CLAIMS

1. An inductive power transfer system comprising:

a transmitter coil and a receiver coil spaced from the transmitter coil;

a transmitter circuit comprising the transmitter coil; and

a receiver circuit comprising the receiver coil,

wherein the transmitter circuit is in the form of a Class E amplifier comprising:

a first inductor and a transistor in series between the terminals of a power supply, the transistor being arranged to switch at a first frequency;

a first transmitter capacitor in parallel with the transistor between the first inductor and a power supply terminal;

a primary tank circuit in parallel with the first transmitter capacitor, the primary tank circuit comprising the transmitter coil and a second transmitter capacitor arranged in parallel or series with the transmitter coil;

a third transmitter capacitor in series with the first inductor between the first transmitter capacitor and the primary tank circuit.

2. An inductive power transfer system as claimed in claim 1, wherein the capacitance of the second transmitter capacitor is selected, such that the resonant frequency of the primary tank circuit is greater than the first frequency.

3. An inductive power transfer system as claimed in claim 1, wherein the capacitance of the second transmitter capacitor is selected, such that the resonant frequency of the primary tank circuit is less than the first frequency.

4. An inductive power transfer system as claimed in claim 2 or 3, wherein the ratio of the first frequency to the resonant frequency of the primary tank circuit is in the range 0.5 to 1.5.

5. An inductive power transfer system as claimed in claim 2, wherein the ratio of the first frequency to the resonant frequency of the primary tank circuit is in the range 0.7 to 0.9.

6. An inductive power transfer system as claimed in any preceding claim, wherein the receiver circuit has a resonant frequency and the transmitter circuit is configured to vary the first frequency, in order to achieve a desired effective impedance of the primary tank circuit.

7. An inductive power transfer system as claimed in any preceding claim, wherein the transmitter coil and/or the receiver coil has an air core.

8. An inductive power transfer system as claimed in any preceding claim, wherein the transmitter coil and/or the receiver coil has a diameter of at least 5cm, preferably at least 10cm.

9. An inductive power transfer system as claimed in any preceding claim, wherein the spacing between the transmitter coil and the receiver coil, in use, is at least 15cm.

10. An inductive power transfer system as claimed in any preceding claim, wherein the transistor is a MOSFET.

11. An inductive power transfer system as claimed in any preceding claim, wherein the first frequency is at least 80kHz, preferably at least 1 MHz.

12. An inductive power transfer system as claimed in any preceding claim, wherein the power transferred between the transmitter coil and the receiver coil is at least 1 watt, preferably at least 10 watts.

13. An inductive power transfer system as claimed in any preceding claim, wherein the receiver circuit comprises a Class E rectifier.

14. An inductive power transfer system as claimed in claim 13, wherein the receiver circuit comprises a first receiver capacitor arranged in parallel with a load, in use, and a secondary tank circuit in parallel with the first receiver capacitor, wherein the secondary tank circuit comprises the receiver coil and a second receiver capacitor arranged in parallel with the receiver coil, and a first diode is provided between the secondary tank circuit and the first receiver capacitor.

15. An inductive power transfer system as claimed in claim 14, wherein the capacitance of the second receiver capacitor is selected such that the resonant frequency of the secondary tank circuit differs from the first frequency, whereby the secondary tank circuit operates in semi-resonance and maintains some reactive impedance.

16. An inductive power transfer system as claimed in claim 15, wherein the ratio of the first frequency to the resonant frequency of the secondary tank circuit is in the range 0.2 to 3.

17. An inductive power transfer system as claimed in any of claims 13 to 16, wherein the only inductor in the receiver circuit is the receiver coil.

18. An inductive power transfer system as claimed in any of claims 14 to 17, wherein the receiver circuit comprises at least a second diode in parallel with the first diode.

19. An inductive power transfer system as claimed in any of claims 13 to 18, wherein the only capacitance in parallel with the diode(s) is provided by the junction capacitance of the diode(s).

20. An inductive power transfer system as claimed in any of claims 13 to 19, wherein the diode(s) are silicon carbide diodes, gallium nitride diodes or are formed of other wide band gap material.

21. The receiver circuit of the inductive power transfer system as claimed in any of claims 14 to 20.

22. The transmitter circuit of the inductive power transfer system as claimed in any preceding claim.

CLAIMS

1. An inductive power transfer system comprising:

a transmitter circuit comprising a transmitter coil; and

a receiver circuit comprising a receiver coil spaced from the transmitter coil,

wherein the transmitter circuit is in the form of a Class E amplifier comprising:

a first inductor and a transistor in series between the terminals of a power supply, the transistor being arranged to switch at a first frequency;

a first transmitter capacitance in parallel with the transistor between the first inductor and a power supply terminal;

a primary tank circuit in parallel with the first transmitter capacitance, the primary tank circuit comprising the transmitter coil and a second transmitter capacitance arranged in parallel or series with the transmitter coil;

a third transmitter capacitance in series with the first inductor between the first transmitter capacitance and the primary tank circuit,

wherein the second transmitter capacitance is selected such that the resonant frequency of the primary tank circuit is not equal to the first frequency.

2. An inductive power transfer system as claimed in claim 1, wherein the second transmitter capacitance is arranged in parallel with the transmitter coil, and wherein the second transmitter capacitance is selected such that the resonant frequency of the primary tank circuit is greater than the first frequency.

3. An inductive power transfer system as claimed in claim 1, wherein the second transmitter capacitance is arranged in series with the transmitter coil, and wherein the second transmitter capacitance is selected such that the resonant frequency of the primary tank circuit is less than the first frequency.

4. An inductive power transfer system as claimed in claim 2, wherein the ratio of the first frequency to the resonant frequency of the primary tank circuit is greater than or equal to 0.5 and less than 1.

5. An inductive power transfer system as claimed in claim 3, wherein the ratio of the first frequency to the resonant frequency of the primary tank circuit is greater than 1 and less than or equal to 1.5.

6. An inductive power transfer system as claimed in any preceding claim, wherein the receiver circuit has a resonant frequency and the transmitter circuit is configured to vary the first frequency, in order to achieve a desired effective impedance of the primary tank circuit.

7. An inductive power transfer system as claimed in any preceding claim, wherein the transmitter coil and/or the receiver coil has an air core.

8. An inductive power transfer system as claimed in any preceding claim, wherein the transmitter coil and/or the receiver coil has a diameter of at least 5cm.

9. An inductive power transfer system as claimed in any preceding claim, wherein the transmitter coil and/or the receiver coil has a diameter of at least 10cm.

10. An inductive power transfer system as claimed in any preceding claim, wherein the spacing between the transmitter coil and the receiver coil, in use, is at least 15cm.

11. An inductive power transfer system as claimed in any preceding claim, wherein the transistor is a MOSFET.

12. An inductive power transfer system as claimed in any preceding claim, wherein the first frequency is at least 80kHz.

13. An inductive power transfer system as claimed in any preceding claim, wherein the first frequency is at least 1MHz.

14. An inductive power transfer system as claimed in any preceding claim, wherein the power transferred between the transmitter coil and the receiver coil is at least 1 watt.

15. An inductive power transfer system as claimed in any preceding claim, wherein the power transferred between the transmitter coil and the receiver coil is at least 10 watts.

16. An inductive power transfer system as claimed in any preceding claim, wherein the first transmitter capacitance is formed of the output capacitance of the transistor.

17. An inductive power transfer system as claimed in any preceding claim, wherein the receiver circuit comprises a Class E rectifier.

18. An inductive power transfer system as claimed in claim 17, wherein:

the receiver circuit comprises a first receiver capacitance and a secondary tank circuit in parallel with the first receiver capacitance;

the receiver circuit is arranged to receive a load in parallel with the first receiver capacitance; and

the secondary tank circuit comprises the receiver coil and a second receiver capacitance arranged in parallel with the receiver coil, and a first diode is provided between the secondary tank circuit and the first receiver capacitance.

19. An inductive power transfer system as claimed in claim 18, wherein the second receiver capacitance is selected such that the resonant frequency of the secondary tank circuit differs from the first frequency, whereby the secondary tank circuit operates in semi-resonance and maintains some reactive impedance.

20. An inductive power transfer system as claimed in claim 19, wherein the ratio of the first frequency to the resonant frequency of the secondary tank circuit is in the range 0.2 to 3.

21. An inductive power transfer system as claimed in any of claims 17 to 20, wherein the only inductor in the receiver circuit is the receiver coil.

22. An inductive power transfer system as claimed in any of claims 18 to 21, wherein the receiver circuit comprises at least a second diode in parallel with the first diode.

23. An inductive power transfer system as claimed in any of claims 17 to 22 wherein the only capacitance in parallel with the diode(s) is provided by the junction capacitance of the diode(s).

24. An inductive power transfer system as claimed in any of claims 17 to 23 wherein the diode(s) are silicon carbide diodes, gallium nitride diodes or are formed of other wide band gap material.

25. A transmitter circuit for use in an inductive power transfer system, the transmitter circuit comprising a transmitter coil and being in the form of a Class E amplifier comprising:

a first inductor and a transistor in series between the terminals of a power supply, the transistor being arranged to switch at a first frequency;

a first transmitter capacitance in parallel with the transistor between the first inductor and a power supply terminal;

a primary tank circuit in parallel with the first transmitter capacitance, the primary tank circuit comprising the transmitter coil and a second transmitter capacitance arranged in parallel or series with the transmitter coil;

a third transmitter capacitance in series with the first inductor between the first transmitter capacitance and the primary tank circuit,

wherein the second transmitter capacitance is selected such that the resonant frequency of the primary tank circuit is not equal to the first frequency.

26. A transmitter circuit as claimed in claim 25, wherein the second transmitter capacitance is arranged in parallel with the transmitter coil, and wherein the second transmitter capacitance is selected such that the resonant frequency of the primary tank circuit is greater than the first frequency.

27. A transmitter circuit as claimed in claim 25, wherein the second transmitter capacitance is arranged in series with the transmitter coil, and wherein the second transmitter capacitance is selected such that the resonant frequency of the primary tank circuit is less than the first frequency.

28. A transmitter circuit as claimed in claim 26, wherein the ratio of the first frequency to the resonant frequency of the primary tank circuit is greater than or equal to 0.5 and less than 1.

29. A transmitter circuit as claimed in claim 27, wherein the ratio of the first frequency to the resonant frequency of the primary tank circuit is greater than 1 and less than or equal to 1.5.

30. A transmitter circuit as claimed in any of claims 25 – 29, wherein the transmitter circuit is for use with a receiver circuit having a resonant frequency and the transmitter circuit is configured to vary the first frequency, in order to achieve a desired effective impedance of the primary tank circuit.

31. A transmitter circuit as claimed in any of claims 25 – 30, wherein the transmitter coil has an air core.

32. A transmitter circuit as claimed in any of claims 25 – 31, wherein the transmitter coil has a diameter of at least 5cm.

33. A transmitter circuit as claimed in any of claims 25 – 32, wherein the transmitter coil has a diameter of at least 10cm.

34. A transmitter circuit as claimed in any of claims 25 – 33, wherein the transistor is a MOSFET.

35. A transmitter circuit as claimed in any of claims 25 – 34, wherein the first frequency is at least 80kHz.

36. A transmitter circuit as claimed in any of claims 25 – 35, wherein the first frequency is at least 1MHz.

37. A transmitter circuit as claimed in any of claims 25 – 36, wherein the first transmitter capacitance is formed of the output capacitance of the transistor.