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(54) **SYSTEM AND PORTABLE DEVICE FOR TRANSMITTING IDENTIFICATION SIGNALS**

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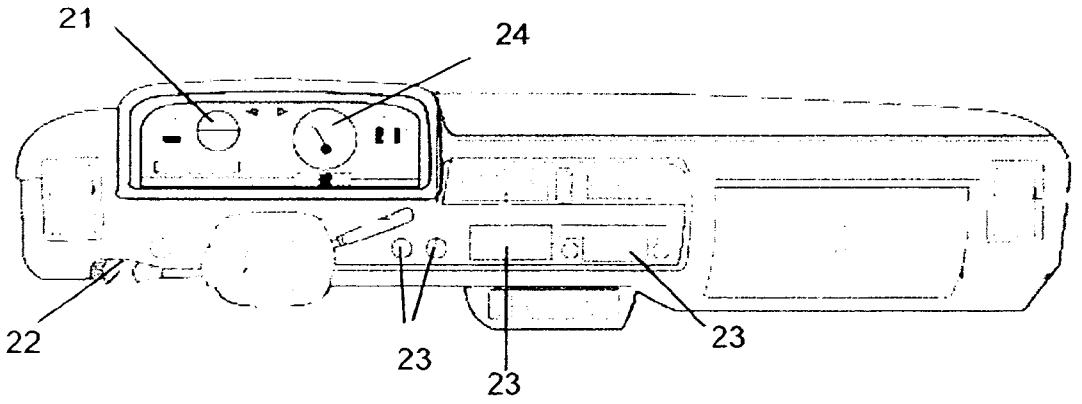
(57) **ABSTRACT**

The invention relates to a system with a portable device for the transmission of a signal to a second device, wherein the portable device is wearable on the body of a user. The portable device includes at least two electrodes and transmitter electronics for the generation of an electrical signal between the electrodes, such that the signal is able to be coupled by the electrodes into the body of the user and detected by at least one electrode of the second device. A portable device or also a second device (receiver) is distinguished in that at least one of the electrodes is at least partially transparent.



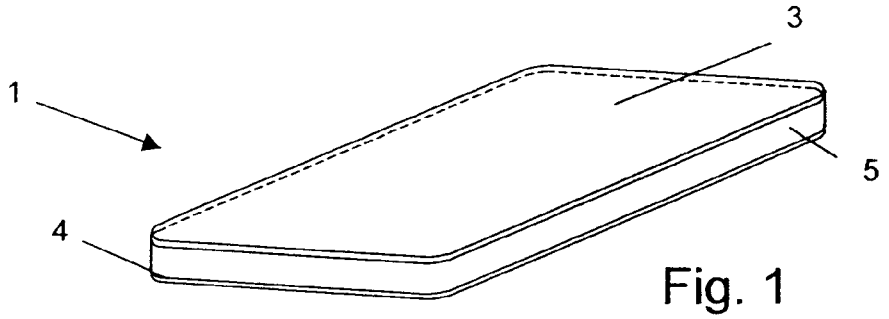


Fig. 1

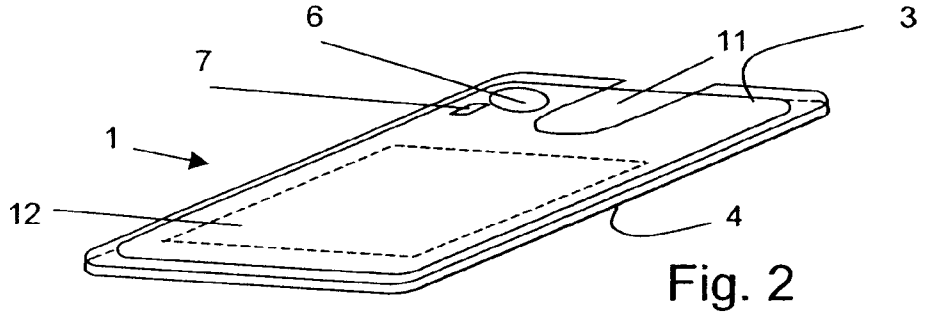


Fig. 2

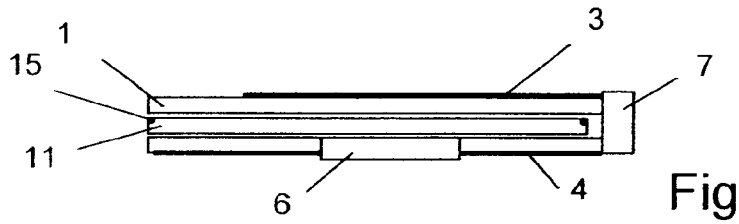


Fig. 3

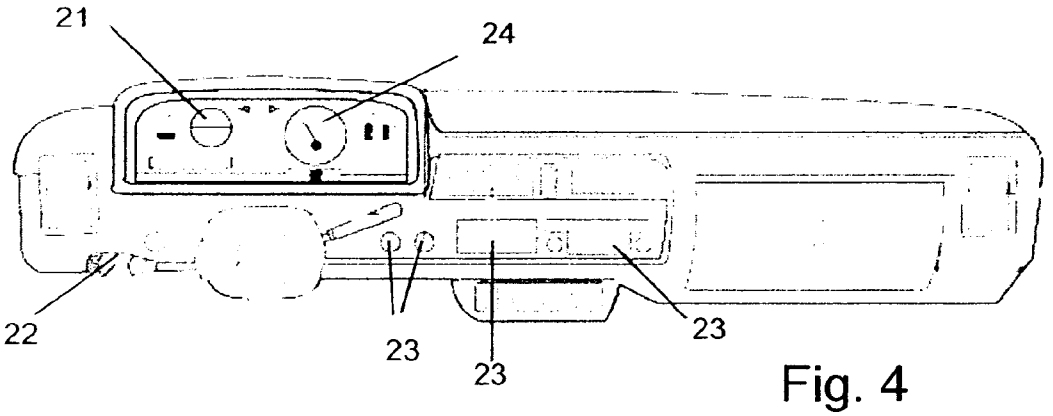


Fig. 4

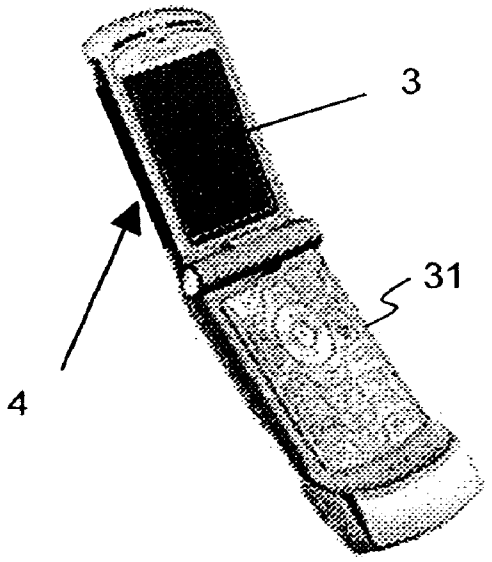


Fig. 5

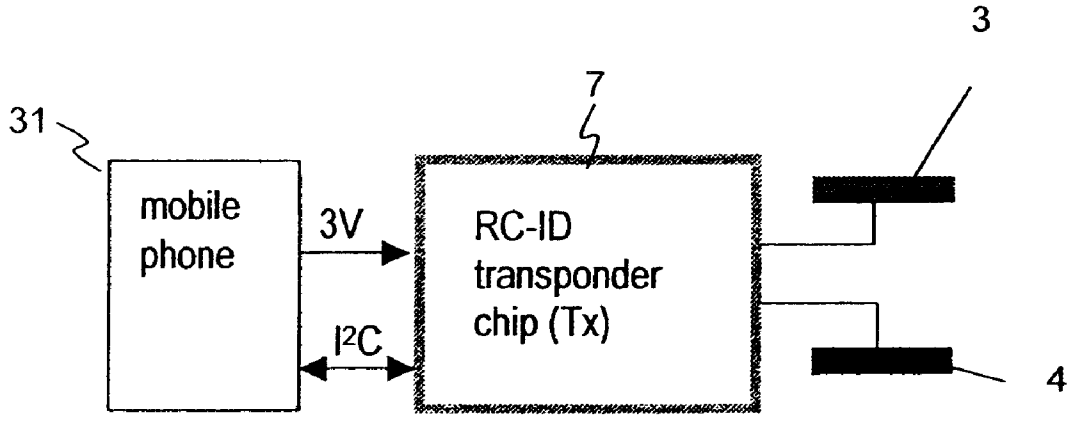


Fig. 6

SYSTEM AND PORTABLE DEVICE FOR TRANSMITTING IDENTIFICATION SIGNALS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention relates to the communication between a sender (transmitter) and a receiver over a capacitive coupling (sometimes also referred to as capacitive resistive coupling, "intrabody" coupling, RCID-coupling or PAN-coupling) in which small electrical currents which are used for the transmission of information between the transmitter and the receiver are generated in the human body, and/or in which the transmitter and the receiver interact with one another over very short distances via electric fields.

[0003] 2. Description of Related Art

[0004] This method of coupling is disclosed in the U.S. Pat. Nos. 4,591,854, 5,914,701 and 5,796,827. Implementations thereof are described in the international patent application PCT/CH 2006/000518 as well as in further published specifications of various authors.

[0005] A particular advantage of the capacitive coupling through the human body or, as the case may be, over short distances is the selectivity of the data transmission. Depending on the configuration, one can determine with a high degree of certainty that the signal received by the receiver can only have been transmitted by the person who is situated in direct proximity to or in physical contact with a receiver electrode that is designated for it.

[0006] A disadvantage is, among other things, that as a result of the poor signal to noise ratio (literally: signal-to-interference ratio), only a small amount of data can be transmitted. A good signal to noise ratio is only possible with a large amplitude of the transmission signal. However, a large amplitude (i.e. high voltage) would rather not be tolerated by the user. In the international patent publication WO 2007/112609, approaches are described, with which these problems can be addressed. Despite these, the bandwidth of the signal transmission remains limited.

[0007] The layout of the electrodes in the transmitter is important for as effective a signal transmission as possible. According to the state of the art, these are designed as electrode pairs, wherein the two electrodes lie parallel and opposite one another in the manner of a plate capacitor. The electrodes should be as large as possible so as to maximize the coupling into the body and also to optimize the signal to noise ratio, in the situation in which no electrically conductive contact exists between the one electrode and the human body. However, these large electrodes have a problematic effect on the design and the dimensions of the transmitter. Furthermore, they cause the power consumption of the transmitter to be quite high, so that more frequent battery changing is necessary.

[0008] With this background in mind, it is an object of the present invention to provide solutions for the layout of transmitter electrodes which ameliorate the above-mentioned disadvantages at least partly and which mean a further step toward the commercial application of the technology and its acceptance by consumers. The solutions mentioned should in particular be usable for access control.

[0009] These objects will be achieved by the invention, as it is described in the claims.

BRIEF SUMMARY OF THE INVENTION

[0010] According to the invention, a portable device or also a receiver is characterized in that at least one of the electrodes is at least partially transparent.

[0011] A portable device according to the approach according to the invention is, for example, wearable on the body of a user; it can, for example, be designed as a card-like identification medium, as a "smart card cover", mobile telephone, watch, portable computer (for example of the "handheld computer" type). It includes at least two electrodes and means for the creation of an electrical signal between the electrodes, such that the signal is able to be coupled through the electrodes into the body of the user and is detectable from the body by at least one electrode of a second device. Such a device also makes possible a direct, short-range communication (not through the body), for example through holding of the portable device in direct proximity of a receiver electrode, i.e. applications of the invention are not limited to coupling through the human body but rather also extend to cases in which the user carries the portable device on his or her person, holds it in the vicinity of a receiver electrode or otherwise makes it possible that the communication between transmitter and receiver takes place directly and not exclusively over the body.

[0012] Transparent electrical conductors, for example of very thin layers of metal that are vacuum-metalized or applied via a sputter deposition technique on a transparent substrate, or certain doped semiconductors on an oxide base (TCOs as for example ITO-layers), are currently available. For a considerable time already, these have been well-known for certain applications, for example as components for flat-screen displays or thin-film solar cells. They have not yet been considered for information transmission, as they are known to have poor electrical conductivity and would result in unacceptably large losses when used with the high frequencies usually employed in information transmission.

[0013] However, it has now been recognized that the capacitive resistive information transmission is configurable such that the conductive capacity of transparent electrodes is adequate. In particular, the combination of comparatively low voltages (for example less than 5V or even less than 3V) and currents and low frequencies (for example less than a 2 MHz center frequency) allows the use of the electrodes with limited conductive capacity. Moreover, it has somewhat surprisingly been recognized that these conductive layers can be used as electrodes, without significantly impairing the read and write capabilities of a RFID transponder used in combination with the capacitive resistive information transmission, even if the respective RFID antenna is situated between the electrodes and, for example, is substantially surrounded by the electrodes.

[0014] Through the amazingly simple technique according to the invention, many new degrees of freedom arise with respect to the design of a receiver or a transmitter, for example of fully transparent buttons, or buttons with an underlying display mechanism.

[0015] Preferably—in particular for applications in which it is used for access control (for example the operation of door locks and/or the release of objects as for example instruments, possibly including data logging)—the transmitter (and/or possibly a receiver) is situated in a portable device. Until now, for portable devices, the design seemed to be less important, since a portable device of the type according to the invention is generally carried in a bag or otherwise covered while worn.

A further realization of the invention is that with the introduction of transparent electrodes, the design possibilities of portable devices multiply considerably:

[0016] Arrangement of the electrodes as layers on a card, comprising a label or labels—in the manner of an identification card or a "badge", possibly with a photo—as well as possibly comprising further functionalities. The electrodes can form the outermost layers—with the exception of, if necessary, thin protective layers—of the card.

[0017] Arrangement of the electrodes in a holder ("shell", "cover") for a smart card. Smart cards are often used as so-called "badges" for the control of access. In the process, they are introduced into transparent holders, which for example are attachable to a piece of clothing by means of a clip and are visible from the outside. According to the first aspect of the invention, it is now possible to form this holder out of rigid or flexible material as part of the transmitter. This arrangement has the additional advantage that the capacitance of the capacitor arrangement formed by the two electrodes is reduced, as will be described in greater detail below.

[0018] Combination with a different electronic device, for example a mobile telephone. Modern electronic devices often have large displays. According to the invention a first of the two sender (and/or receiver) electrodes can be arranged in or over the display. This also has the advantage of a reduced capacitance, if the second—transparent or not transparent—electrode is for example arranged in the area of a back side of the device. Furthermore, this results in multifaceted possible combinations of the functionality, as will be described below in more detail.

[0019] In all of these cases, elements of the transmitter electronics and/or elements of other applications can be arranged between the transparent electrodes. A special application envisions the arrangement of a RFID tag (RFID transponder with antenna) between the transparent electrodes. As already mentioned, the electrodes can even substantially cover the RFID antenna without substantially influencing the functionality of the RFID application.

[0020] Furthermore, the allowance for transparent electrodes has the particularly attractive advantage for the "access control" application that one does not notice the electrode, or even that it is an electrode and therefore a part of an electronic device. Rather, depending on the design, it seems to be simply a shell, a design element or another functional element.

[0021] According to a preferred form of the invention, the two electrodes of a portable device (transmitter) are arranged such that between the electrodes there are arranged either component parts of the transmitter electronics and/or of another application distinct from the transmitter electronics—therein can also be designated a battery—or an air gap is present, in which such a component part—for example with a "smart card" as carrier of the component part—can be inserted.

[0022] Component parts here are meant to be active or passive preferably electronic component parts, which are more than a mere separating layer between the electrodes, for example in particular active electronic component parts such as ASICs, processors, integrated circuits, memory modules, sender and/or receiver for contact-free information transmission, including active or passive RFID transponders, passive component parts such as antennas, resistors, capacitors, coils, etc. or also batteries, optical elements etc.

[0023] Of course the transmitter electronics and electronic component parts for the application which is distinct from the transmitter electronics may be integrated together with one another in at least one unified component—for example in an integrated circuit. The feature of the "component part of an application which is distinct from the transmitter electronics" is simply that between the electrodes are arranged electronic elements which can administrate functions that are entirely separate from the capacitive resistive information transmission and preferably from other contact-free information transmission methods, for example as they control or constitute the display of a mobile telephone or as they store information and/or have stored information which is not communicated with the intrabody information transmission, etc.

[0024] This approach makes use of the recent finding that for the transmission of data, the area of the electrodes is important, however not the capacitive coupling there-between. On the contrary, it has been found that for a given electrode size a large capacitance is unfavorable, because a large capacitance creates a negative effect on the life of a battery of the portable device, since larger currents flow in the generation of signals. Furthermore, as a result of the larger flowing current of larger capacitance, the requirements on the electrode conductivity are higher. It has further been found that a parallel arrangement of the electrodes is indeed a possibility, but is not necessary.

[0025] In the case of a plate capacitor, the capacitance is proportional to the area of the electrodes and to the dielectric constant of the material between the electrodes, but inversely proportional to the distance between the electrodes. As a result of the approach according the preferred embodiment, the two electrodes are in general farther apart from one another than according to the state of the art, without this precluding a compact design of the portable device. Through the larger electrode separation, the capacitance is limited. In combination with the transparent electrodes with their comparatively limited electric conductivity this results in a synergy effect, because such transparent electrodes are particularly good to use as a result of their smaller flowing current.

[0026] In embodiments in which between the electrodes there is an air gap in which the components of a distinct application—for example an identity card and/or smart card—are able to be inserted, the compatibility with existing systems as well as backwards compatibility are also a given.

[0027] According to a special embodiment of the invention, the portable device with the air gap can comprise a communications interface, over which data can be exchanged with the application that is inserted into the air gap. Such an interface can, for example, be formed like a conventional smart card reader.

[0028] According to a further special embodiment, a communication link can exist between the transmitter electronics and an input unit, wherein the signals transmitted by the transmitter electronics can be dependent on data that are input. For example, the transmitted signal can include a PIN, which the user previously has input in the input unit. In this embodiment, the portable device can, for example, be designed as a mobile telephone, wherein the input unit can correspond to the input unit of the mobile telephone (keypad, touch screen, voice recognition device etc.).

[0029] Particularly preferably, in this embodiment the display of the mobile telephone is furnished or covered with a transparent electrode.

[0030] If the portable device is a mobile telephone, the electrical supply for the transmitter electronics can be obtained by simple means: namely as the transmitter electronics are energized by the very powerful battery of the mobile telephone, for example over a 3V DC supply. The communication between the transmitter electronics and the remaining electronic component parts of the mobile telephone can be accomplished—in case these are not integrated with one another—over any known or yet to be developed interface, for example over a I^2C data bus.

[0031] The receiver includes at least one receiver electrode and evaluation electronics, through which a signal that is generated by the capacitive resistive signal transmission is detectable between the receiver electrode and a further electrode or between the receiver electrode and a ground closure, and can be evaluated.

[0032] Particularly preferable is the use of an information transmission method, which relies on the spread spectrum method, wherein the signal is transmitted as an ultra-broadband signal, preferably according to the teaching of WO 2007/112609. Ultra-broadband is defined as the use of a frequency range of a bandwidth of at least 20% of the center frequency or, as the case may be, carrier frequency. According to the teaching of this document, in particular a direct sequence spread spectrum is used. The data are preferably first modulated with a method of digital data modulation and subsequently spectrum-spread. In WO 2007/112609, methods are also described for the analysis of a capacitive resistive signal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] In the following, embodiments of the invention are illustrated by means of schematic figures. Shown are:

[0034] FIG. **1** a depiction of a transmitter according to the invention;

[0035] FIG. **2** a depiction of a transmitter according to the invention with a smart card of a further application inserted;

[0036] FIG. **3** a sectional view of a transmitter with smart card;

[0037] FIG. **4** a depiction of an automobile interior with transparent receiver electrodes;

[0038] FIG. **5** a mobile telephone in a form according to the invention; and

[0039] FIG. **6** a schematic of the mobile telephone from FIG. **5**.

DETAILED DESCRIPTION OF THE INVENTION

[0040] The portable device **1** according to FIG. **1** is in the depicted example designed to be substantially card-shaped and comprises a first electrode **3** and a second electrode **4**. Between the first and the second electrode are arranged further elements, for example a plastic carrier **5** with integrated and/or applied electronic component parts and a battery compartment (not depicted in the figure). The integrated and/or applied electronic component parts can, for example, include an ASIC for the control of the electrodes, EEPROM or EPROM memory, conductive pathways and/or further elements. Rather than plastic, the carrier can be of ceramic, of fabric or of a different material, the important factor is simply that the two electrodes are electrically isolated from one another.

[0041] According to the first aspect of the invention, now at least one of the electrodes is at least partly transparent, in the depicted example, the first electrode **3**. On an upper side of the plastic carrier **5**, letters, pictures, etc. can be applied by known means such that they are visible through the transparent electrode.

[0042] FIG. **2** depicts an illustrative example that according to a preferred embodiment comprises, between the electrodes, an air gap in which here are inserted elements of a further application. The transmitter **1** is designed as a so-called "smart card cover". Smart card covers are as such known to those skilled in the art. They are designed as, for example, rigid, transparent shells, which for example can be attached to a piece of clothing and in which a smart card (i.e. a card-shaped medium with memory and communication functionalities) is able to be inserted.

[0043] The transmitter comprises a compartment for a battery **6** as well as control electronics, here represented schematically by a chip **7**, for the at least partly transparent electrodes **3**, **4**. The smart card **11** is able to be inserted into an air gap. A possible inscription area **12** of the smart card remains visible behind the transparent first electrode **3**.

[0044] FIG. **3** depicts a variant of the embodiment from FIG. **2**, in which the smart card (or as the case may be other component part of the transmitter electronics of a distinct application) simultaneously serves as RFID identification medium. In addition to the elements already described, one sees schematically the RFID antenna **15**, which here is not completely covered by one of the electrodes—in the depicted example by the transparent electrode **3**. The RFID communication also functions, however, if otherwise than as depicted in the figure, both transparent electrodes completely cover the RFID antenna **15**, i.e. if the transparent electrode **3** covers the entire upper surface shown in the figure.

[0045] In FIG. **4** the dashboard of an automobile is depicted very schematically, in which and/or on which a plurality of receiver electrodes are arranged. The automobile is driven by a user, into whom a transmitter is able to couple a capacitive resistive data signal. The transmitter can, for example, be worn by the user and individually customized for him, or it can also be situated at a site necessarily contacted by the user—for example in the seat. The personalized variant is particularly preferable.

[0046] The dashboard comprises, in a known manner, display panels **21** and controls **22**. In addition, it features a plurality of receiver electrodes **23**, **24** which function as input surfaces. A contact upon a receiver electrode by the user—in which as mentioned a data signal is continually coupled—is registered by a controller of the receiver electrode. This controller has a communication link with the automobile electronics, through which a corresponding event can be triggered, for example the turning-on of a turn signal or a low-beam headlight etc. This event can be dependent on the user—for example a control surface can have a different function for a first user than for a second user, or it can be that other parameters, for example seat adjustments etc. are selected. The user selectivity results from the fact that the first and the second user can be assigned different transmitters and thus different capacitive resistive data signals. Obviously, it can also be imagined that a particular user is altogether not

authorized to operate the vehicle functions or only authorized for specific times/for a particular number of inputs.

[0047] A transference from automobiles to other objects—for example buildings etc.—is of course also possible.

[0048] According to the invention, now at least one of the receiver electrodes **23**, **24** are transparent, for example at least those receiver electrodes **24** that cover a display field. Through these surprisingly simple approaches, new possibilities for interaction arise, for example in that a set speed for a cruise control can be set directly on the speedometer. Transparent receiver electrodes—for example all receiver electrodes are transparent—can be rear-projected upon and/or labeled by a corresponding display field depending on the situation.

[0049] FIGS. **5** and **6** relate to a portable device according to the invention that is designed as a mobile telephone **31**. The first electrode **3** is integrated into the display and is at least in the area of the display transparent, while the second electrode **4**, as in the previous examples of transmitter electrodes, is not necessarily transparent. The second electrode is situated on a reverse side of the mobile telephone (or rather as in the depicted example on the clamshell lid or on a different part of the mobile telephone) and can as the case may be, also be formed by a conductive section of the housing. It is arranged at as large a fixed distance away from the first electrode as possible. In FIG. **6** it is very schematically depicted how the transmitter electronics **7** can have a connection to the remaining mobile telephone electronics: the mobile telephone supplies the transmitter electronics (3V), and a communication link exists over a I^2C interface.

[0050] The integration of the transmitter electronics **7** in a mobile telephone makes possible the integration of several functionalities with one another in one portable device. The following are for example possible:

[0051] Dynamic alteration of the capacitive resistive transmitted data signals. The active data signal can for example be used as a PIN code, which can be altered arbitrarily often.

[0052] Increased security can be made possible, for example through so-called "rolling codes" or other known means of secure data transmission.

[0053] An even further increased security can be achieved as the UHF transmission means of mobile telephones (Bluetooth, 3G et.) is included in the information transmission procedure, for example as a downlink. This makes possible for example the use of known "challenge-response" systems. A central unit can also be included into communication and, for example, issue certificates (Cerberus etc.).

[0054] The mobile telephone with the transmitter electronics can be used as a programming device. A continuous data stream can be sent to the receiver with the help of the transmitter electronics.

[0055] Future mobile telephones will perhaps be furnished with NFC, RFID or low-power-wireless (for example as distributed under the brand name Wibree™ (www.wibree.com)) or Ultra Low Power Bluetooth or other standards of identification. Through the use of the capacitive resistive information transmission such an identification technology can be integrated into a single device, and the user must not necessarily know which technology is in actuality used. Particularly interesting is the combination of the approach according to the invention with other things, because for example, the selective capacitive resistive information transmission follows a short-range (<10 m) contactless nonselective information transmission, and can work together with this.

[0056] Transmitter electronics for a mobile telephone can be designed according to standard dimensions and may be integrated in existing mobile telephone architecture without further ado.

1.-16. (canceled)

17. A system for the transmission of signals, the system comprising:

a first, portable device, which is wearable by a user, and

a second device,

wherein the first and the second device comprise means for the transmission of information signals at least from the first to the second device,

the means for the transmission of information comprising electrodes of the first device and at least one electrode of the second device and being equipped to couple information into the body of the user by the electrodes of the first device, and to detect the information signals by the electrode(s) of the second device,

wherein at least one of an electrode of the first device and of an electrode of the second device is at least partially transparent.

18. A portable device for the transmission of signals to a second device, wherein the portable device is wearable by a user, the portable device comprising:

at least two electrodes and

a signal generator for the generation of an electrical signal between the electrodes,

such that the signal is by means of the electrodes able to be coupled into the body of the user and able to be detected from the body by at least one electrode of the second device,

wherein at least one of the electrodes of the portable device is at least partly transparent.

19. The portable device according to claim **18**, wherein the portable device is designed substantially in a card shape and wherein the electrodes form layers of the substantially card-shaped device.

20. The portable device according to claim **19**, further comprising labeling.

21. The portable device according to claim **20**, wherein at least one of the electrodes is transparent and covers the labeling.

22. The portable device according to claim **18**, further comprising an antenna for communication by means of induction or over electromagnetic waves.

23. The portable device according to claim **18**, further comprising at least one of the group comprising:

component parts of the transmitter electronics arranged between the electrodes,

components of another application distinct from the transmitter electronics arranged between the electrodes, and

and an air gap between the electrodes.

24. The portable device according to claim **23**, further comprising an air gap between the electrodes, wherein the air gap has dimensions that are matched to those of an element distinct from the portable device, such distinct element being able to be inserted into the air gap with an accurate fit.

25. The portable device according to claim **23**, wherein the distance between the electrodes amounts to at least 1 mm.

26. The portable device according to claim **25**, wherein the distance between the electrodes amounts to at least 1.5 mm.

27. The portable device according to claim **26**, wherein the distance between the electrodes amounts to at least 2 mm.

28. The portable device according to claim **23**, comprising an air gap between the electrodes, the portable device further comprising, in the air gap, a communications interface for the exchange of data between the portable device and a device that is distinct from the portable device, which distinct device and can be inserted into the air gap.

29. The portable device according to claim **23**, wherein a communications link exists or can be formed between the transmitter electronics and an input unit, and the transmitter electronics are designed and/or programmed such that the electric signal is a function dependent upon the data that is input into the input unit.

30. The portable device according to claim **29**, wherein component parts of an application distinct from the transmitter electronics are arranged between the electrodes, and wherein the portable device is designed as a mobile telephone and the input unit is the input unit of the mobile telephone.

31. The portable device according to claim **30**, wherein a display field of the mobile telephone is furnished with or at least partly covered by the transparent electrode or one of the transparent electrodes, respectively.

32. The portable device according to claim **18**, wherein the signal generator is designed such that a maximal voltage between the electrodes does not exceed 5 V and/or wherein a center frequency of the generated signal does not exceed 2 MHz.

33. A device for the reception of signals which are coupled into the body of a user by electrodes of a first, portable device, comprising at least one electrode, wherein at least one of the electrode(s) is/are at least partially transparent.

34. The device according to claim **33**, comprising a plurality of electrodes, wherein the device for the receiving of signals triggers different actions depending upon which of the electrodes receives a signal.

35. A method of controlling access to an object, the method comprising the steps of:

providing a system for the transmission of signals, the system comprising: a first, portable device, which is wearable by a user, and a second device, wherein the first and the second device comprise means for the transmission of information signals at least from the first to the second device, the means for the transmission of information comprising electrodes of the first device and at least one electrode of the second device and being equipped to couple information into the body of the user by the electrodes of the first device, and to detect the information signals by the electrode(s) of the second device, wherein at least one of an electrode of the first device and of an electrode of the second device is at least partially transparent,

the method further comprising the step of using the system for transmitting authentication information between the first and the second device, and the step of using the authentication information to control the access.

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