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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.1 7(H))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(Hi))*

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(54) Title: CHARGING SYSTEM FOR AN IMPLANTABLE MEDICAL DEVICE EMPLOYING MAGNETIC AND ELECTRIC FIELDS

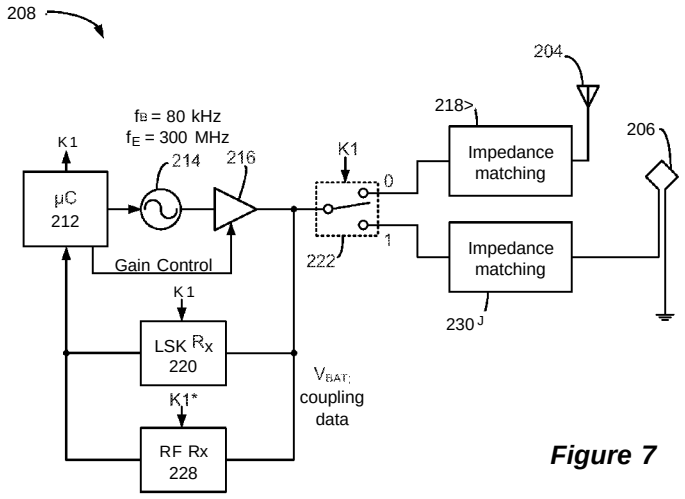

Figure 7

(57) Abstract: A base station for passively recharging a battery in an implant without patient involvement is disclosed. The base station can be hand held or may comprise equipment configured to be placed at a fixed location, such as under a bed, on or next to a wall, etc. The base station can generate electric and magnetic fields (E- field and B-field) that couple with an antenna and a receiving coil within the implant to generate a charging current for charging the implant's battery. No handling or manipulation on part of the patient is necessary; the implant battery is passively charged whenever the patient is within range of either the magnetic or electric charging fields generated by base station. Charging using the B-field occurs when the IPG is at a relatively short distance from the base station, while charging using the E-field occurs at longer distances. Back telemetry from the implant can inform the base station whether B-field or E-field charging is indicated, and is preferred if possible for its ability to transfer higher amounts of power to the implant.

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AMENDED CLAIMS
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1. An external device for charging a battery in an implantable medical device, comprising:

at least one first antenna selectively enabled to generate an electric field for charging the battery in the implantable medical device;

at least one second antenna selectively enabled to generate a magnetic field for charging the battery in the implantable medical device; and

control circuitry for selectively enabling either the first antenna or the second antenna based on charging information telemetered from the implantable medical device.

2. The device of claim 1, wherein the at least one first antenna comprises a quarter-wavelength monopole antenna or a half-wavelength dipole antenna.

3. The device of claim 1, wherein the at least one first antenna comprises a wire, patch or slot antenna.

4. The device of claim 1, wherein the at least one second antenna comprises a coil.

5. The device of claim 1, wherein the electric field comprises a first frequency and the magnetic field comprises a second frequency lower than the first frequency.

6. The device of claim 1, wherein the external device is positionable on a floor or wall.

7. The device of claim 1, wherein the electric field is not modulated with data.

8. The device of claim 1, further comprising first demodulation circuitry coupleable to the first antenna for receiving the charging information from the implantable medical device, and second demodulation circuitry coupleable to the second antenna for receiving the charging information from the implantable medical device.

9. The device of claim 1, further comprising demodulating circuitry for receiving charging information from either or both of the first and second antennas.

10. The device of claim 1, further comprising a third antenna for receiving the charging information transmitted from the implantable medical device during generation of either the electric or magnetic fields.

11. The device of claim 1, wherein only one of the first and second antennas are enabled at one time.

12. An implantable medical device, comprising:

a battery;

a first antenna configured to receive an electric field for charging the battery;

a second antenna configured to receive a magnetic field for charging the battery; and

a microcontroller for determining whether either or both of the electric field and the magnetic field have been received at the first or second antennas respectively, and for issuing at least one control signal enabling charging of the battery either by the electric field or the magnetic field.