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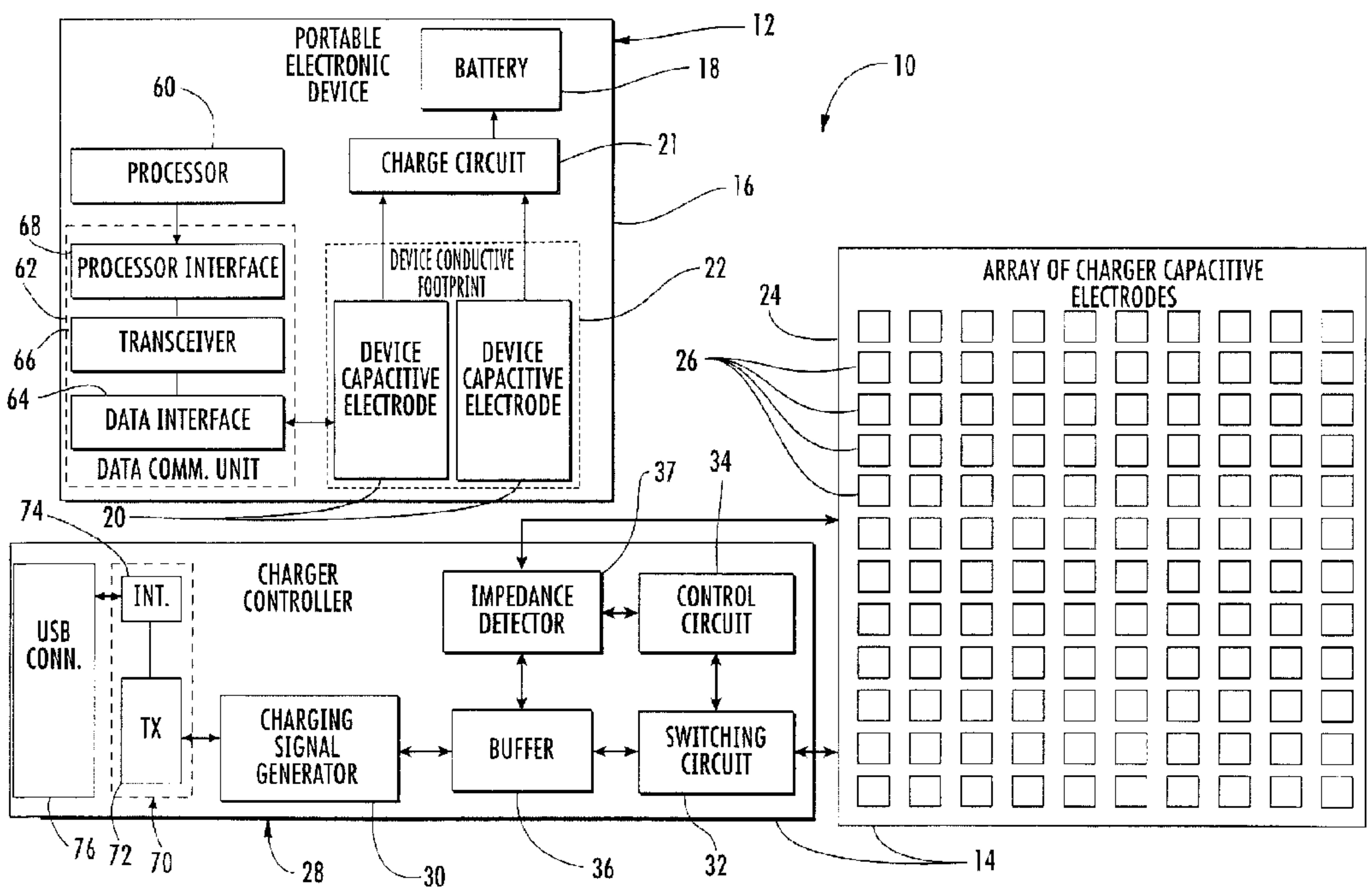
(54) Title: A PORTABLE ELECTRONIC DEVICE AND CAPACITIVE CHARGER PROVIDING DATA TRANSFER AND ASSOCIATED METHODS



(57) **Abrégé/Abstract:**

The electronic apparatus includes a portable electronic device and a charger for capacitively charging the portable electronic device when the portable electronic device is temporarily placed adjacent the charger. The portable electronic device includes a device data communication unit and an associated battery, and a pair of device capacitive electrodes, defining a device conductive footprint, to receive a charging signal to charge the battery. The charger includes a base having an area larger than the device conductive footprint and able to receive the portable electronic device thereon in a plurality of different positions, and an array of charger capacitive electrodes carried by the base. A charger controller selectively drives only the charger capacitive electrodes within the device conductive footprint with a charging signal to capacitively charge the battery. A charger data communication unit communicates with the device data communication unit via the charger capacitive electrodes and device capacitive electrodes, e.g. by modulating data onto the charging signal.

ABSTRACT

The electronic apparatus includes a portable electronic device and a charger for capacitively charging the portable electronic device when the portable electronic device is temporarily placed adjacent the charger. The portable electronic device includes a device data communication unit and an associated battery, and a pair of device capacitive electrodes, defining a device conductive footprint, to receive a charging signal to charge the battery. The charger includes a base having an area larger than the device conductive footprint and able to receive the portable electronic device thereon in a plurality of different positions, and an array of charger capacitive electrodes carried by the base. A charger controller selectively drives only the charger capacitive electrodes within the device conductive footprint with a charging signal to capacitively charge the battery. A charger data communication unit communicates with the device data communication unit via the charger capacitive electrodes and device capacitive electrodes, e.g. by modulating data onto the charging signal.

A PORTABLE ELECTRONIC DEVICE AND CAPACITIVE CHARGER PROVIDING DATA TRANSFER AND ASSOCIATED METHODS

Field of the Invention

The invention relates to the field of portable electronic devices, and, more particularly, to portable electronic devices and battery chargers therefor and associated methods.

Background of the Invention

Rechargeable batteries are used to power many of today's portable electronic devices. Rechargeable batteries make the portable electronic device more mobile than a device requiring a plug-in power source and this generally adds convenience for the user. However, recharging the batteries for a portable electronic device may be an inconvenience to the user.

For example, a rechargeable battery may carry a limited charge and therefore a user may have to monitor the charge level. Also, a user may have to make arrangements to provide for the charging of the batteries such as by carrying chargers and/or power cords.

Compounding these inconveniences for the user is the potential increased power consumption by modern portable electronic devices. Most portable electronic devices provide more functionality than their predecessors, which usually results in increased power consumption. This means more frequent recharging of the batteries of the portable electronic device, which may result in more recharging inconvenience for the user.

A number of attempts have been made to address recharging for portable electronic devices. For instance, U.S. Patent No. 6,756,765 to Bruning discloses a system for the contactless recharging of a portable device. The system includes a capacitive plate in a pad onto which the portable device is placed for recharging.

Similarly, U.S. Patent No. 6,275,681 to Vega et al. discloses a system that includes capacitively coupled capacitor plates for generating an electrostatic field for electrostatic charging a smart card. The system also includes a charge controller in the rechargeable device for controlling the charging of the battery in the rechargeable device. The charger can also be an electrostatic reader so that it can charge a rechargeable device and communicate with the rechargeable device through the capacitive coupling.

Another patent to Vega et al. is U.S. Patent No. 6,282,407, which discloses active and passive electrostatic transceivers that include capacitive charging plates for electrostatically charging. The system also includes an electrostatic reader that continuously generates and transmits an excitation signal to the medium surrounding the reader. In both of the Vega et al. patents, an embodiment is disclosed where a user can manually activate the electrostatic reader instead of having the reader radiating continuously.

Unfortunately for some of the above devices, a user may still need to monitor the charge level of the battery in the portable electronic device. In addition, some of the above devices may require the user to precisely align the electrodes of the charging device with the electrodes in the device being charged. Undesired electromagnetic interference (EMI) may also be generated by capacitive charging arrangements. Also, many portable electronic devices may need to be synchronized with a personal computer (PC) and existing wireless links may not be secure and consume too much power.

Brief Description of the Drawings

FIG. 1 is a schematic perspective view of the electronic apparatus for communicating with and charging a portable electronic device in a typical work environment.

FIG. 2 is a block diagram of the electronic apparatus as shown in FIG.1.

FIG. 3 is a schematic cross-sectional view of the electronic apparatus as shown in FIG. 1.

FIG. 4 is a flow chart illustrating a method of capacitively charging a portable electronic device with a charger.

FIG. 5 is a more detailed schematic block diagram of an embodiment of a portable electronic device.

Detailed Description of the Preferred Embodiments

The present description is made with reference to the accompanying drawings, in which preferred embodiments are shown. However, many different embodiments may be used, and thus the description should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete. Like numbers refer to like elements throughout, and prime and multiple prime notation are used to indicate similar elements in alternate embodiments.

Generally, an electronic apparatus and method is disclosed for conveniently charging a portable electronic device battery while also providing secure data transfer capability. The electronic apparatus includes a portable electronic device and a charger for capacitively charging the portable electronic device when the portable electronic device is temporarily placed adjacent the charger. The portable electronic device comprises a housing, a device data communication unit and an associated battery carried by the housing, and at least one pair of device capacitive electrodes carried by the housing to receive a charging signal to charge the battery. The pair of device capacitive electrodes define a device conductive footprint. The charger includes a base having an area larger than the device conductive footprint and able to receive the portable electronic device thereon in a plurality of different positions, and an array of charger capacitive electrodes carried by the base. A charger controller selectively drives only the charger capacitive electrodes within the device conductive footprint with a charging signal to capacitively charge the battery of the portable electronic device when the portable electronic device is positioned on the base of the charger. A charger data communication unit communicates with the device data communication unit via the charger capacitive electrodes and device capacitive electrodes.

The charger controller may sense impedances of the charger capacitive electrodes to determine whether a respective charger capacitive electrode is within the device conductive footprint or not. Also, the charger data communication unit may modulate data onto the device charging signal to communicate with the device data communication unit via the charger and device capacitive electrodes. The device may comprise a processor connected to the device data communication unit, and the device data communication unit may include a device data interface connected to the pair of device capacitive electrodes, a device data transceiver connected to the device data interface to demodulate and decode the data communicated on the charging signal, and a processor interface connected between the device data transceiver and the processor.

The charger data communication unit may include a charger data transceiver to modulate and encode the data communicated on the charging signal. As such, the charger data transceiver may modulate the data onto the charging signal using Frequency Shift Keying (FSK) modulation. Also, the charger may include a Universal Serial Bus (USB) connector to connect the charger to a personal computer (PC). The charger controller may also include a charging signal generator, a switching circuit connected between the charging signal generator and the charger capacitive electrodes, a control circuit connected to the switching circuit, a buffer connected between the charging signal generator and the switching circuit, and an impedance detector connected to the buffer and the control circuit.

A method is directed to communicating with and capacitively charging a portable electronic device with a charger. The portable electronic device includes a housing, a device data communication unit and associated battery carried by the housing, and at least one pair of device capacitive electrodes carried by the housing to receive a charging signal to charge the battery. Again, the device capacitive electrodes define a device conductive footprint. The charger includes a base having an area larger than the device conductive footprint and able to receive the portable electronic device thereon in a plurality of different positions, an array of charger capacitive electrodes carried by the base, a charger controller connected to the charger capacitive electrodes, and an associated charger data communication unit.

The method may include placing the portable electronic device adjacent the charger, and selectively driving, via the charger controller, only the charger capacitive electrodes within the device conductive footprint with a charging signal to capacitively charge the battery of the portable electronic device to thereby capacitively charge the battery of the portable electronic device. The method further includes communicating data between the charger data communication unit and the device data communication unit via the charger capacitive electrodes and device capacitive electrodes.

The method may also include sensing, via the charger controller, the impedances of the charger capacitive electrodes to determine whether a respective charger capacitive electrode is within the device conductive footprint. The charger data communication unit may comprise a charger data transceiver, and communicating may include modulating and encoding data, with the charger data transceiver, onto the charging signal. The charger data transceiver may modulate the data onto the charging signal using Frequency Shift Keying (FSK) modulation. The charger may include a Universal Serial Bus (USB) connector, and the method may include connecting the charger to a personal computer (PC) via the USB connector.

Referring initially to FIGS. 1-3, an electronic apparatus **10** including a portable electronic device **12** and a charger **14** for capacitively charging the portable electronic device is now described. The portable electronic device **10** may be in the form of a cell phone, personal digital assistant (PDA), wireless email device, pager, or the like, for example. The portable electronic device **12** illustratively includes a housing **16**, a battery **18** carried by the housing, and a pair of device capacitive electrodes **20** carried by the housing for charging the battery and defining a device conductive footprint **22**. A charging circuit **21** receives the differential signals from the pair of device capacitive electrodes **20**. Such a charging circuit **21** may include a diode rectifier, DC-DC converter and trickle charge circuit as would be appreciated by those skilled in the art.

The portable electronic device **10** includes a processor **60** and a device data communication unit **62** which receives and processes data to be sent from or used by the processor **60** as will be discussed in further detail below. The data communication unit **62** includes a data interface **64** to send/receive signals to/from the device capacitive electrodes **20**. A transceiver **66** modulates/demodulates and encodes/decodes the data to be sent via the interface **64**. A processor interface **68** interfaces with the processor **60** and the transceiver **66**.

The housing **16** may further include a housing dielectric layer **17** adjacent the device capacitive electrodes **20**. The device capacitive electrodes **20** are arranged in closely spaced, side-by-side relation. In other embodiments, more than one pair of device electrodes **20** may be provided and/or these electrodes can be arranged in different configurations as will be appreciated by those skilled in the art.

The charger **14** illustratively includes a base **24** having an area larger than the device conductive footprint **22** and able to receive the portable electronic device **12** thereon in a plurality of different positions. The charger **14** also includes and an array of charger capacitive electrodes **26** and a base dielectric layer **25** carried by the base **24**. The charger **14** further includes, for example, a charger controller **28** for selectively driving the charger capacitive electrodes **26** within the device conductive footprint **22** with a charging signal sufficient to capacitively charge the battery **18** of the portable electronic device **12,** and not driving charger capacitive electrodes outside the device conductive footprint with the charging signal when the portable electronic device is positioned on the charger **14** to thereby capacitively charge the battery of the portable electronic device while reducing undesired (EMI).

To help control the undesired EMI, the charger controller **28** selectively drives the charger capacitive electrodes **26** within the device conductive footprint **22** with a charging signal while not driving the charger capacitive electrodes outside the device conductive footprint. In other words, because the charger capacitive electrodes **26** being driven by the charging signal are covered by the device capacitive electrodes **20**, the device capacitive electrodes function as an EMI shield as will be appreciated by those skilled in the art. As a result, for example, a wireless communication link or the USB communication link **80** between the portable electronic device **12** and the computer **82** will be less likely to be disrupted by the operation of charger **14**.

The charger controller **28** may sense impedances, for example, of the charger capacitive electrodes **26** to determine whether a respective charger capacitive electrode is within the device conductive footprint **22** or not. Such sensing permits the charger controller **28** to accommodate the portable electronic device **12** if it is moved across the array of charger capacitive electrodes **26**. The charger controller **28** may sequentially drive the charger capacitive electrodes **26** with a sensing signal to sense impedances thereof as will be appreciated by those skilled in the art. To further reduce EMI while providing efficient charging, the charging signal may have an amplitude at least one hundred times greater than an amplitude of the sensing signal, for example.

The charger controller **28** illustratively comprises a charging signal generator **30**, a switching circuit **32** connected between the charging signal generator and the charger capacitive electrodes **26**, and a control circuit **34** connected to the switching circuit. The charger controller **28** further comprises a buffer **36** connected between the charging signal generator **30** and the switching circuit **32**, and an impedance detector **37** connected to the buffer and the control circuit **34**. The control circuit **28** may preferably operate the charging signal generator **30** at a reduced amplitude to serve as a signal generator for the sensing signal, for example.

The device capacitive electrodes **20** are driven by an alternating current (sine wave) and receive differential excitation signals from charger base **24**. In other words, when one device capacitive electrode **20** receives a positive potential from the charger capacitive electrodes **26** of the base **24** under such device electrode, the other capacitive electrode **20** receives a negative potential from the charger capacitive electrodes **26** of the base **24** under the other device electrode, and vice versa. To generate the differential excitation signals, the charger capacitive electrodes **26** of the base **24** under one capacitive electrode **20** receive an inverted excitation signal relative to charger capacitive electrodes **26** of the base **24** under the other capacitive electrode **20**.

In Fig. 2, the buffer **36** produces two excitation signals, one is "normal" and other is "inverted". Then switching circuit **32** connects the normal signal to charger capacitive electrodes **26** of the base **24** under one capacitive electrode **20,** and the inverted signal is connected to charger capacitive electrodes **26** of the base **24** under the other capacitive electrode **20.** The impedance detector **37** first detects the device conductive footprint **22** relative to the charger capacitive electrodes **26,** then this area is divided in two parts: one connected to the normal excitation signal and other connected to the inverted signal.

The charger controller **28** and the portable electronic device **12** can also communicate via the charger capacitive electrodes **26** and the device capacitive electrodes **20** such as to indicate the state of charge of the battery **18** or to provide various other synchronization operations between the device **12** and the computer **82,** for example. The charger **14** is illustratively powered by the computer **82** via the Universal Serial Bus (USB) connection **80,** for example. As such, the charger controller **28** may include a USB connector **76.** In other embodiments, the charger **14** can be powered through a wall transformer or other devices as will be appreciated by those skilled in the art.

The control circuit **34** determines which charger capacitive electrodes **26** are within the device conductive footprint **22** by operating the charging signal generator **30** to generate a sensing signal. The impedance detector **36** senses a first impedance when a charger capacitive electrode **26** is within the device conductive footprint **22,** and senses a second impedance when a charger capacitive electrode **26** is not. This sensing data is communicated to the control circuit **34.**

The control circuit **34** uses this data to selectively drive the charger capacitive electrodes **26** within the device conductive footprint **22** with the charging signal, which may be about 1 MHz, for example. The charging signal generator **30** generates the charging signal, which is relayed to the buffer **36.** The buffer **36** may be a differential buffer, for example, that generates the charging signal to have two components that are substantially 180 degrees out of phase with each other. The switching circuit **32** receives the charging signal and selects which device capacitive electrodes **20** receive the charging signal. The device capacitive electrodes **20** capacitively receive the charging signals to a charging circuit within the housing **16**, as will be appreciated by those skilled in the art, and the charging circuit charges the battery **18**.

To communicate via the charger capacitive electrodes **26**, the charger controller **28** includes a charger data communication unit **70** which includes a transceiver **72** to transmit/receive data to/from the device **12** via the charger capacitive electrodes **26** and device capacitive electrodes **20**. The transceiver **72** preferably modulates and encodes data onto the charging signal provided by the charging signal generator **30** to the switching circuit **32** and charger capacitive electrodes **26**. The device transceiver **66** demodulates and decodes signals at the charging signal carrier frequency to detect information being transmitted by the charger transceiver **72**. An interface **74**, e.g. a USB interface, is provided between the charger data communication unit **70** and the USB connector **76**.

In the preferred embodiment, transceiver **72** modulates the data onto the carrier or charging signal using Frequency Shift Keying (FSK) modulation, and encodes data using NRZ encoding for communication from the transceiver to the reader. It is to be appreciated that other modulation schemes such as Amplitude Modulation (AM), Binary Phase Shift Keying (BPSK), a form of Phase Shift Keying (PSK), and others can also be used to modulate the read data signal. Other data encoding techniques may also be used as would be appreciated by those skilled in the art.

That device data communication unit **62** and the charger data communication unit **70** provide an alternative way to "Blue Tooth" or wirelessly connect to synchronize a handheld device **12** with a PC **82**. This will provide better security, lower cost and lower power consumption compared to a wireless link. Charger **14** recognizes that the handheld device **12** has been placed on it's surface and establishes PC-USB-handheld link through capacitive coupling by using phase or frequency modulation (for example FSK). Eliminating the need for a Radio Frequency (RF) link to the PC **82** provides a more secure connection. There is a very low RF emission from capacitive electrodes **20/26** that is difficult to pick-up and decode. Also, the handheld device **12** receives power from charger **14** during data link, so the battery **18** is not draining but charging at this time.

Referring now additionally to the flowchart shown in FIG. 4, a method aspect of the invention is now described. The method is for communicating with and capacitively charging the portable electronic device **12** with the charger **14**. As discussed in detail above, the portable electronic device **12** includes a housing **16**, a data communication unit **62** and associated battery **18** carried by the housing, and at least one pair of device capacitive electrodes **20** carried by the housing for charging the battery and defining a device conductive footprint **22**. The charger **14** includes a base **24** having an area larger than the device conductive footprint **22** and able to receive the portable electronic device **12** thereon in a plurality of different positions, an array of charger capacitive electrodes **26** carried by the base, and a charger controller **28** connected to the charger capacitive electrodes.

The method starts at Block **40** and includes temporarily placing the portable electronic device **12** adjacent the charger **14** at Block **42**. The charger controller **28** senses the portable electronic device **12** at Block **44**. The charger controller then selectively drives, at Block **46**, the charger capacitive electrodes **26** within the device conductive footprint **22** with a charging signal sufficient to capacitively charge the battery **18** of the portable electronic device **12** and not driving charger capacitive electrodes outside the device conductive footprint with the charging signal to thereby capacitively charge the battery of the portable electronic device while reducing undesired EMI. At block **48** data is communicated between the charger data communication unit **70** and the device data communication unit **62** via the charger capacitive electrodes **26** and device capacitive electrodes **20**. Such communication may include modulating and encoding data, with the charger data transceiver **72**, onto the charging signal, as discussed in detail above. The charger controller **28** continues to sense the charger capacitive electrodes **26** to monitor the location of the portable electronic device at Block **50** before the method ends at Block **52**.

Another example of a handheld mobile wireless communications device **1000** that may be used in accordance the present device and method is further described with reference to FIG. 5. The device **1000** includes a housing **1200**, a keyboard **1400** and an output device **1600**. The output device shown is a display **1600**, which is preferably a full graphic LCD. Other types of output devices may alternatively be utilized. A processing device **1800** is contained within the housing **1200** and is coupled between the keyboard **1400** and the display **1600**. The processing device **1800** controls the operation of the display **1600**, as well as the overall operation of the mobile device **1000**, in response to actuation of keys on the keyboard **1400** by the user.

The housing **1200** may be elongated vertically, or may take on other sizes and shapes (including clamshell housing structures). The keyboard may include a mode selection key, or other hardware or software for switching between text entry and telephony entry.

In addition to the processing device **1800**, other parts of the mobile device **1000** are shown schematically in FIG. 5. These include a communications subsystem **1001**; a short-range communications subsystem **1020**; the keyboard **1400** and the display **1600**, along with other input/output devices **1060**, **1080**, **1100** and **1120**; as well as memory devices **1160, 1180** and various other device subsystems **1201**. The mobile device **1000** is preferably a two-way RF communications device having voice and data communications capabilities. In addition, the mobile device **1000** preferably has the capability to communicate with other computer systems via the Internet.

Operating system software executed by the processing device **1800** is preferably stored in a persistent store, such as the flash memory **1160**, but may be stored in other types of memory devices, such as a read only memory (ROM) or similar storage element. In addition, system software, specific device applications, or parts thereof, may be temporarily loaded into a volatile store, such as the random access memory (RAM) **1180**. Communications signals received by the mobile device may also be stored in the RAM **1180**.

The processing device **1800**, in addition to its operating system functions, enables execution of software applications **1300A-1300N** on the device **1000**. A predetermined set of applications that control basic device operations, such as data and voice communications **1300A** and **1300B**, may be installed on the device **1000** during manufacture. In addition, a personal information manager (PIM) application may be installed during manufacture. The PIM is preferably capable of organizing and managing data items, such as e-mail, calendar events, voice mails, appointments, and task items. The PIM application is also preferably capable of sending and receiving data items via a wireless network **1401**. Preferably, the PIM data items are seamlessly integrated, synchronized and updated via the wireless network **1401** with the device user's corresponding data items stored or associated with a host computer system.

Communication functions, including data and voice communications, are performed through the communications subsystem **1001**, and possibly through the short-range communications subsystem. The communications subsystem **1001** includes a receiver **1500**, a transmitter **1520**, and one or more antennas **1540** and **1560**. In addition, the communications subsystem **1001** also includes a processing module, such as a digital signal processor (DSP) **1580**, and local oscillators (LOs) **1601**. The specific design and implementation of the communications subsystem **1001** is dependent upon the communications network in which the mobile device **1000** is intended to operate. For example, a mobile device **1000** may include a communications subsystem **1001** designed to operate with the Mobitex™, Data TAC™ or General Packet Radio Service (GPRS) mobile data communications networks, and also designed to operate with any of a variety of voice communications networks, such as AMPS, TDMA, CDMA, PCS, GSM, etc. Other types of data and voice networks, both separate and integrated, may also be utilized with the mobile device **1000**.

Network access requirements vary depending upon the type of communication system. For example, in the Mobitex and DataTAC networks, mobile devices are registered on the network using a unique personal identification number or PIN associated with each device. In GPRS networks, however, network access is associated with a subscriber or user of a device. A GPRS device therefore requires a subscriber identity module, commonly referred to as a SIM card, in order to operate on a GPRS network.

When required network registration or activation procedures have been completed, the mobile device **1000** may send and receive communications signals over the communication network **1401**. Signals received from the communications network **1401** by the antenna **1540** are routed to the receiver **1500**, which provides for signal amplification, frequency down conversion, filtering, channel selection, etc., and may also provide analog to digital conversion. Analog-to-digital conversion of the received signal allows the DSP **1580** to perform more complex communications functions, such as demodulation and decoding. In a similar manner, signals to be transmitted to the network **1401** are processed (e.g. modulated and encoded) by the DSP **1580** and are then provided to the transmitter **1520** for digital to analog conversion, frequency up conversion, filtering, amplification and transmission to the communication network **1401** (or networks) via the antenna **1560**.

In addition to processing communications signals, the DSP **1580** provides for control of the receiver **1500** and the transmitter **1520**. For example, gains applied to communications signals in the receiver **1500** and transmitter **1520** may be adaptively controlled through automatic gain control algorithms implemented in the DSP **1580**.

In a data communications mode, a received signal, such as a text message or web page download, is processed by the communications subsystem **1001** and is input to the processing device **1800**. The received signal is then further processed by the processing device **1800** for an output to the display **1600**, or alternatively to some other auxiliary I/O device **1060**. A device user may also compose data items, such as e-mail messages, using the keyboard **1400** and/or some other auxiliary I/O device **1060**, such as a touchpad, a rocker switch, a thumb-wheel, or some other type of input device. The composed data items may then be transmitted over the communications network **1401** via the communications subsystem **1001**.

In a voice communications mode, overall operation of the device is substantially similar to the data communications mode, except that received signals are output to a speaker **1100**, and signals for transmission are generated by a microphone **1120**. Alternative voice or audio I/O subsystems, such as a voice message recording subsystem, may also be implemented on the device **1000**. In addition, the display **1600** may also be utilized in voice communications mode, for example to display the identity of a calling party, the duration of a voice call, or other voice call related information.

The short-range communications subsystem enables communication between the mobile device **1000** and other proximate systems or devices, which need not necessarily be similar devices. For example, the short-range communications subsystem may include an infrared device and associated circuits and components, or a Bluetooth communications module to provide for communication with similarly-enabled systems and devices.

Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is understood that the invention is not to be limited to the specific embodiments disclosed, and that other modifications and embodiments are intended to be included within the scope of the appended claims.

CLAIMS:

1. A charger for capacitively charging a portable electronic device when the portable electronic device is placed adjacent the charger, the portable electronic device comprising a housing, a device data communication unit and associated battery carried by the housing, and at least one pair of device capacitive electrodes carried by the housing to receive a charging signal to charge the battery, the at least one pair of device capacitive electrodes defining a device conductive footprint, the charger comprising:

a base having an area larger than the device conductive footprint and able to receive said portable electronic device thereon in a plurality of different positions;

an array of charger capacitive electrodes carried by said base;

a charger controller for selectively driving only said charger capacitive electrodes within the device conductive footprint with a charging signal to capacitively charge said battery of said portable electronic device when said portable electronic device is positioned on said base of said charger; and

a charger data communication unit to communicate with the device data communication unit via said charger capacitive electrodes and device capacitive electrodes.

2. The charger according to Claim 1 wherein said charger controller senses impedances of said charger capacitive electrodes to determine whether a respective charger capacitive electrode is within the device conductive footprint or not.

3. The charger according to Claim 1 wherein said charger data communication unit comprises a charger data transceiver to modulate and encode data on the charging signal to communicate with the device data communication unit.

4. The charger according to Claim 3 wherein said charger data transceiver modulates the data onto the charging signal using Frequency Shift Keying (FSK) modulation.

5. The charger according to Claim 1 wherein said charger comprises a Universal Serial Bus (USB) connector to connect to a personal computer (PC).

6. The charger according to Claim 1 wherein said charger controller comprises:

a charging signal generator;

a switching circuit connected between said charging signal generator and said charger capacitive electrodes; and

a control circuit connected to said switching circuit.

7. The charger according to Claim 6 wherein said charger controller further comprises:

a buffer connected between said charging signal generator and said switching circuit; and

an impedance detector connected to said buffer and said control circuit.

8. A method of capacitively charging a portable electronic device with a charger, the portable electronic device comprising a housing, a device data communication unit and associated battery carried by the housing, and at least one pair of device capacitive electrodes carried by the housing to receive a charging signal to charge the battery, the at least one pair of device capacitive electrodes defining a device conductive footprint, and the charger comprising a base having an area larger than the device conductive footprint and able to receive the portable electronic device thereon in a plurality of different positions, an array of charger capacitive electrodes carried by the base, a charger controller connected to the charger capacitive electrodes, and an associated charger data communication unit, the method comprising:

placing the portable electronic device adjacent the charger;

selectively driving, via the charger controller, only the charger capacitive electrodes within the device conductive footprint with a charging signal to capacitively charge the battery of the portable electronic device to thereby capacitively charge the battery of the portable electronic device; and

communicating data between the charger data communication unit and the device data communication unit via the charger capacitive electrodes and device capacitive electrodes.

9. The method according to Claim 8 further comprising sensing, via the charger controller, the impedances of the charger capacitive electrodes to determine whether a respective charger capacitive electrode is within the device conductive footprint.

10. The method according to Claim 8 wherein the charger data communication unit comprises a charger data transceiver; and wherein communicating comprises modulating and encoding data, with the charger data transceiver, onto the charging signal.

11. The method according to Claim 10 wherein the charger data transceiver modulates the data onto the charging signal using Frequency Shift Keying (FSK) modulation.

12. The method according to Claim 8 wherein the charger comprises a Universal Serial Bus (USB) connector; and further comprising connecting the charger to a personal computer (PC) via the USB connector.

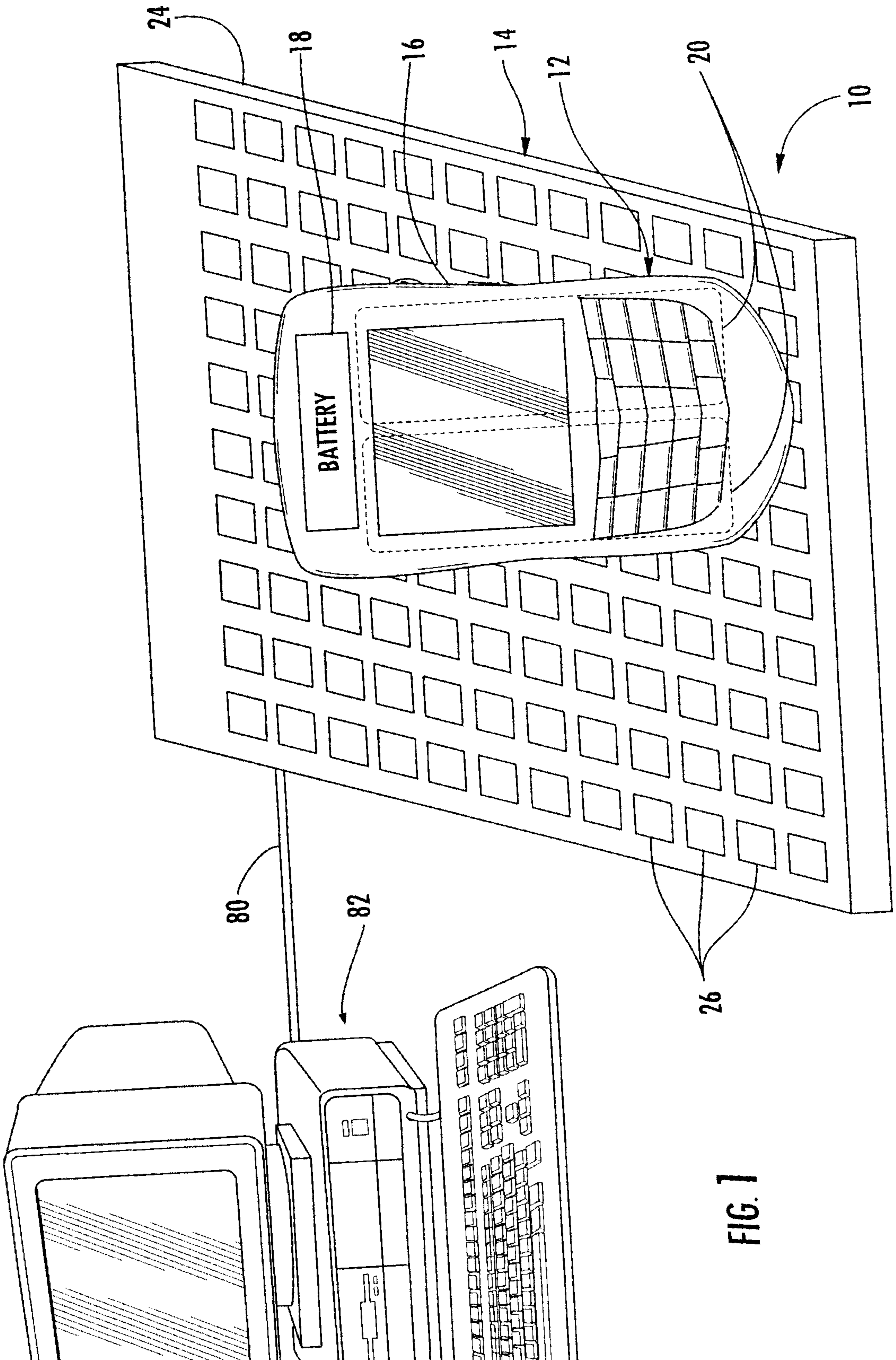
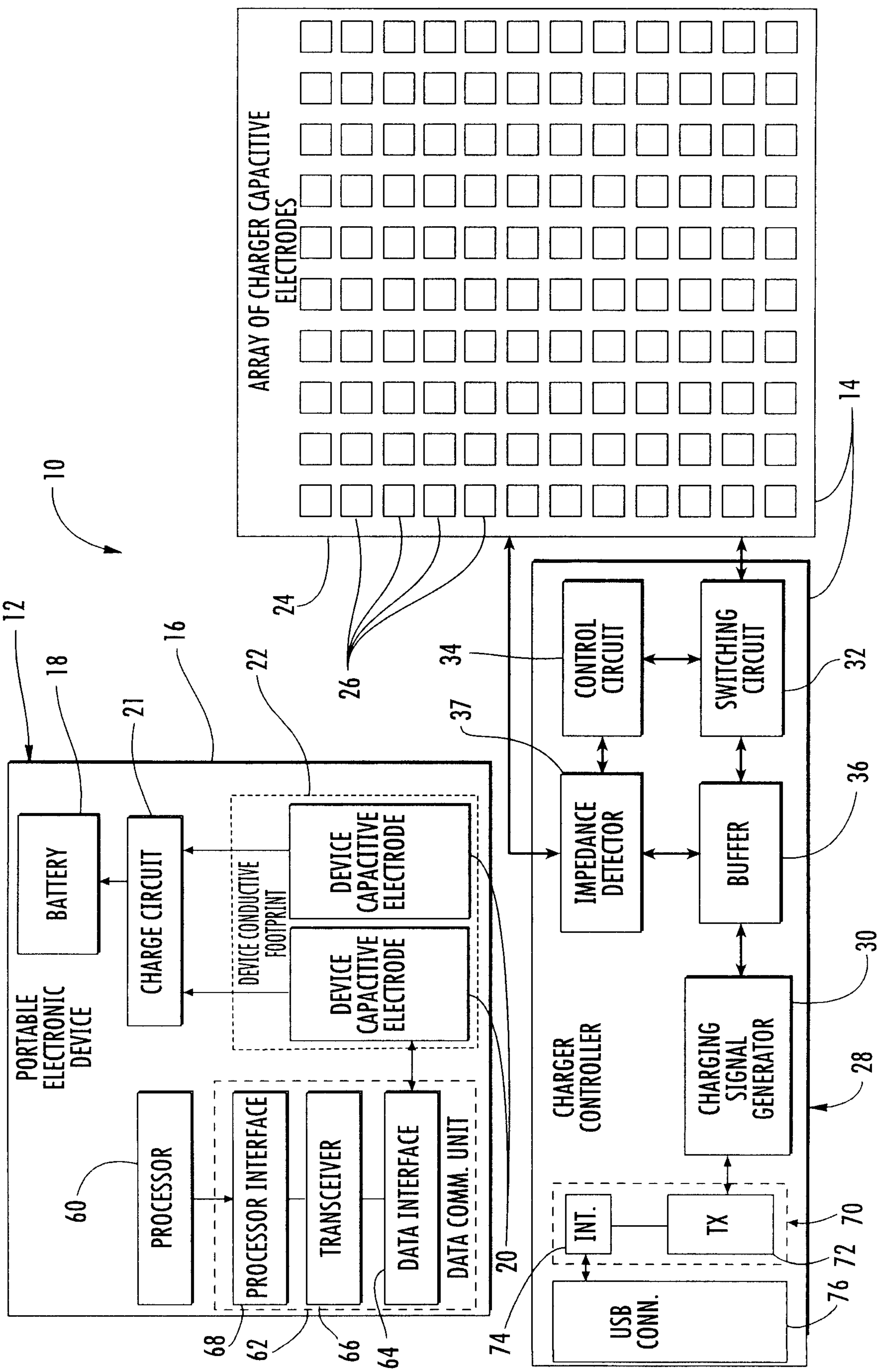


FIG. 1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12
PORTABLE ELECTRONIC DEVICE
BATTERY
18
CHARGE CIRCUIT
21
16
DEVICE CONDUCTIVE FOOTPRINT
DEVICE CAPACITIVE ELECTRODE
DEVICE CAPACITIVE ELECTRODE
22
PROCESSOR
60
PROCESSOR INTERFACE
TRANSCEIVER
DATA INTERFACE
DATA COMM. UNIT
68
62
66
64
20
ARRAY OF CHARGER CAPACITIVE ELECTRODES
24
26
14
CHARGER CONTROLLER
CONTROL CIRCUIT
34
SWITCHING CIRCUIT
32
IMPEDANCE DETECTOR
37
BUFFER
36
CHARGING SIGNAL GENERATOR
30
28
INT.
TX
70
72
74
USB CONN.
76

FIG. 2

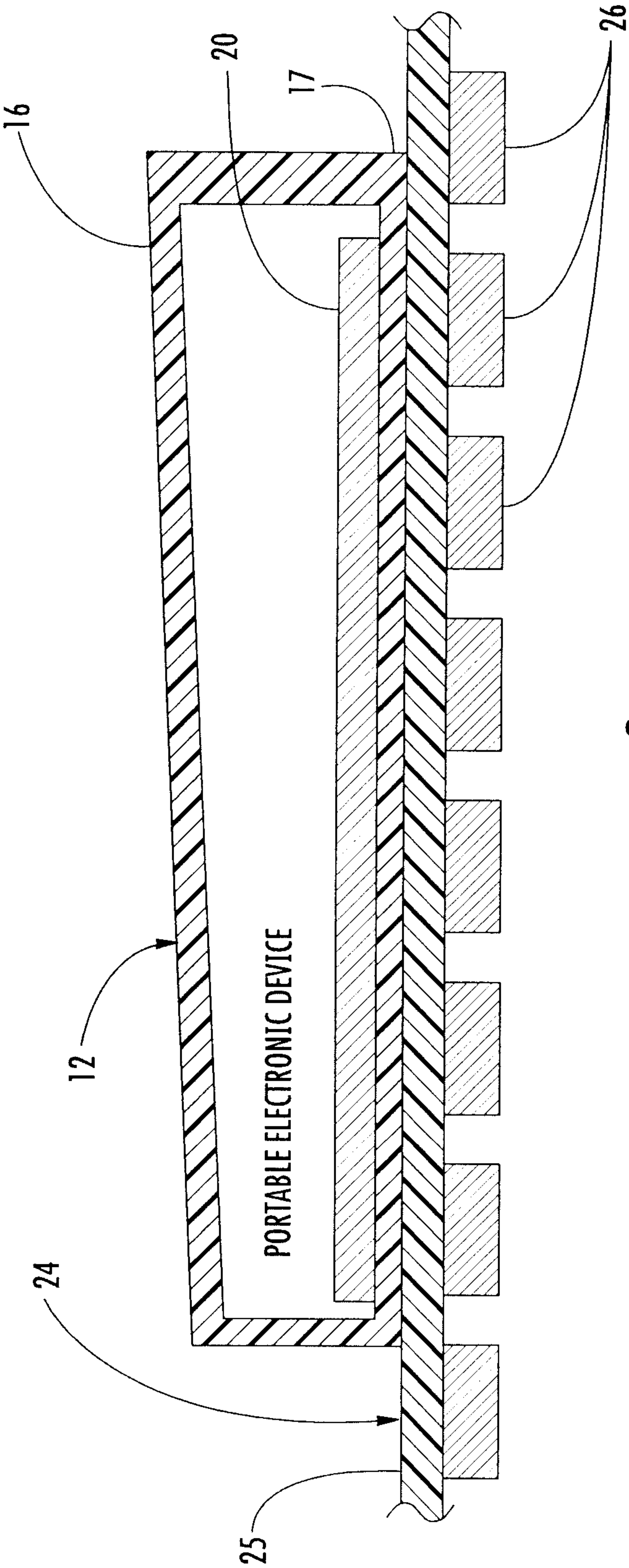


FIG. 3

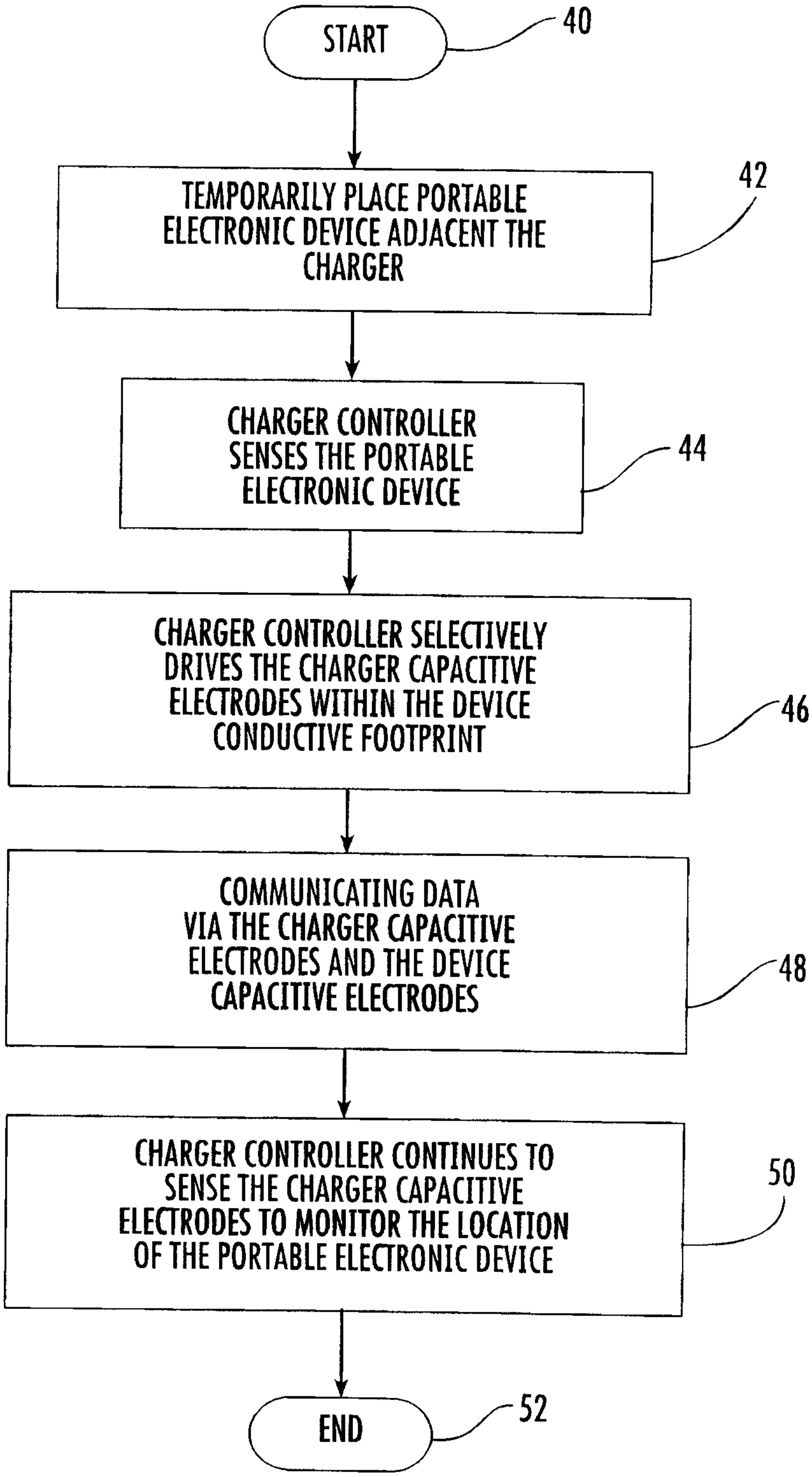

START
40
TEMPORARILY PLACE PORTABLE ELECTRONIC DEVICE ADJACENT THE CHARGER
42
CHARGER CONTROLLER SENSES THE PORTABLE ELECTRONIC DEVICE
44
CHARGER CONTROLLER SELECTIVELY DRIVES THE CHARGER CAPACITIVE ELECTRODES WITHIN THE DEVICE CONDUCTIVE FOOTPRINT
46
COMMUNICATING DATA VIA THE CHARGER CAPACITIVE ELECTRODES AND THE DEVICE CAPACITIVE ELECTRODES
48
CHARGER CONTROLLER CONTINUES TO SENSE THE CHARGER CAPACITIVE ELECTRODES TO MONITOR THE LOCATION OF THE PORTABLE ELECTRONIC DEVICE
50
END
52

FIG. 4

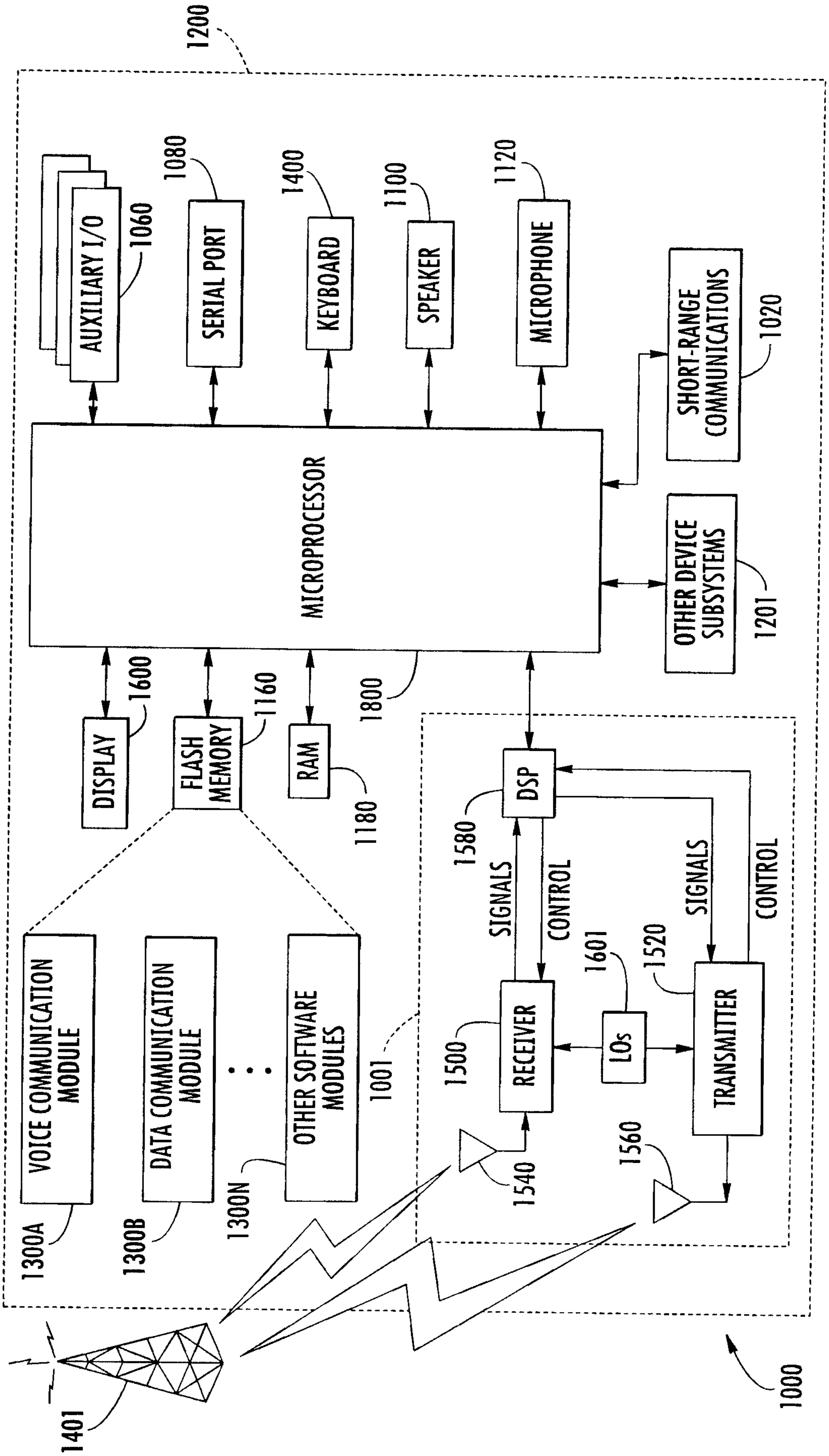
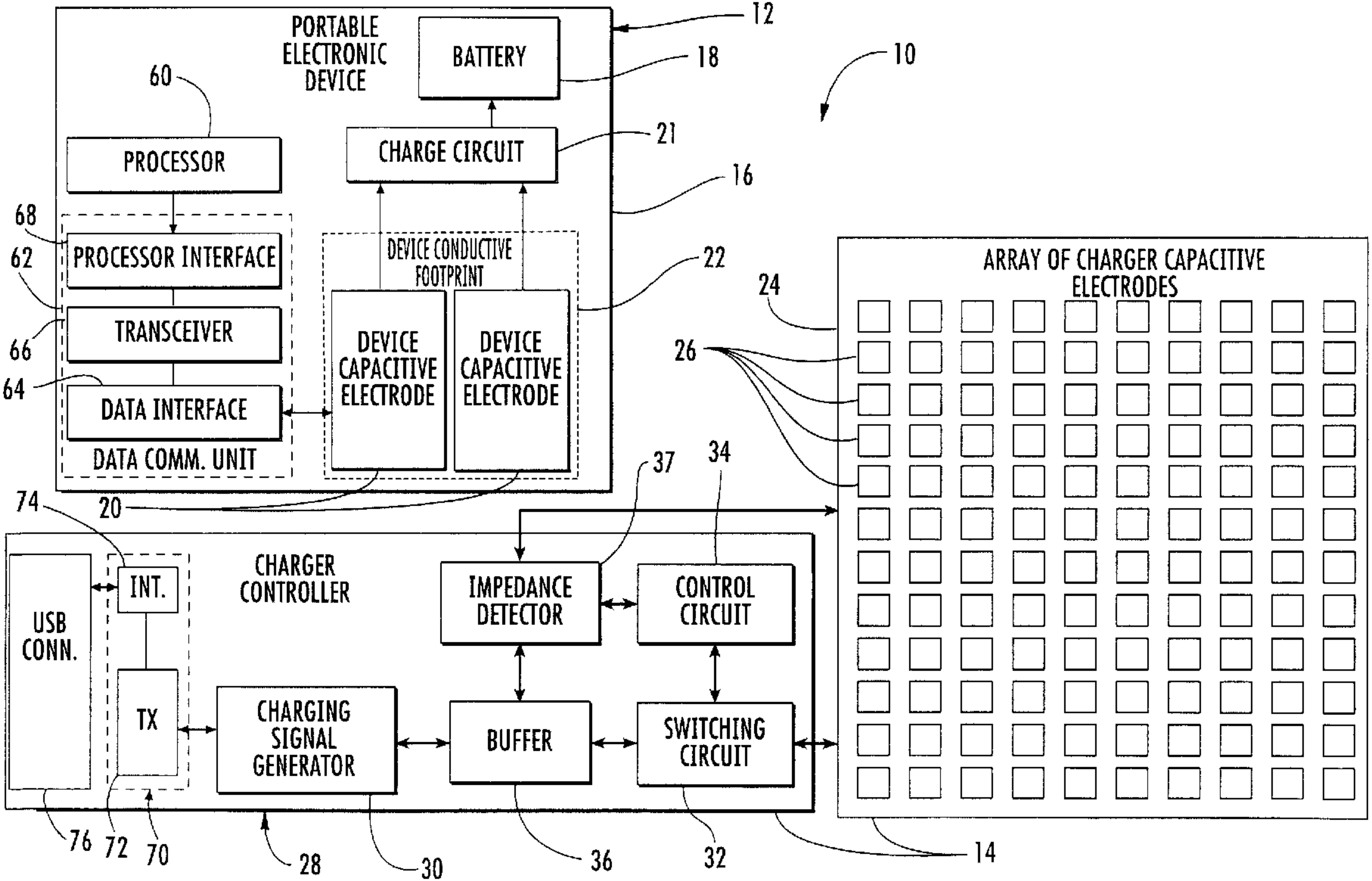

1200
AUXILIARY I/O
1060
SERIAL PORT
1080
KEYBOARD
1400
SPEAKER
1100
MICROPHONE
1120
SHORT-RANGE COMMUNICATIONS
1020
MICROPROCESSOR
OTHER DEVICE SUBSYSTEMS
1201
DISPLAY
1600
FLASH MEMORY
1160
RAM
1180
1800
VOICE COMMUNICATION MODULE
1300A
DATA COMMUNICATION MODULE
1300B
OTHER SOFTWARE MODULES
1300N
1001
DSP
1580
SIGNALS
CONTROL
SIGNALS
CONTROL
RECEIVER
1500
LOs
1601
TRANSMITTER
1520
1540
1560
1401
1000

FIG. 5


PORTABLE ELECTRONIC DEVICE
BATTERY
PROCESSOR
CHARGE CIRCUIT
PROCESSOR INTERFACE
TRANSCEIVER
DATA INTERFACE
DATA COMM. UNIT
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