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(54) CHARGING DEVICE AND METHOD USING DUAL-MODE MAGNETIC COUPLING FOR AN AUTOMOBILE VEHICLE

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(57) **ABSTRACT**

A device (**10**) for charging a mobile terminal by magnetic coupling, includes a first charging module (**11**) designed to form a charging signal at a first charging frequency, a primary coil (**13**) composed of a set of turns, a ferromagnetic body (**14**), a second charging module (**12**) designed to form a charging signal at a second charging frequency, higher than the first charging frequency. Furthermore, the charging device includes first routing elements (**150**) designed to connect/disconnect the primary coil (**13**) to/from the first charging module (**11**) and to/from the second charging module (**12**), elements (**16**) for adjusting the number of turns on the primary coil (**13**) and elements (**19**) for saturating the ferromagnetic body (**14**) at the second charging frequency. A charging method is also described.

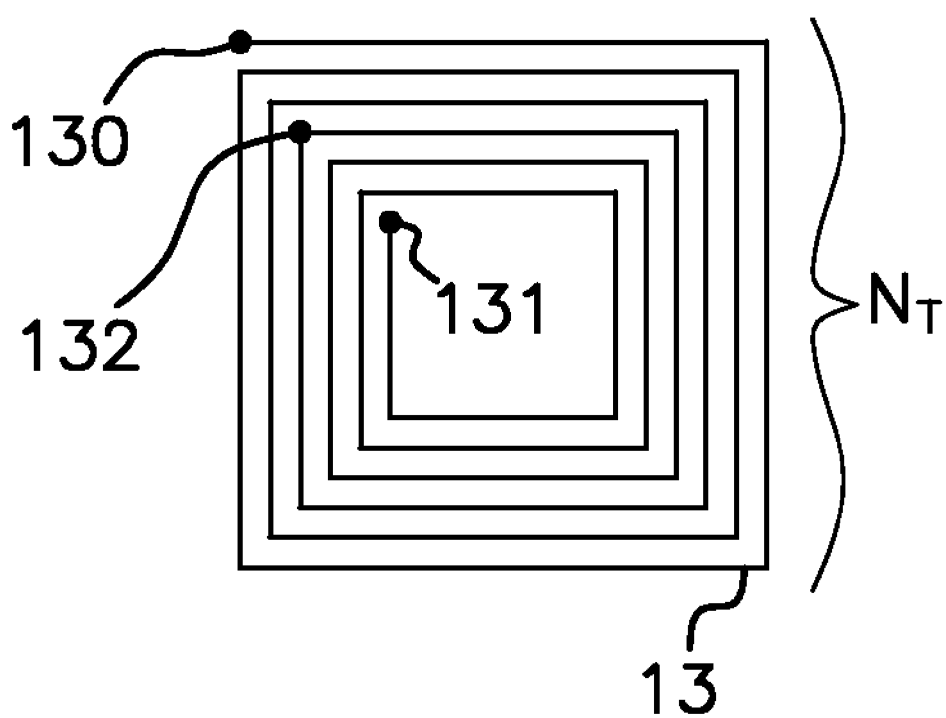


Fig 1

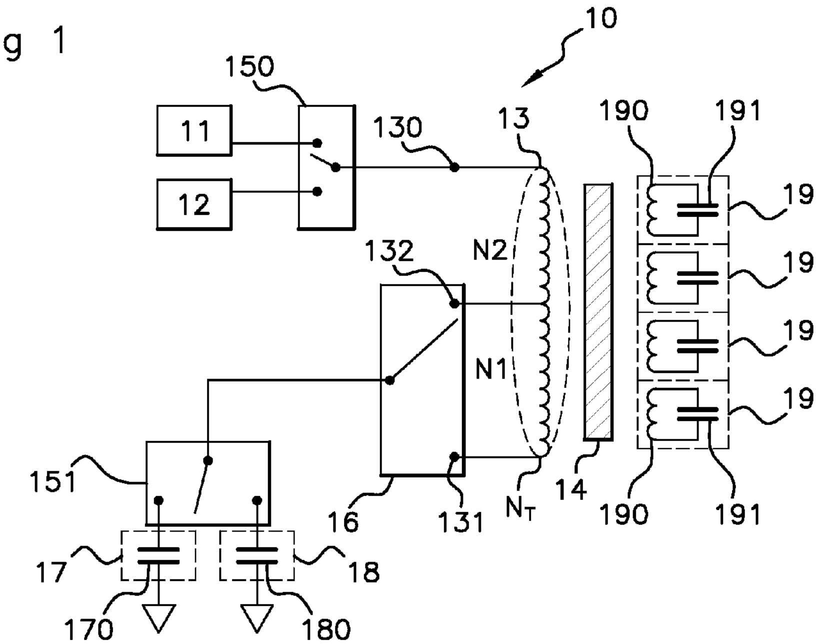


Fig 2

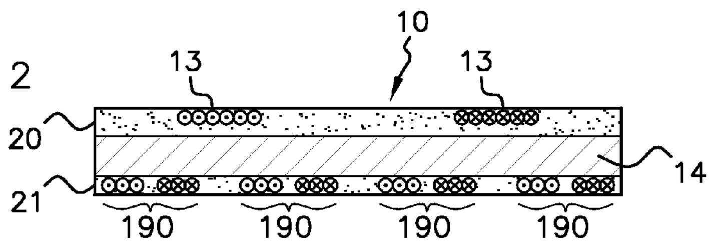


Fig 3

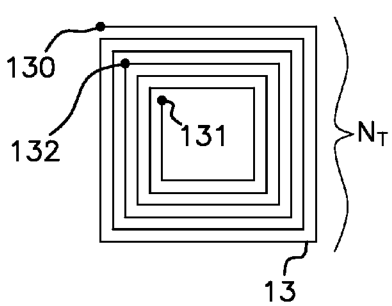
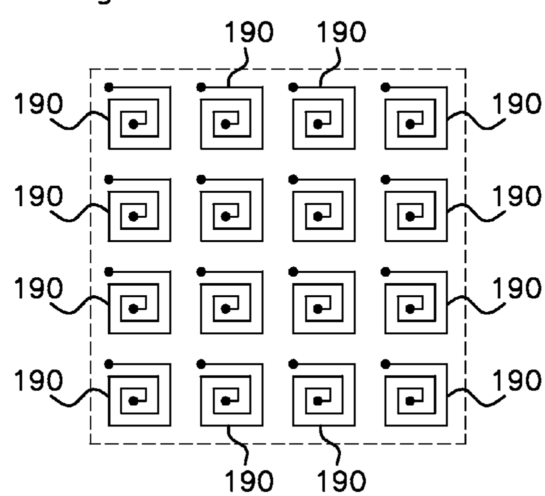


Fig 4



CHARGING DEVICE AND METHOD USING DUAL-MODE MAGNETIC COUPLING FOR AN AUTOMOBILE VEHICLE

[0001] The present invention relates to a device and a method for charging a mobile terminal by magnetic coupling. The present invention has one particularly advantageous application, although this is in no way limiting, in the charging devices installed onboard automobile vehicles.

[0002] Charging devices using magnetic coupling, enabling mobile terminals (mobile telephones, laptops, touchscreen tablets, digital cameras, etc.) to be charged wirelessly, are becoming increasingly widespread.

[0003] Conventionally, a charging device using magnetic coupling comprises a conducting coil, known as the "primary coil", which is connected to a charging module. When charging a mobile terminal, the charging module forms a charging signal which makes an electrical current flow in the primary coil whose intensity varies with time. The primary coil thus powered generates a variable magnetic field.

[0004] The mobile terminal comprises a receiver module comprising a conducting coil, known as "secondary coil". When said secondary coil is placed in the variable magnetic field formed by the primary coil, an electrical current is induced in said secondary coil. This electrical current allows an electrical accumulator connected to the secondary coil to be charged thus supplying current to the mobile terminal.

[0005] Several types of charging devices using magnetic coupling are known operating according to the general principle described hereinbefore, notably those defined by:

- **[0006]** the WPC (Wireless Power Consortium) consortium, which defines charging devices referred to as "magnetic induction" devices, which use a charging frequency in principle in the range between 100 and 200 kiloHertz (kHz),
- **[0007]** the A4WP (acronym for "Alliance for Wireless Power") consortium, which defines charging devices referred to as "magnetic resonance" devices, which use a charging frequency in principle in the range between 6 and 7 MegaHertz (MHz).

[0008] In order to provide interoperability with all mobile terminals, there presently exists a need for charging devices using dual-mode magnetic coupling, in other words compatible with both the requirements defined by the WPC consortium and with the requirements defined by the A4WP consortium.

[0009] However, the requirements compatible with needs of the WPC and A4WP consortia (for the sake of simplicity, in the following part, they will be referred to as WPC primary coil and A4WP primary coil) have very different characteristics. Notably, the WPC primary coils are generally associated with a ferromagnetic body which can interfere with the operation of the A4WP primary coils, such that the WPC and A4WP primary coils cannot easily be co-localized. The WPC and A4WP charging surfaces must then be separated, and there consequently exists a constraint on the positioning of the mobile terminal depending on whether it is equipped with a WPC or A4WP receiver module.

[0010] The aim of the present invention is to overcome all or part of the limitations of the solutions of the prior art, notably those presented hereinbefore, by providing a solution which allows dual-mode charging devices using magnetic coupling to be obtained having a single charging surface for the WPC and A4WP charging modules.

[0011] For this purpose, and according to a first aspect, the invention relates to a device for charging a mobile terminal by magnetic coupling, comprising a first charging module designed to form a charging signal at a first charging frequency, a primary coil composed of a set of turns, a ferromagnetic body associated with said primary coil, a second charging module designed to former a charging signal at a second charging frequency, higher than the first charging frequency. Furthermore, the charging device comprises:

- **[0012]** first routing means designed to connect/disconnect the primary coil to/from the first charging module and to/from the second charging module,
- **[0013]** means for adjusting the number of turns on the primary coil designed to activate/disable a sub-set of de-activatable turns on the primary coil,
- **[0014]** means for saturating the ferromagnetic body designed to reduce, within said ferromagnetic body, the magnetic field formed by the primary coil when said primary coil is connected to the second charging module.

[0015] Thanks to first routing means, the primary coil is shared between the first charging module and the second charging module, in such a manner that it is possible to charge the mobile terminal on the same charging surface.

[0016] The ferromagnetic body allows the efficiency of the charging by the first charging module, whose charging frequency is the lower, to be improved. However, the presence of the ferromagnetic body can decrease the efficiency of the charging by the second charging module, whose charging frequency is the higher. Thanks to the saturation means, the interference induced by the ferromagnetic body is reduced and the charging by the second charging module can be implemented even in the presence of the ferromagnetic body.

[0017] Furthermore, the means for adjusting the number of turns allow the number of turns to be adapted according to the charging module used, and hence according to the charging frequency used.

[0018] In particular embodiments, the charging device may furthermore comprise one or more of the following features, taken alone or according to all the technically possible combinations.

[0019] In one particular embodiment, the saturation means comprise passive resonator circuits arranged, with respect to the ferromagnetic body, on the opposite side from the primary coil.

[0020] In one particular embodiment, each passive resonator circuit is formed by a saturation coil and a capacitor.

[0021] In one particular embodiment, the passive resonator circuits are arranged so as to cover an entire surface of the ferromagnetic body.

[0022] In one particular embodiment, the charging device comprises a first circuit for matching the resonance frequency of the primary coil to the first charging frequency, and a second circuit for matching the resonance frequency of the primary coil to the second charging frequency, and second routing means, the second routing means being furthermore designed to connect/disconnect the primary coil to/from the first matching circuit and to/from the second matching circuit.

[0023] According to a second aspect, the invention relates to an automobile vehicle comprising a charging device according to the invention.

[0024] According to a third aspect, the invention relates to a method for charging a mobile terminal by magnetic coupling by means of a charging device according to the invention, in which:

[0025] when the mobile terminal is to be charged at a first charging frequency, the primary coil is connected to the first charging module and the de-activatable sub-set of turns on said primary coil is activated,

[0026] when the mobile terminal is to be charged at a second charging frequency, the primary coil is connected to the second charging module and the de-activatable sub-set of turns on said primary coil is disabled.

[0027] In particular embodiments, the charging process may furthermore comprise one or more of the following features, taken alone or according to all the technically possible combinations.

[0028] In one particular embodiment:

[0029] when the mobile terminal is to be charged at a first charging frequency, the primary coil is connected to a first circuit for matching the resonance frequency of said primary coil to the first charging frequency,

[0030] when the mobile terminal is to be charged at a second charging frequency, the primary coil is connected to a second circuit for matching the resonance frequency of the primary coil to the second charging frequency.

[0031] In one particular embodiment, the search for the presence of a mobile terminal to be charged is carried out by means of the primary coil connected to the second charging module.

[0032] The invention will be better understood upon reading the following description, given by way of non-limiting example, and presented with reference to the figures which show:

[0033] FIG. **1**: a schematic diagram of one exemplary embodiment of a charging device,

[0034] FIGS. **2**, **3** and **4**: different partial views of one preferred embodiment of the charging device in FIG. **1**.

[0035] In these figures, identical references from one figure to another denote identical or analogous elements. For reasons of clarity, the elements shown are not to scale, except where specifically stated.

[0036] FIG. **1** shows schematically one exemplary embodiment of a device **10** for charging a mobile terminal by magnetic coupling.

[0037] The charging device **10** is for example installed onboard an automobile vehicle (not shown). The mobile terminal (not shown) is for example a mobile telephone, a laptop, a touchscreen tablet, a digital camera, etc.

[0038] The charging device **10** comprises a first charging module **11** designed to form a charging signal at a first charging frequency F1. In the following part of the description, the non-limiting case is considered where the first charging module **11** is a WPC charging module **11**, the first charging frequency F1 being in the range between 100 and 200 kHz.

[0039] The charging device **10** also comprises at least one primary coil **13**, associated with the WPC charging module **11**, composed of a set of N_T turns. In order to optimize the charging at the first charging frequency F1, the charging device **10** also comprises a ferromagnetic body, for example a ferrite **14**, whose magnetic properties are optimized for an operation at the first charging frequency F1. In other words, at the first charging frequency F1, the ferrite **14** behaves as a mirror with respect to the magnetic field formed by the primary coil **13** connected to the WPC charging module **11**.

[0040] The device **10** for charging by magnetic coupling is a dual-mode device, in other words designed to charge a mobile terminal at two different charging frequencies. For this purpose, the charging device **10** comprises a second charging module **12** designed to form a charging signal at a second charging frequency F2, higher than the first charging frequency F1. In the following part of the description, the non-limiting case is considered where the second charging module **12** is an A4WP charging module **12**, the second charging frequency F2 being in the range between 6 and 7 MHz.

[0041] Furthermore, and according to the invention, the primary coil **13** is also used in the case of charging at the second charging frequency F2.

[0042] For this purpose, the charging device **10** comprises first routing means **150** designed to connect/disconnect the primary coil **13** to/from the WPC charging module **11**, and connect/disconnect the primary coil **13** to/from the A4WP charging module **12**.

[0043] In the non-limiting example illustrated in FIG. **1**, the first routing means notably comprise, for this purpose, a selector circuit **150** designed to connect the primary coil **13** to either the WPC charging module **11** or to the A4WP charging module **12**. Said selector circuit **150** is such that, when the primary coil **13** is connected to the WPC charging module **11** (respectively to the A4WP charging module **12**), said primary coil is simultaneously disconnected from the A4WP charging module **12** (respectively from the WPC charging module **11**).

[0044] The charging device **10** illustrated in FIG. **1** also comprises means **16** for adjusting the number of turns on the primary coil **13**, depending on whether said primary coil **13** is connected to the WPC charging module **11** or to the A4WP charging module **12**.

[0045] Indeed, the number of turns required for the primary coil **13**, recommended by the WPC consortium, is different from that recommended by the A4WP consortium, taking into account the respective values of the first and second charging frequencies F1 and F2. More particularly, the number of turns defined by the WPC consortium is greater than that defined by the A4WP consortium.

[0046] As a consequence, the number N_T of turns on the primary coil **13** is chosen to be adapted for an operation in association with the WPC charging module **11**. The N_T turns on the primary coil **13** is divided into two complementary sub-sets of turns:

[0047] a first sub-set comprising N1 turns (the N1 turns being de-activatable),

[0048] a second sub-set comprising N2 turns.

[0049] The number N2 of turns on the second sub-set is chosen to be adapted for an operation in association with the A4WP charging module **12**, and the means **16** for adjusting the number of turns are designed to activate/disable the N1 turns on the first sub-set of the primary coil **13**. In other words, the means **16** for adjusting the number of turns allow the operation to switch from N2 turns for the A4WP charging module **12** to N_T turns for an operation with the WPC charging module **11**, and vice versa.

[0050] In the non-limiting example illustrated in FIG. **1**, the means for adjusting the number of turns notably comprise, for this purpose, a selector circuit **16** designed to connect any components downstream of the primary coil **13** to two different outputs of the primary coil **13**:

[0051] a first output **131** arranged, with respect to an input **130** of the primary coil **13**, in such a manner that all of the N_T turns on the primary coil **13** are activated,

[0052] a second output **132** arranged, with respect to the input **130**, in such a manner that only the N2 turns of the second sub-set of the primary coil **13** are activated, the N1 turns of the first sub-set then being disabled.

[0053] FIG. **1** shows one particular embodiment, in which the charging device **10** furthermore comprises:

[0054] a first circuit **17** for matching the resonance frequency of the primary coil **13**, all the N_T turns being activated, to the first charging frequency F1,

[0055] a second circuit **18** for matching the resonance frequency of the primary coil **13**, the N1 turns of the first sub-set being disabled, to the second charging frequency F2.

[0056] The phrase "matching the resonance frequency to the first charging frequency F1" (respectively the second charging frequency F2) is understood to mean that the resonance frequency of the assembly formed by the first matching circuit **17** (respectively the second matching circuit **18**) and the primary coil **13** is equal or close to said first charging frequency F1 (respectively said second charging frequency F2). The phrase "close to the charging frequency" (first charging frequency F1 or second charging frequency F2) is for example understood to mean that said resonance frequency is separated from the charging frequency by less than 10% of said charging frequency.

[0057] In the non-limiting example illustrated in FIG. **1**, the first matching circuit **17** and the second matching circuit **18** each comprise a capacitor, respectively **170** and **180**, with a value designed to match the resonance frequency of the primary coil **13** respectively to the first charging frequency F1 and to the second charging frequency F2. There is no reason why, according to other examples not detailed here, other components could not be included.

[0058] Furthermore, second routing means **151** are designed to connect/disconnect the primary coil **13** to/from the first matching circuit **17**, and to connect/disconnect said primary coil **13** to/from the second matching circuit **18**.

[0059] In the non-limiting example illustrated in FIG. **1**, said second routing means **151** comprise, for this purpose, a selector circuit **151** for the resonance frequency matching circuit, designed to connect the output of the primary coil **13** (which is, by virtue of the means **16** for adjusting the number of turns, either the first output **131** or the second output **132**) to either the first matching circuit **17** or to the second matching circuit **18**.

[0060] The charging device **10** also comprises means **19** for saturating the ferrite **14** designed to reduce, within said ferrite **14**, the magnetic field formed by the primary coil **13** when said primary coil is connected to the A4WP charging module **12**.

[0061] Indeed, the ferrite **14** is needed in the case of charging by magnetic induction (WPC) in order to improve the efficiency of the charging process, and notably the range of the charging device. The ferrite **14** is no longer required in the case of charging by magnetic resonance (A4WP) and, on the contrary, its presence could generating interference effects. By saturating the ferrite **14**, its magnetic properties tend to be suppressed, as are the potential interference effects generated during charging of the mobile terminal by means of the A4WP charging module **12**.

[0062] FIG. **1** shows one preferred embodiment of the charging device **10**, in which the saturation means **19** comprise passive resonator circuits **19** with a resonance frequency close to the second charging frequency F2. The passive resonator circuits **19** are furthermore arranged, with respect to the ferrite **14**, on the opposite side from the primary coil **13**, preferably in contact with said ferrite **14**. When the passive resonator circuits **19** and the primary coil **13** are close and, as a consequence, exhibit a strong coupling between them, the latter are advantageously configured such that the assembly formed by said passive resonator circuits **19** and said primary coil **13** has a resonance frequency equal to the second charging frequency F2.

[0063] In the example illustrated in FIG. **1**, each passive resonator circuit **19** is formed by a saturation coil **190** and a capacitor **191**.

[0064] When the primary coil **13** is connected to the A4WP charging module **12** (the N1 turns of the first sub-set being disabled), a variable magnetic field is created on either side of said primary coil **13**. The ferrite **14**, optimized for an operation at the first charging frequency F1, allows a part of the magnetic field through which generates induced currents in the saturation coils **190**. The flow of these induced currents in the saturation coils **190** also creates a magnetic field that tends to oppose the magnetic field formed by the primary coil **13**, and hence tends to saturate the ferrite **14**. By adapting the characteristics of the saturation coils **190** and of the capacitors **191**, it is furthermore possible to render the magnetic field formed by said saturation coils **190** negligible beyond the ferrite **14**, in order for it not to interfere with the charging of the mobile terminal.

[0065] FIGS. **2**, **3** and **4** show partial views of one preferred embodiment of the charging device **10** in FIG. **1**, in which the primary coil **13** and the saturation coils **190** are fabricated in the form of respective printed circuit tracks **20** and **21**.

[0066] FIG. **2** shows a cross-sectional view of said integrated circuits **20** and **21**, between which the ferrite **14** is arranged.

[0067] FIG. **3** shows a top view of the integrated circuits **20**, **21**, from the side of the primary coil **13**. Such as illustrated in FIG. **3**, the input **130** of the primary coil **13**, designed to be connected to the WPC charging module **11** or to the A4WP charging module **12**, and the second output **132** are arranged in such a manner that the N2 turns of the second sub-set of the primary coil **13** correspond to the largest turns. Such dispositions allow the performance of the charging by means of the A4WP charging module **12** to be improved.

[0068] FIG. **4** shows a top view of the integrated circuits **20**, **21**, on the side of the saturation coils **190**. In FIG. **4**, the outline of the ferrite **14** is also shown as dashed lines. As illustrated in FIG. **4**, said saturation coils **190** are advantageously arranged so as to cover the whole surface of the ferrite **14**, in order to improve the saturation of said ferrite **14** at the second charging frequency F2.

[0069] The present invention also relates to a method for charging a mobile terminal by magnetic coupling by means of a charging device **10** such as illustrated in FIG. **1**. The various steps of the charging method are for example executed by means of a control module (not shown), which notably controls the first and second routing means **151** and the means **16** for adjusting the number of turns on the primary coil **13**.

[0070] Generally speaking, when the mobile terminal is to be charged at the first charging frequency F1, the control module commands the first routing means **150** so as to connect the primary coil **13** to the WPC charging module **11**, and the means **16** for adjusting the number of turns so as to activate the N1 turns of the first sub-set of the primary coil **13**. When the mobile terminal is to be charged at the second charging frequency F2, the control module commands the first routing means **150** so as to connect the primary coil **13** to the A4WP charging module **12**, and the means **16** for adjusting the number of turns so as to disable the Ni turns of the first sub-set of the primary coil **13**.

[0071] In the case of the charging device **10** in FIG. **1**, which comprises a first matching circuit **17** and a second matching circuit **18**:

[0072] when the mobile terminal is to be charged at the first charging frequency F1, the control module commands the second routing means **151** so as to connect the primary coil **13** to the first matching circuit **17**,

[0073] when the mobile terminal is to be charged at the second charging frequency F2, the control module commands the second routing means **151** so as to connect the primary coil **13** to the second matching circuit **18**.

[0074] In one preferred embodiment, the charging method uses by default the A4WP charging module **12** in order to search for the presence of a mobile terminal near to a charging surface of the charging device **10**.

[0075] Such dispositions are advantageous owing to the fact that the devices for charging by magnetic resonance have a longer range than the charging devices using magnetic induction. The presence of a mobile terminal near to the charging surface of the charging device **10** will interfere with the magnetic field generated by the primary coil **13** whatever the type of receiver module installed onboard said mobile terminal (WPC or A4WP). This interference will be able to be detected and considered as induced by the presence of a mobile terminal near to the charging surface. The charging device **10** will then be able to determine whether the mobile terminal detected is equipped with a WPC or A4WP receiver module, by successively activating the WPC charging module **11** and the A4WP charging module **12**.

[0076] Generally speaking, it should be noted that the embodiments considered hereinabove have been described by way of non-limiting examples, and that consequently others variants may be envisioned.

[0077] Notably, the invention has been described by considering saturation means formed by passive resonator circuits. There is no reason why, according to other examples, other types of means may not be used for saturating the ferromagnetic body **14**, including active saturation means.

1. A device (**10**) for charging a mobile terminal by magnetic coupling, comprising a first charging module (**11**) designed to form a charging signal at a first charging frequency (F1), a primary coil (**13**) composed of a set of turns, a ferromagnetic body (**14**), a second charging module (**12**) designed to form a charging signal at a second charging frequency (F2), higher than the first charging frequency (F1), characterized in that it comprises:

first routing means (**150**) designed to connect/disconnect the primary coil (**13**) to/from the first charging module (**11**) and to/from the second charging module (**12**),

means (**16**) for adjusting the number of turns (N_T, N2) of the primary coil (**13**) designed to activate/disable a de-activatable sub-set of turns (N1) of the primary coil (**13**),

means (**19**) for saturating the ferromagnetic body (**14**) designed to reduce, within said ferromagnetic body (**14**), the magnetic field formed by the primary coil (**13**) when said primary coil (**13**) is connected to the second charging module (**12**).

2. The device (**10**) as claimed in claim **1**, characterized in that the saturation means (**19**) comprise passive resonator circuits (**19**) arranged, with respect to the ferromagnetic body (**14**), on the opposite side from the primary coil (**13**).

3. The device (**10**) as claimed in claim **2**, characterized in that each passive resonator circuit (**19**) is formed by a saturation coil (**190**) and a capacitor (**191**).

4. The device (**10**) as claimed in claim **2**, characterized in that the passive resonator circuits (**19**) are arranged so as to cover an entire surface of the ferromagnetic body (**14**).

5. The device (**10**) as claimed in claim **1**, characterized in that it comprises a first circuit (**17**) for matching the resonance frequency of the primary coil (**13**) to the first charging frequency (F1), and a second circuit (**18**) for matching the resonance frequency of the primary coil (**13**) to the second charging frequency (F2), and second routing means (**151**), the second routing means (**151**) being furthermore designed to connect/disconnect the primary coil (**13**) to/from the first matching circuit (**17**) and to/from the second matching circuit (**18**).

6. The device (**10**) as claimed in claim **1**, characterized in that the first charging module (**11**) is a charging module compatible with the WPC consortium and the second charging module (**12**) is a module compatible with the A4WP consortium.

7. An automobile vehicle comprising a charging device (**10**) as claimed in claim **1**.

8. A method for charging a mobile terminal by magnetic coupling by means of a charging device (**10**) as claimed in claim **1**, characterized in that:

when the mobile terminal is to be charged at a first charging frequency (F1), the primary coil (**13**) is connected to the first charging module (**11**) and the sub-set of de-activatable turns (N1) of said primary coil (**13**) is activated,

when the mobile terminal is to be charged at a second charging frequency (F2), the primary coil (**13**) is connected to the second charging module (**12**) and the sub-set of de-activatable turns (N1) of said primary coil is disabled.

9. The method as claimed in claim **8**, characterized in that:

when the mobile terminal is to be charged at a first charging frequency (F1), the primary coil (**13**) is connected to a first circuit (**17**) for matching the resonance frequency of said primary coil (**13**) to the first charging frequency (F1),

when the mobile terminal is to be charged at a second charging frequency (F2), the primary coil (**13**) is connected to a second circuit (**18**) for matching the resonance frequency of the primary coil (**13**) to the second charging frequency (F2).

10. The method as claimed in claim **8**, characterized in that the search for the presence of a mobile terminal to be charged is carried out by means of the primary coil (**13**) connected to the second charging module (**12**).

11. The method as claimed in claim **9**, characterized in that the search for the presence of a mobile terminal to be charged is carried out by means of the primary coil (**13**) connected to the second charging module (**12**).

12. The device (**10**) as claimed in claim **3**, characterized in that the passive resonator circuits (**19**) are arranged so as to cover an entire surface of the ferromagnetic body (**14**).

13. The device (**10**) as claimed in claim **2**, characterized in that it comprises a first circuit (**17**) for matching the resonance frequency of the primary coil (**13**) to the first charging frequency (F1), and a second circuit (**18**) for matching the resonance frequency of the primary coil (**13**) to the second charging frequency (F2), and second routing means (**151**), the second routing means (**151**) being furthermore designed to connect/disconnect the primary coil (**13**) to/from the first matching circuit (**17**) and to/from the second matching circuit (**18**).

14. The device (**10**) as claimed in claim **3**, characterized in that it comprises a first circuit (**17**) for matching the resonance frequency of the primary coil (**13**) to the first charging frequency (F1), and a second circuit (**18**) for matching the resonance frequency of the primary coil (**13**) to the second charging frequency (F2), and second routing means (**151**), the second routing means (**151**) being furthermore designed to connect/disconnect the primary coil (**13**) to/from the first matching circuit (**17**) and to/from the second matching circuit (**18**).

15. The device (**10**) as claimed in claim **4**, characterized in that it comprises a first circuit (**17**) for matching the resonance frequency of the primary coil (**13**) to the first charging frequency (F1), and a second circuit (**18**) for matching the resonance frequency of the primary coil (**13**) to the second charging frequency (F2), and second routing means (**151**), the second routing means (**151**) being furthermore designed to connect/disconnect the primary coil (**13**) to/from the first matching circuit (**17**) and to/from the second matching circuit (**18**).

16. The device (**10**) as claimed in claim **2**, characterized in that the first charging module (**11**) is a charging module compatible with the WPC consortium and the second charging module (**12**) is a module compatible with the A4WP consortium.

17. The device (**10**) as claimed in claim **3**, characterized in that the first charging module (**11**) is a charging module compatible with the WPC consortium and the second charging module (**12**) is a module compatible with the A4WP consortium.

18. The device (**10**) as claimed in claim **4**, characterized in that the first charging module (**11**) is a charging module compatible with the WPC consortium and the second charging module (**12**) is a module compatible with the A4WP consortium.

19. The device (**10**) as claimed in claim **5**, characterized in that the first charging module (**11**) is a charging module compatible with the WPC consortium and the second charging module (**12**) is a module compatible with the A4WP consortium.

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