, wherein the enclosure includes a Hopfion geometry.

[0054] Clause 4. The device according to any of clauses 1-3, wherein the enclosure includes a powder sintered via a laser sintering process.

[0055] Clause 5. The device according to any of clauses 1-4, wherein the enclosure includes a material including an irregular atomic arrangement configured to reduce a magnetic crystalline anisotropy associated with the inductive core.

[0056] Clause 6. The device according to any of clauses 1-5, wherein the enclosure includes a plurality of strips configured to reduce eddy current losses associated with the generated electrical output.

[0057] Clause 7. The device according to any of clauses 1-6, wherein the enclosure includes a material including a crystalline alloy configured to increase a hysteresis loss associated with the inductive core.

[0058] Clause 8. The device according to any of clauses 1-7, wherein the conductive path establishes a coverage angle of 120 degrees.

[0059] Clause 9. The device according to any of clauses 1-8, wherein the conductive path includes two closely spaced, parallel windings.

[0060] Clause 10. A system for enhancing the provision of electrical energy, the system including a processing device including an inductive core configured to receive an electrical input from an energy source and magnetically annul a peak in the electrical input that results from an inductive load and a resistive load associated with the electrical input, a capacitor

configured to balance the inductive load with a capacitive load and generate an electrical output based on the balancing, wherein the electrical output includes less electrical power than the electrical input, and a connectivity circuit electrically coupled to the inductive core and the capacitor, and a host server communicably coupled to the connectivity circuit of the processing device, wherein the host server includes a control circuit configured to receive data associated with the electrical output from the connectivity circuit of the processing device, process the received data associated with the electrical output, generate a carbon credit based on the processing of data associated with the electrical output, and traceably store the generated carbon credit.

[0061] Clause 11. The system according to clause 10, wherein the control circuit is configured to tokenize the generated carbon credit.

[0062] Clause 12. The system according to either of clauses 10 or 11, wherein traceably storing the generated carbon credit includes storing the tokenized carbon credit in a distributed ledger hosted by a blockchain network.

[0063] Clause 13. The system according to any of clauses 10-12, wherein the host server further includes a memory configured to store an artificial intelligence model that, when executed by the control circuit, causes the control circuit to process the received data associated with the electrical output.

[0064] Clause 14. The system according to any of clauses 10-13, wherein the inductive core includes an enclosure and a conductive path configured to traverse through the enclosure.

[0065] Clause 15. The system according to any of clauses 10-14, wherein the enclosure includes a Hopfion geometry.

[0066] Clause 16. The system according to any of clauses 10-15, wherein the conductive path establishes a coverage angle of 120 degrees.

[0067] Clause 17. The system according to any of clauses 10-16, wherein the conductive path includes two closely spaced, parallel windings.

[0068] Clause 18. A computer implemented method of enhancing the provision of electrical energy, the method including receiving, via a processing device, an electrical input from an energy source, generating, via an inductive core and a capacitor of the processing device, an electrical output based on the received electrical input, transmitting, via a connectivity circuit of the processing device, data associated with the electrical output to a host server, processing, via a control circuit of the host server, the data associated with the electrical output to a host server, generating, via the control circuit of the host server, a carbon credit based on the processing of data associated with the electrical output, and traceably storing the generated carbon credit.

[0069] Clause 19. The computer implemented method according to clause 18, further including tokenizing, via the host server, the generated carbon credit and wherein traceably storing the generated carbon credit includes storing the tokenized carbon credit in a distributed ledger hosted by a blockchain network.

[0070] Clause 20. The computer implemented method according to either of clauses 18 or 19, wherein the host server further includes a memory configured to store an artificial intelligence model that, when executed by the control circuit, causes the control circuit to process the received data associated with the electrical output.

[0071] Although the various aspects of the fall protection apparatus, system and method have been described herein in connection with certain disclosed aspects, many modifications and variations to those aspects may be implemented. Also, where materials are disclosed for certain components, other materials may be used. Furthermore, according to various aspects, a single component may be replaced by multiple components, and multiple components may be replaced by a single component, to perform a given function or functions. The foregoing description and the appended claims are intended to cover all such modifications and variations as falling within the scope of the disclosed aspects.

[0072] While this invention has been described as having exemplary designs, the described invention may be further modified within the spirit and scope of the disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. For example, although the invention was described in the context of its use with aerial lifts and other boom/basket lifting devices, the general principles of the invention are equally applicable to other types of workplace environments (e.g., in an environment where a ladder is being used).

[0073] Any patent, patent application, publication, or other disclosure material, in whole or in part, that is said to be incorporated by reference herein is incorporated herein only to the extent that the incorporated materials does not conflict with existing definitions, statements, or other disclosure material set forth in this disclosure. As such, and to the extent necessary, the disclosure as explicitly set forth herein supersedes any conflicting material incorporated herein by reference. Any material, or portion thereof, that is said to be incorporated by reference herein, but which conflicts with existing definitions, statements, or other disclosure material set forth herein will only be incorporated to the extent that no conflict arises between that incorporated material and the existing disclosure material.

CLAIMS

What is claimed is:

1. A device for enhancing a provision of electrical energy, the device comprising:
an inductive core configured to receive an electrical input from an energy source and magnetically annul a peak in the electrical input that results from an inductive load and a resistive load associated with the electrical input; and
a capacitor configured to balance the inductive load with a capacitive load and generate an electrical output based on the balancing, wherein the generated electrical output comprises less electrical power than the electrical input.
2. The device of claim 1, wherein the inductive core comprises an enclosure and a conductive path configured to traverse through the enclosure.
3. The device of claim 2, wherein the enclosure comprises a Hopfion geometry.
4. The device of claim 3, wherein the enclosure comprises a metal sintered via a fine-powder laser sintering process.
5. The device of claim 3, wherein the enclosure comprises a material comprising an irregular atomic arrangement configured to reduce a magnetic crystalline anisotropy associated with the inductive core.
6. The device of claim 5, wherein the enclosure comprises a plurality of laminated strips configured to reduce eddy current losses associate with the generated electrical output.
7. The device of claim 3, wherein the enclosure comprises a material comprising a crystalline alloy configured to increase a hysteresis loss associated with the inductive core.
8. The device of claim 2, wherein the conductive path establishes a coverage angle of 120 degrees.
9. The device of claim 2, wherein the conductive path comprises two closely spaced, parallel windings.
10. A system for enhancing a provision of electrical energy, the system comprising:
a processing device comprising:

an inductive core configured to receive an electrical input from an energy source and magnetically annul a peak in the electrical input that results from an inductive load and a resistive load associated with the electrical input;

a capacitor configured to balance the inductive load with a capacitive load and generate an electrical output based on the balancing, wherein the electrical output comprises less electrical power than the electrical input; and

a connectivity circuit electrically coupled to the inductive core and the capacitor; and

a host server communicably coupled to the connectivity circuit of the processing device, wherein the host server comprises a control circuit configured to:

receive data associated with the electrical output from the connectivity circuit of the processing device;

process the received data associated with the electrical output;

generate a carbon credit based on the processing of data associated with the electrical output; and

traceably store the generated carbon credit.

11. The system of claim 10, wherein the control circuit is configured to tokenize the generated carbon credit.

12. The system of claim 11, wherein traceably storing the generated carbon credit comprises storing the tokenized carbon credit in a distributed ledger hosted by a blockchain network.

13. The system of claim 10, wherein the host server further comprises a memory configured to store an artificial intelligence model that, when executed by the control circuit, causes the control circuit to process the received data associated with the electrical output.

14. The system of claim 10, wherein the inductive core comprises an enclosure and a conductive path configured to traverse through the enclosure.

15. The system of claim 14, wherein the enclosure comprises a Hopfion geometry.

16. The system of claim 15, wherein the conductive path establishes a coverage angle of 120 degrees.

17. The system of claim 16, wherein the conductive path comprises two closely spaced, parallel windings.

18. A computer implemented method of enhancing a provision of electrical energy, the method comprising:

receiving, via a processing device, an electrical input from an energy source;

generating, via an inductive core and a capacitor of the processing device, an electrical output based on the received electrical input;

transmitting, via a connectivity circuit of the processing device, data associated with the electrical output to a host server;

processing, via a control circuit of the host server, the data associated with the electrical output to a host server;

generating, via the control circuit of the host server, a carbon credit based on the processing of data associated with the electrical output; and

traceably storing the generated carbon credit.

19. The computer implemented method of claim 18, further comprising:

tokenizing, via the host server, the generated carbon credit; and

wherein traceably storing the generated carbon credit comprises storing the tokenized carbon credit in a distributed ledger hosted by a blockchain network.

20. The computer implemented method of claim 18, wherein the host server further comprises a memory configured to store an artificial intelligence model that, when executed by the control circuit, causes the control circuit to process the received data associated with the electrical output.