

CLAIMS:

1. An electric power converter for a photovoltaic energy source, including:
 - an inverter component configured to receive electrical energy in the form of a dynamically changing DC signal generated by the photovoltaic energy source and to generate a corresponding dynamically changing AC signal having a frequency substantially equal to a mains supply frequency; and
 - an electromagnetic apparatus, including:
 - a magnetic core;
 - a plurality of windings around corresponding portions of the magnetic core, the plurality of windings including:
 - one or more input windings to receive the dynamically changing AC signal as an AC input signal having dynamically changing electrical characteristics;
 - one or more output windings to provide an AC output signal; and
 - control windings configured to control electromagnetic coupling between the input windings and the output windings; and
 - a control component configured to dynamically control electrical currents through the control windings in dependence on the dynamically changing electrical characteristics of the AC input signal so that corresponding electrical characteristics of the AC output signal are relatively constant and include a fundamental frequency equal to the mains supply frequency.
2. The electric power converter of claim 1, wherein the control component is configured to dynamically control the electrical currents through the control windings to reduce harmonics in the AC output signal.
3. The electric power converter of claim 1 or 2, wherein the control component is configured to dynamically control the electrical currents through the control windings to maintain a substantially constant amplitude of the AC output signal.
4. The electric power converter of any one of claims 1 to 3, wherein the control component is configured to dynamically inject or absorb reactive power to or from the input windings to maintain a power factor of substantially unity.

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5. The electric power converter of any one of claims 1 to 4, wherein the control component is configured to execute a maximum power point tracking ("MPPT") process to dynamically control the output voltage of the inverter component and thereby increase power extracted from the photovoltaic energy source.
6. The electric power converter of any one of claims 1 to 5, wherein the control component includes a power electronics component to generate the electrical currents for the control windings, and one or more signal processing components to control the power electronics component, the power electronics component including a rectifier component, one or more capacitors, and a second inverter component, the rectifier component being configured to receive AC power from windings around the magnetic core and to generate corresponding DC power to charge the capacitors, and the second inverter component being configured to generate the electrical currents for the control windings from power stored in the capacitors, under control of the one or more signal processing components.
7. The electric power converter of claim 6, wherein the one or more signal processing components generate PWM signals to control switching transistors of the second inverter component to generate the electrical currents for the control windings.
8. The electric power converter of claim 6 or 7, wherein the rectifier component is further configured to dynamically transfer reactive power between the capacitors and the input windings to maintain a power factor of substantially unity.
9. The electric power converter of claim 8, wherein the one or more signal processing components generate second PWM signals to control second switching transistors of the second inverter component to control the transfer of reactive power between the capacitors and the input windings.
10. The electric power converter of any one of claims 6 to 9, wherein the one or more signal processing components includes a first signal processing component configured to generate control signals for controlling the current through the control windings, and a second signal processing component configured to process the control signals to generate corresponding PWM signals to control switching transistors of the power electronics component.

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11. An electric power converter process for execution by the control component of the electric power converter of any one of claims 1 to 10, the electric power converter process including the steps of:

- (i) receiving signals representing an output voltage of the photovoltaic energy source, an output current of the photovoltaic energy source, and a voltage of the output windings of the magnetic core; and
- (ii) processing the received signals to generate corresponding first control signals to control the output voltage of the inverter to maximise output power of the photovoltaic energy source, and second control signals to dynamically control the electrical currents through the control windings.

12. At least one computer-readable storage medium having stored thereon processor-executable instructions and/or configuration data representing the electric power converter process of claim 11.