Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 2650192 C 2020/07/21

(11)(21) **2 650 192**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

(22) **Date de dépôt/Filing Date:** 2009/01/19

(41) **Mise à la disp. pub./Open to Public Insp.:** 2009/07/18

(45) **Date de délivrance/Issue Date:** 2020/07/21

(30) **Priorités/Priorities:** 2008/01/18 (US60/022,208); 2008/01/18 (US60/022,213)

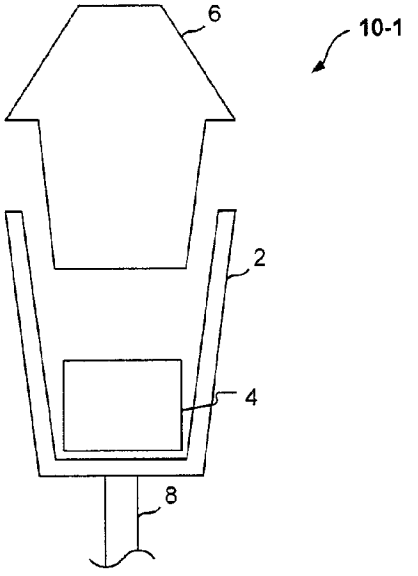
(51) **Cl.Int./Int.Cl.** ***G08C 17/02*** (2006.01), ***G06Q 20/40*** (2012.01), ***G07F 17/24*** (2006.01), ***G08G 1/14*** (2006.01), ***H04W 88/02*** (2009.01), ***H04W 88/04*** (2009.01)

(72) **Inventeurs/Inventors:**
KING, DAVID WILLIAM, US;
SCHWARZ, ALEXANDER, US;
HUNTER, STEPHEN JOHN, US

(73) **Propriétaire/Owner:**
IPS GROUP, INC., US

(74) **Agent:** SMART & BIGGAR LLP

(54) **Titre : METHODE ET APPAREILLAGE PERMETTANT L'EXPLOITATION D'UN COMPTEUR AMOVIBLE**
(54) **Title: METHOD AND APPARATUS FOR OPERATING A REMOVABLE METER UNIT**



(57) **Abrégé/Abstract:**
A method and apparatus for operating a meter uniquely associated with a physical location are provided. The method includes monitoring a communication channel for a message from a remote device and identifying an initial message directed to the meter uniquely associated with the physical location, establishing a communication session with a data manager in response to the initial message from the remote device, receiving configuration information from the data manager, the configuration information associated with operation of the meter and uniquely associated with the physical location of the meter, and transmitting meter operating data to the data manager, wherein the meter is self-powered.

METHOD AND APPARATUS FOR OPERATING A REMOVABLE METER UNIT

ABSTRACT

A method and apparatus for operating a meter uniquely associated with a physical location are provided. The method includes monitoring a communication channel for a message from a remote device and identifying an initial message directed to the meter uniquely associated with the physical location, establishing a communication session with a data manager in response to the initial message from the remote device, receiving configuration information from the data manager, the configuration information associated with operation of the meter and uniquely associated with the physical location of the meter, and transmitting meter operating data to the data manager, wherein the meter is self-powered.

METHOD AND APPARATUS FOR OPERATING A REMOVABLE METER UNIT

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 61/022,208 filed January 18, 2008 entitled "A PARKING METER" and claims the benefit of U.S. Provisional Application No. 61/022,213 filed January 18, 2008 entitled "THE OPERATION OF PARKING METERS". This application is related to U.S. Non-provisional application filed on even date herewith entitled "METHOD AND APPARATUS FOR AUTOMATIC LOCATION-SPECIFIC CONFIGURATION MANAGEMENT OF A REMOVABLE METER UNIT".

BACKGROUND

[0002] Field of the Invention

[0003] The invention relates generally to electronic communications for remotely operating a removable meter unit, more particularly, but not by way of limitation, to location-specific operation of a removable meter unit for vehicle parking.

[0004] Description of the Related Art

[0005] A "meter" can be any of various devices configured to measure time, distance, speed, or intensity, or to indicate, record, and/or regulate an amount or volume, such as, for example, the flow of a gas or an electric current. As technology has advanced, meters have also become more advanced. Meters that measure the passage of time, e.g., parking meters, typically include timer mechanisms similar to those of mechanical watches. Since these timer mechanisms had limited life spans, the parking meters were constructed with a fixed housing that was configured to receive a replaceable meter unit including the meter timer mechanism. When the timer mechanism wore out, the meter unit could be replaced.

Other types of meters that can have replaceable meter units include water meters and gas meters that measure the flow of material, such as water or gas, respectively.

[0006] Many mechanical meters have been replaced by digital-based meters. Digital meter units can have longer life spans than their mechanical predecessors, but they still are replaced when they malfunction, are damaged, or even when the technology changes.

[0007] With advances in communications, e.g., wireless telecommunications, it is possible to monitor many meters remotely. For example, a group of meters can report information to a central data manager using wireless communications. The information reported can be related to financial transactions such as credit card information or periodic measures such as the amount of gas or water consumed. Meters that communicate local information are often associated with a specific geographic location. For example, a meter might be associated with locations such as a parking spot, a house, a ticket booth, a cash register, a vending machine, and so forth. The central data manager can maintain a database that associates each meter with corresponding meter information such as transactions or consumption measures.

[0008] A parking meter is typically associated with a single parking space such that the parking space can be occupied for a predetermined amount of time in accordance with the amount of payment received at the meter. Expiration of the amount of time at the meter exposes the vehicle occupying the parking space to a fine. Advances in meter technology have generally not been propagated for managing parking meter enforcement and parking meter fee payment. Enforcement of parking meter fees is still largely performed by an individual manually traveling to each parking space and checking the time remaining on the associated parking meter. The individual is generally charged with noting violations of fee payment and issuing citations. This is a time-consuming and costly service. As with many tasks, manual involvement produces inefficiencies and unreliability.

[0009] From the discussion above, it should be apparent that there is a need for more efficient and reliable automated reporting and monitoring of meter operations and transactions. The present invention satisfies this need.

SUMMARY

[0010] A technique for operating a meter uniquely associated with a physical location includes monitoring a communication channel for a message from a remote device and identifying an initial message directed to the meter uniquely associated with the physical location, establishing a communication session with a data manager in response to the initial message from the remote device, receiving configuration information from the data manager, the configuration information associated with operation of the meter and uniquely associated with the physical location of the meter, and transmitting meter operating data to the data manager, wherein the meter is capable of low-power operation so as to be self-powered.

[0011] In one aspect, automatic reporting is provided by receiving an indication of an arrival event at a location uniquely associated with a meter, producing an occupancy indication by the meter in response to the arrival event at the location, generating a location report comprising an alert signal in response to completion of a predetermined time period without receiving a payment at the meter, the location report otherwise comprising an indication of a received payment at the meter, and transmitting the location report to a data manager. In this way, payment transactions are automatically reported with increased efficiency and reliability.

[0012] In another aspect, the indication of the arrival event can be received via wireless communication. In another aspect, the indication of the arrival event can be received in response to a manually initiated interaction with the meter.

[0013] In yet another aspect, the location corresponds to a single parking space and the indication of the arrival event is received from a parking sensor associated with the single parking space. In another aspect, a data signal is received from a tag that is fixedly identified with the location, the data signal including tag information, and the tag information being uniquely associated with the location, such that the tag information is transmitted to the data manager.

[0014] Further areas of applicability of the present disclosure will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating various embodiments, are intended for purposes of illustration only and are not intended to necessarily limit the scope of the disclosure.

[0014a] Various embodiments of the claimed invention relate to a method of operating a meter, the method comprising: a. establishing a network communication session with a meter, the meter having an electronic display, the meter being uniquely associated with a physical location; b. transmitting configuration information toward the meter over the network during the established network communication session, the configuration information associated with operation of the meter and uniquely associated with the physical location of the meter, the configuration information comprising meter display message updates, and one or more of: coin validation criteria updates, firmware updates, and operating software updates; c. receiving meter operating data from the meter, the meter operating data comprising an acknowledgement of receipt of the configuration information; d. providing a web-based administrative user interface comprising a meter revenue summary, wherein the meter revenue summary comprises cash amounts, credit amounts, and total revenue collected by the meter; and e. providing a web-based administrative user interface comprising a tool, wherein an administrative end user uses the tool to remotely configure the meter display message on the display of the meter via the network.

[0014b] Various embodiments of the claimed invention relate to a method of operating a meter, the method comprising: a. communicating data representing web-based administrative user interface screens to a computer of an administrative end user via a network, wherein the administrative user interface screens comprise: i. a meter revenue summary, wherein the meter revenue summary comprises cash amounts, credit amounts, and total revenue collected by the meter; and ii. a tool, wherein the administrative end user uses the tool to remotely configure the meter display message on an electronic display of the meter via the network; b. receiving configuration information from the administrative end user via the network, the configuration information associated with operation of a meter and uniquely associated with a physical location of the meter, the configuration information comprising meter display message updates, and one or more of: coin validation criteria updates, firmware updates, operating software updates, or any combination thereof; c. establishing a network communication session with the meter, the meter being uniquely associated with the physical location; d. communicating the configuration information from the management server toward the meter over the network during the established communication session; e. updating a message on the electronic display of the meter based on the remote configuration; and f. receiving meter operating data from the

meter, the meter operating data comprising an acknowledgement of receipt of the configuration information.

[0014c] Various embodiments of the claimed invention relate to a device for operating a plurality of meters, the device comprising: a. a radio configured to communicate with at least one meter, the at least one meter having an electronic display, the at least one meter being uniquely associated with a physical location; and b. a processor coupled to the radio and configured to: i. establish a network communication session with the at least one meter, ii. transmit configuration information toward the meter over the network during the established communication session via the radio, the configuration information associated with operation of the meter and uniquely associated with the physical location of the meter, the configuration information comprising meter display message updates, and one or more of: coin validation criteria updates, firmware updates, and operating software updates; iii. receive meter operating data from the meter via the radio, the meter operating data comprising an acknowledgement of receipt of the configuration information; iv. provide a web-based administrative user interface comprising a meter revenue summary, wherein the meter revenue summary comprises cash amounts, credit amounts, and total revenue collected by each meter and by physical location; and v. provide a web-based administrative user interface comprising a tool, wherein the tool is configured for an end user to remotely configure the meter display message on the display of each meter or a group of meters via the network.

[0014d] Various embodiments of the claimed invention relate to device for operating a meter, the device comprising: a processor coupled to a network configured to: a. communicate data representing web-based administrative user interface screens to a computer of an administrative end user via the network, wherein the administrative user interface screens comprise: i. a meter revenue summary, wherein the meter revenue summary comprises cash amounts, credit amounts, and total revenue collected by the meter; and ii. a tool, wherein the tool is configured for the administrative end user to remotely configure the meter display message on an electronic display of the meter via the network; b. receive configuration information from the administrative end user via the network, the configuration information associated with operation of a meter and uniquely associated with a physical location of the meter, the configuration information comprising meter display message updates, and one or more of: coin validation criteria updates, firmware updates, operating software updates, or any

combination thereof; c. establish a communication session with the meter, the meter being uniquely associated with the physical location; d. communicate the configuration information toward the meter over the network during the established communication session; e. update a message on the electronic display of the meter based on the remote configuration; and f. receive meter operating data from the meter, the meter operating data comprising an acknowledgement of receipt of the configuration information.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The invention is now described, by way of a non-limiting example, with reference to the accompanying drawings, in which:

[0016] FIGS. 1A, 1B and 1C are schematic illustrations of embodiments of single space parking meters.

[0017] FIG. 2A shows a functional block diagram of a removable meter unit used in the parking meter of FIG 1A.

[0018] FIG. 2B shows a functional block diagram of a removable meter unit and a tag device used in the parking meter of FIGS. 1B and 1C.

[0019] FIG. 3 is a schematic illustration of a parking meter system which uses a number of the parking meters of FIGS. 1A, 1B and/or 1C.

[0020] FIG. 4 shows an example of a local group of parking meters that can be monitored by the parking meter system of FIG. 3.

[0021] FIG. 5 shows another example of a local group of parking meters that can be monitored by the parking meter system of FIG. 3.

[0022] FIG. 6 shows a flowchart of an embodiment of a process for automatic location reporting performed by a meter such as the parking meters of FIGS. 1A, 1B and/or 1C in the system of FIG. 3.

[0023] FIG. 7 shows a flowchart of an embodiment of a process of operating a meter to receive configuration updates and/or to report meter operating data.

[0024] FIG. 8 shows a flowchart of an embodiment of a process for operating a data manager to initiate configuration updates with a meter.

[0025] FIG. 9 shows schematically a parking meter management system for monitoring and updating a parking meter system.

[0026] FIGS. 10A and 10B show examples of user interface screens regarding meter locations generated by the parking meter management system of FIG. 9.

[0027] FIGS. 11A and 11B show examples of user interface screens regarding financial data generated by the parking meter management system of FIG. 9.

[0028] FIG. 12 shows an example of a user interface screens regarding credit card transactions generated by the parking meter management system of FIG. 9.

[0029] FIGS. 13A and 13B show examples of user interface screens regarding coin collection generated by the parking meter management system of FIG. 9.

[0030] FIG. 14 shows an example of a user interface screens regarding battery status generated by the parking meter management system of FIG. 9.

[0031] FIG. 15 shows example of user interface screens regarding terminal events generated by the parking meter management system of FIG. 9.

[0032] FIGS. 16A, 16B and 16C show examples of user interface screens regarding meter configuration generated by the parking meter management system of FIG. 9.

[0033] FIG. 17 shows a flowchart of an embodiment of a process for operating a meter with the parking meter management system of FIG. 9.

[0034] FIG. 18 is a block diagram of a computer system that may incorporate embodiments of the disclosure for performing the operations described herein, including operations of the parking meter management system of FIG. 9.

[0035] FIG. 19 shows a block diagram illustrating examples of various electrical and other components of a parking meter device.

[0036] In the appended figures, similar components and/or features may have the same reference label. Further, various components of the same type may be distinguished by following the reference label (e.g. "6") by a dash and a second label that distinguishes among the similar components (e.g. "6-1" and "6-2"). If only the first reference label is used in the specification, the description is applicable to any one of the similar components having the same first reference label irrespective of the second reference label.

DETAILED DESCRIPTION

[0037] According to one embodiment of a parking meter as described herein, a parking meter includes a short range radio transceiver for communicating with a data manager. Operation of the parking meter includes transmitting radio signals to, and receiving radio signals from, the data manager.

[0038] The parking meter may be a single space parking meter. Preferably, the single space parking meter displays an amount of time paid for, thereby not requiring a printer to print out tickets such as commonly used in multi-space parking meter systems.

[0039] The transceiver of the parking meter may have a maximum range of up to 150 meters, but should preferably operate at less than 80 meters.

[0040] Still further according to the invention, the parking meter device may have a payment received arrangement for receiving an instruction from a call centre that payment has been effected, via the call centre, from a cellular telephone.

[0041] The parking meter device may have a solar power charging arrangement whereby the power supply unit is recharged by solar energy. The parking meter device may then also have a power management facility.

[0042] As a further feature, the parking meter device may have a locating arrangement for determining the location of the parking meter device. The locating arrangement may be GPS operable.

[0043] The parking meter device may have a management communication arrangement for communicating management information to a management center. For example such management information may include malfunction details, a tampering alert, duration expiration and the location of the parking meter device.

[0044] Embodiments of the disclosure include a method of controlling parking in a single parking bay, which includes accepting payment for parking in the bay by means of coins, parking tokens, a credit or debit card account, a smart card, from an electronic purse, or by means of a cellular telephone.

[0045] If payment is effected by means of a cellular telephone, then the method may include receiving an authorization signal that payment for the parking has been made. This signal may be provided by the second financial institution or from a control center.

[0046] The method of controlling parking may include sensing if a vehicle is parked in the bay when the paid for parking time has expired or the maximum parking time has been exceeded and transmitting a time expired signal to a management centre. A location signal, providing the location of the bay, may also be transmitted.

[0047] The data manager may comprise a plurality of data managers that include one or more local data managers that in turn communicate with a central data manager.

[0048] It will thus be appreciated that a predetermined number of single space parking meters, together with an associated local data manager, can form a local group, such that the local data manager communicates with a central data manager.

[0049] According to another aspect, a vehicle parking control system includes a number of parking meters that are members of an operational group; an associated local data manager that has a complementary transceiver for receiving radio transmissions from parking meter members of the operational group and a transmitter for transmitting signals to the group members, and a communication facility for communicating with a central data manager, the grouped parking meter members and the associated local data manager forming a local group.

[0050] The system may thus include a number of local groups and a central data manager.

[0051] It will be appreciated that the local data manager will generally be located less than 150 meters and preferably less than 80 meters from its associated group members.

[0052] The transceivers may operate in the 2.4GHz frequency band and may have a power of between 1 mW and 6 mW. At low power levels, batteries could last for months or even years (e.g., up to three years or more).

[0053] The communication facility of the local hub manager may communicate with the central data manager by means of a data channel, which may use a cellular telephone network, a wireless local area network (LAN), a wired LAN or the Internet.

[0054] Communications between the parking meters and the central data manager may be in regard to payment authorization, arrival event reporting, payment alerts, time lapse alerts, status reports, fault reporting and/or configuration and software updates.

[0055] It will be appreciated by those skilled in the art that the local data managers may concentrate data received from their respective parking meter group members before communicating with the central data manger; synchronized time division multiplexing may be used to keep active transmit and receive times short; data may be encrypted; and messages may be acknowledged to improve reliable delivery.

[0056] Each group of parking meters and its associated local data manager may be in the form of a mesh radio network, such that certain parking meters may act as relays for other parking meters that don't have direct communication with the local data manager.

[0057] Group members may communicate with members of other groups, as desired for system operation.

[0058] In FIG. 1A, an embodiment of a single space parking meter is designated generally by the reference numeral 10-1. The parking meter 10-1 includes a location housing 2, a cash collection box 4, and a meter unit 6. The location housing 2 is fixedly attached to a pole 8 associated with a parking space at a geographic location, with the cash collection box 4 and the meter unit 6 being received in the location housing. The meter unit 6 is a removable meter unit that can be replaced independently of other components of the meter 10-1 such as the housing 2 and cash collection box 4. The cash collection box is also removable and can also be replaced independently of the other meter components.

[0059] In FIG. 1B, another embodiment of a single space parking meter is designated generally by the reference numeral 10-2. The parking meter 10-2 includes the location housing 2, the cash collection box 4, the meter unit 6, and an auxiliary device 3-1 in the form of a tag. The cash collection box 4, the meter unit 6, and the tag 3-1 are received within the housing 2. The housing 2 is fixedly attached to the pole 8. The tag 3-1 is permanently attached to an inner surface of the housing 2. Attachment to an inner surface shields the tag from the outside environment and helps prevent damage and vandalism to the tag. The cash collection box 4 and meter unit 6 are removable and replaceable. In the example shown in FIG. 1A, the tag 3-1 is connectable to the meter unit 6 by means of a length of wire 5 and a plug-in connector 7 at the meter unit, and can be powered by the meter unit (e.g., by a battery, solar cell, or other power source associated with the meter unit). The tag 3-1 is useful for associating the collection box 4 and meter unit 6 with the location.

[0060] Referring to FIG. 1C, another embodiment of a single space parking meter is designated generally by the reference numeral 10-3. The parking meter 10-3 is similar to the parking meter 10-2 of FIG. 1B except that the parking meter 10-3 includes a wireless tag 3-2 and the meter unit 6-2 includes a wireless transceiver 9. The wireless tag 3-2 communicates wirelessly with the meter unit and can be, for example, an RFID tag, a smart card, an ID token, or the like. The wireless transceiver 9 receives information from

the tag 3-2 and, for example, can be a radio transceiver that uses WiFi, Bluetooth, WiMax, or other short range wireless radio technology, in accordance with the wireless communication channel used by the tag.

[0061] In some embodiments, such as, for example, where the tag 3-2 is an RFID and/or a smart card, the wireless tag 3-2 is powered by the signal transmitted by the transceiver 9. In other embodiments, the wireless tag 3-2 can be powered by a battery. Since the distance from the wireless transceiver 9 to the tag 3-2 is relatively small, the power consumed by the wireless transceiver 9 and/or the tag 3-2 can be very low, such that a relatively small capacity battery that is compact provides sufficient power to the transceiver and/or tag for operation without need for hibernation or sleep modes. That is, the transceiver 9 is always available to receive communications and transmit data. In some embodiments and deployments, the meters 10 can be powered by solar panels such as photovoltaic structures, which can supplement or replace battery power. The self-powered feature eliminates the need for wired power connections from an electrical supply utility grid to the meters.

[0062] The wireless transceiver 9 of the parking meter 10-3 could be an Infrared (IR) transceiver that emits an infrared beam for data communication. In that case, the transceiver 9 is aligned with the tag 3-2 such that the infrared beam of the transceiver is properly targeted at the tag 3-2.

[0063] In one embodiment, the wired tag 3-1 or the wireless tag 3-2 is used to monitor the content of the cash collection box 4, as will be explained further below. Each tag 3 has a unique identifier that identifies the parking meter 10 with which it is used, and that is associated with a unique physical location where the parking meter is fixedly located, e.g., the location of the pole 8 and the location housing 2.

[0064] The wireless transceiver 9 can be configured to receive a signal from a parking sensor associated with the physical location. For example, the signal from the parking sensor can signal an arrival event at the location that is associated with the tag 3 that is fixedly identified with the physical location. Details of methods and apparatus for providing and reporting the arrival event signal are discussed further below.

[0065] Preferably, the location housing 2 is configured to permanently receive the tag 3. In the context of the present description, permanently receiving the tag 3 means that the

tag is affixed to the location housing 2 such that the tag cannot be removed without leaving clear physical evidence of its removal from the location housing, and/or such that removal makes the tag 3 inoperable. The tag 3 can be permanently affixed with an adhesive glue, double sided tape, single sided tape, soldering, and similar techniques that will be known to those skilled in the art.

[0066] The embodiment of the location housing 2 in FIGS. 1A, 1B, and 1C is a clam-shell type of housing that is affixed to the pole 8 and is configured to mate with a removable meter unit 6. In other embodiments, however, the location housing 2 can be a cabinet or other enclosed space that is configured to mate with one or more removable meter units, where the removable meter units are configured to be mated in compartments or sockets of the cabinet, such that each of the compartments is associated with a physical location that is not necessarily at the same location as the cabinet or the compartment. In other embodiments, the location housing can be another type of receptacle fixedly placed and associated with a physical location.

[0067] FIG. 2A is a functional block diagram of a removable meter unit that can be used in the meter 10-1 of FIG. 1A and is designated generally by reference numeral 6-1. The removable meter unit 6-1 includes a radio transceiver 12, an antenna 14, a control module 16, and a user interface 18 through which payment can be received. As indicated above, the parking meter 10 is self-powered and, and as described more fully below, communicates with a local data manager via the radio transceiver 12 and operates under control of the control module 16.

[0068] The control module 216 includes one or more processors such as application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), processors, controllers, micro-controllers, microprocessors, other electronic units designed to perform the functions described herein, and/or a combination thereof. The control module 16 also includes one or more storage mediums. A storage medium can include one or more memories for storing data, including read only memory (ROM), random access memory (RAM), magnetic RAM, core memory, magnetic disk storage mediums, optical storage mediums, flash memory devices and/or other machine readable mediums for storing information.

[0069] The user interface 18 provides a means for a location user to interact with the meter unit 6-1 and can include, for example, a display, one or more lights, and a keypad. The user interface 18 can provide a payment interface including a currency receiver for receiving coins and/or bills from a user in payment for using the parking location, as well as a reader for processing credit cards, debit cards, payment tokens, and the like. The control module 16 is coupled to the user payment interface and is configured to receive payment information regarding the amount of a payment and/or card or token information received at the payment interface. The control module 16 communicates the payment information from the user interface 18, via the radio transceiver 12, with the local data manager. The one or more lights of the user interface 18 can be used as an indicator as to the payment status or, as discussed further below, can be used to produce an indication that a parking space that is associated with the location of the meter 10 is occupied.

[0070] FIG. 2B shows functional block diagrams of an exemplary removable meter unit 6-2 and a tag 3 that can be used in meters such as the meters 10-2 and 10-3 of FIGS. 1B and 1C. The meter unit 6-2 includes similar components to the meter unit 6-1 in FIG. 2A, including the radio transceiver 12, the antenna 14, the control module 15, and the user interface 18. In addition, the meter unit 6-2 also includes a short range interface 11 by means of which it communicates with the tag 3. The tag 3 has a short range interface 13, an ID module 15, and an optional memory module 17 for storing information regarding operating parameters including a payment collection history and/or configuration settings. Operating parameters that effect the configuration settings of the removable meter unit can include such things as a parking rate, a geographic location, parking rules, an amount of currency in a cash box and times when parking rates or rules apply, and so forth. The meter unit 6-2 is linked to the tag 3 for data communications by a link 37. In the case where the tag 3 is a wired tag 3-1, the link 37 is the wire 5. In the case where the tag 3 is a wireless tag 3-2, the link 37 can be a radio link or an optical link. In the case of a wireless tag 3-2, the short range interfaces 11 and 13 can be RFID devices, Bluetooth devices, WiFi devices, IR devices, smart card devices, and the like.

[0071] In one embodiment, the control module 16 communicates the payment information, via the link 37, to the short range interface 13 of the tag 3. The short range interface 13 then updates the optional memory module 17 based on the received payment information. The memory module 17 can add the amount of currency indicated to have

been received by the received payment information to the stored amount. In addition, the memory module 17 can also receive and store transaction-time information including the date and time of day that the payment was received.

[0072] The ID module 15 stores a unique identifier, e.g., a serial number, that is associated with the tag 3. Preferably, the unique identifier of the tag 3 and the value stored in the memory module 17 are externally readable via the short range interface 13. The identifier of the tag 3 and value stored in the memory module 17 may be read, for example, by a suitable reader (not illustrated). If the short range interface 13 is an RFID module, then the reader could be an RFID reader. Other types of readers that can be used depend on the configuration of the tag and module, but can include devices such as IR readers, smart card readers (contact or non-contact), plug-in readers, and the like. In this way, periodic downloading of the value stored in the memory module 17 and the identifier of the associated tag 3 can be performed in order to monitor how much cash should be in the cash collection box 4 (FIG. 1). This downloaded cash value can then be used to catch a thief that is pocketing some of the cash.

[0073] In one embodiment, the payment collection history information stored in the memory module 17 can be externally reset to zero whenever the cash collection box 4 is emptied or replaced. In one aspect of this embodiment, the removable meter unit 6-2 automatically detects when the cash collection box 4 is removed. This can be accomplished using a sensor such as a motion sensor, an IR sensor, a magnetic field sensor, or the like.

[0074] When the removable meter unit 6-2 detects that the cash collection box 4 is removed, the short range interface 11 of the removable meter unit 6-2 communicates a signal to the short range interface 13 of the tag 3. In response to the signal indicating removal of the cash collection box 4, the short range interface 13 of the tag 3 resets the payment collection history stored in the memory module 17 to indicate no collection history and, preferably, stores the total amount of currency collected since the last cash collection box removal in the memory module 17. In another aspect of this embodiment, the tag 3 is configured to detect the removal of the cash storage box 4 and to autonomously reset the payment history and store the total amount of currency collected into the memory module 17.

[0075] Referring to FIG. 3, a parking meter system that uses a number of the parking meters of FIGS. 1A, 1B and/or 1C is designated generally by the reference numeral 20. The system 20 utilizes a number of the parking meters 10. In general, the system includes one parking meter 10 for each parking space. The parking meters 10 can be, for example, any of the parking meters 10-1, 10-2, or 10-3 shown in FIGS. 1A, 1B, and 1C, respectively, that include the removable meter unit 6 with the radio transceiver 12. The parking meters 10 are operated according to groups, such that a predetermined number of parking meters 10 comprise group members and each group includes a local data manager 22. Thus, each group of parking meters 10 and its associated local data manager 22 form a local group 24. In FIG. 3, each operational group is indicated by a dashed line. In one embodiment, there are approximately thirty parking meters 10 in each local group 24. For simplicity of illustration, not all the parking meters 10 are shown in the local groups 24 illustrated in FIG. 3. The local data manager 22 can perform management tasks associated with maintaining the parking meters 10 in proper operational condition, in addition to performing communications with all of the group members. The local data manager will generally require resources greater than required by the parking meters to perform their respective functions.

[0076] Each of the local data managers 22 communicates with a central data manager 26. In the example system 20 this is effected by means of a cellular telephone network, with each local data manager 22 and the central data manager 26 being connected to a base station 28 of the cellular telephone network. Data links are thereby established between the local data managers 22 and the central data manager 26. The central data manager 26 can perform management tasks associated with maintaining the local data managers 22 in proper operational condition and managing operations of the system. The central data manager will generally require resources greater than required by the local data managers to perform their respective functions. If desired, one of the local data managers can be operated as, and perform the functions of, the central data manager. It should be apparent that a local data manager performing the functions of a central data manager must have sufficient resources to perform such functions. In FIG. 3, the central data manager 26 is generally indicated by dashed lines. Although only three local groups 24 are shown in FIG. 3, it should be understood that there can be more or fewer of the local groups 24.

[0077] Each local data manager 22 has a modem 30, a control device 32, a memory 34, and a radio transceiver 36 with an antenna 38. As indicated above, each local data manager 22 communicates with the parking meters 10 in its local group 60 via its radio transceiver 36 and the radio transceiver 12 of the parking meter 10. The local data managers 22 may do so directly, or indirectly via another parking meter 10 as indicated with parking meters 10-4 and 10-5 in FIG. 3.

[0078] The memory 34 of a data manager 22 can include one or more memories for storing data, including read only memory (ROM), random access memory (RAM), magnetic RAM, core memory, magnetic disk storage mediums, optical storage mediums, flash memory devices and/or other machine readable mediums for storing information. The memory 34 stores the payment collection history information received from the parking meters 10 in the local group 60. The payment collection history information stored in the memory 34 is communicated to the central data manager 26 via the modem 30, the base station 28 and any intervening networks such as, for example, the Internet.

[0079] The control device 32 comprises one or more processors coupled to the memory 34 and configured to control the functions associated with the radio transceiver 36 and the modem 30. The processor can include one or more of application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), processors, controllers, micro-controllers, microprocessors, other electronic units designed to perform the functions described herein, and/or a combination thereof.

[0080] Alternatively to communicating with a local data manager 22, some embodiments can provide the parking meter 10 with a radio interface 12 that communicates with the central data manager 26 rather than through a local data manager. In these embodiments, the radio transceiver 12 can comprise a cellular telephone transceiver, a MAN transceiver, a satellite transceiver, or other type of transceiver that communicates over a network to the central data manager 26 without using an intermediary (local) data manager.

[0081] The central data manager 26 has a controller 40 with a modem and a database store 42. It also has a communication module for communicating with financial institutions (not shown) to obtain authorization for credit or debit card payments and payment. The modem of the central data manager 26 can be any modem configured to

communicate over a network such as the Internet. In one embodiment, the data store 42 includes a database that stores tag IDs and/or parking sensor IDs and associates the IDs with the unique physical locations and the removable meter unit IDs in order to store the payment collection histories as discussed above.

[0082] In a typical implementation, the transceivers 12 of the removable meter units 6 and the transceivers 36 of the local data mangers 22 have a power rating of about 1 mW and have a useful range of about 80 meters. Thus, each local group 24 can extend over an area having a radius of approximately 80 meters. Such a configuration is easily achievable with currently available technology. Alternative configurations may be suitable with other operating ranges and technologies.

[0083] In use, if a person wishing to park at a space associated with a parking meter as described herein wants to pay for parking time by means of a credit card or debit card or other payment token, the relevant information is read by a reader of the parking meter and is transmitted to the central data manager 26 via the relevant local data manager 22. The central data manager 26 obtains authorization and communicates the authorization back to the appropriate parking meter 10 via the relevant local data manager 22. Status reports, fault reporting, and/or configuration and software updates, may be communicated between the parking meters 10, the local data manager 22, and/or the central data manager 26.

[0084] In one embodiment where the parking meter 10-4 communicates with one or more other intermediate parking meters 10-5, and the intermediate parking meter 10-5 in turn communicates with the local data manger 22, the parking meters 10-4 and 10-5 communicate using a mesh network protocol. Mesh network protocols can be provided by several conventional protocols including Bluetooth, WiFi, and 802-15 (e.g., 802.15.4 commonly referred to as WPAN (Wireless Personal Area Network) including Dust, ArchRock, and ZigBee).

[0085] Referring to FIG. 4, an example of a local group 24-1 of parking meters 10 that can be monitored by the parking meter system 20 of FIG. 3 is shown. The local group 24-1 includes eight parking meters 10, but other numbers of parking meters 10 could be included in the local group 24-1. Each parking meter 10 is fixedly located at and associated with a parking space 50. The parking spaces 50 are angled parking spaces that could be located in a parking lot or on a street, for example. Other arrangements of

parking spaces are suitable, such as parallel spaces, and will occur to those skilled in the art.

[0086] The parking meters 10 each include a removable meter unit 6, such as the removable meter units 6-1 and 6-2 illustrated in FIGS. 2A and 2B, that include a radio transceiver 12. The eight parking meters 10 communicate, via the radio transceiver 12, with the antenna 38 and the radio transceiver 36 of the local data manager 22. The parking meters 10 can communicate directly with the local data manager 22, as illustrated by connections 62, or indirectly (e.g., using a mesh network) via one of the other parking meters 10, as illustrated by connection 64 between parking meters 10-4 and 10-5. As discussed above, the removable meter units communicate information to the local data manager 22, the information including tag IDs, parking sensor IDs, removable meter unit IDs, payment collection information including currency received and credit/debit card information.

[0087] Each of the parking spaces 50 has an associated parking sensor that detects when a vehicle is parked in the parking space 50. Each of the parking spaces 50 in the local group 24-1 is shown with three parking sensors 51, 52, and 53. Typically, a single parking space 50 only has one parking sensor, it should be understood that the example shown in FIG. 4 shows three possible locations for purposes of illustration.

[0088] The parking sensors 51, 52, and 53 can be any of various sensors to detect occupancy (and vacating) of the physical location associated with the space 50, including magnetic field sensors, motion sensors, contact sensors, and the like. The parking sensors 51 and 52 are located away from the parking meters 10 whereas a sensor such as the parking sensor 53 is co-located with one of the parking meters 10. Preferably, each of the remote parking sensors 51 and 52 includes a short range wireless interface that is configured to communicate with the short range interface 11 of the parking meters 10, as illustrated by the connections 54 and 56 in FIG. 4. Alternatively, the remote parking sensors 51 and 52 could be connected via a wire to one of the parking meters 10. The co-located parking sensors 53 could be connected via a wired or wireless connection to the parking meter 10 with which each is co-located (e.g., using similar connections as the tag connection 37 discussed above).

[0089] The parking sensor 51 could be, for example a magnetic field sensor that is affected by the presence of a large metallic object such as a vehicle. The parking sensor

51 could also be a motion sensor that is triggered by motion of a vehicle or a contact sensor (including sensors such as an accelerometer or inclinometer) that is triggered by the weight of a vehicle. The location of the parking sensor 51 as depicted in FIG. 4 is only an example. Those skilled in the art will understand that other locations could also be suitable. The parking sensors 51 are sufficiently sensitive to detect a vehicle that is present in the parking space 50 with which the particular parking sensor 51 is uniquely associated, but are not so sensitive that they produce a "false positive" signal, such as if they mistakenly determine that a vehicle in a neighboring parking space is parked in the parking space 50 that is uniquely associated with the particular parking sensor 51 and parking meter 10.

[0090] The parking sensors 52 are located at the base of each parking meter 10. For example, a sensor 52 could be located at the bottom of the support pole 8 for a meter (see FIG. 1). This location has the advantage of being close to the parking meter 10, thereby affording a short transmission distance and low power consumption for communications. In addition, with a base location, the parking sensor 52 will not be blocked by the presence of a vehicle in the associated parking space, as would be the case if the parking sensor 51 were located in the middle of the parking space 50. The parking sensors 52 detect the presence of a vehicle in the associated space and can be sensors such as magnetic sensors, motion sensors, or contact sensors.

[0091] The co-located sensors 53 could also be magnetic sensors, motion sensors, or contact sensors. In the case of contact sensors, the parking sensor 53 could simply be a button that a person manually interacts with, thereby alerting the meter 10 that the associated parking space is occupied.

[0092] The remote parking sensors 51 and 52 can be powered by an internal battery. The typical transmission distances are relatively small, so the battery lifetime with currently available technology can be on the order of months or even years. Alternatively, the remote parking sensors 51 and 52 could be powered by the meter 10 (e.g., via battery or solar cell contained in the meter 10) if they are connected via a wire. The co-located parking sensor 53 can be powered by a power source at the meter 10 (e.g., a battery or solar cell).

[0093] Regardless of which type of sensors are used, the parking sensors 51, 52, 53 are configured to transmit an indication of an arrival event to one of the meters 10 that is

uniquely associated with the parking space 50 where the parking sensor is located. In an alternative embodiment, the parking sensors 51, 52, 53 could transmit to any of the parking meters 10, as illustrated by the multicast connections 58. In this embodiment, the local group 24-1 could employ a mesh network protocol. In such a configuration, the parking meters 10 that receive the transmission from another sensor will forward the arrival event notification to the local data manager 22.

[0094] Each of the parking sensors 51, 52, 53 has an ID, e.g., a serial number, that is transmitted with the arrival event indication to the parking meters 10. The local data manager 22, or alternatively the central data manager 26, maintains a data base that associates the parking sensor IDs with tag IDs, meter IDs, and location information. This database is used to keep track of which locations are occupied and to keep track of the currency collected and handling credit or debit card transactions associated with each location (space).

[0095] In the embodiment shown in FIG. 4, the local data manager 22 uses the modem 30 to communicate with the central data manager 26 via the Internet 60. It should be understood that "modem" as used herein refers to any device that provides a communications interface between the local data manager and the network. The information communicated to the central data manager 26 includes tag IDs, removable meter unit IDs, arrival event indication reports, alerts regarding failure to receive payment subsequent to detecting an arrival event, and payment collection information including currency received and credit/debit card information.

[0096] Referring to FIG. 5, another example of a local group 24-2 of parking meters 10 that can be monitored by the parking meter system 20 of FIG. 3 is shown. The local group 24-2 includes eight parking meters 10, but other numbers of parking meters 10 could be included in the local group 24-2. Each parking meter 10 is fixedly located at and associated with a parking space 50 (only four of the eight parking spaces 50 are shown). The parking spaces 50 are parallel parking spaces that can be located on a street, for example.

[0097] The parking meters 10 each include a removable meter unit 6, such as the removable meter units 6-1 and 6-2 illustrated in FIGS. 2A and 2B, that include a radio transceiver 12. The eight parking meters 10 communicate, via the network transceiver 12 with the antenna 38 and the radio transceiver 36 of the local data manager 22. The

parking meters 10 can communicate directly with the local data manager 22, as illustrated by connections 62, or indirectly (e.g., using a mesh network) via one of the other parking meters 10, as illustrated by connection 64 between parking meters 10-4 and 10-5. As discussed above, the removable meter units communicate information to the local data manager 22 which then communicates the information to the central data manager 26, e.g. via the modem 30 and the Internet 60. The information communicated to the central data manager 26 includes tag IDs, removable meter unit IDs, arrival event indication reports, alerts regarding failure to receive payment subsequent to detecting an arrival event, and payment collection information including currency received and credit/debit card information.

[0098] The location of the parking sensors 51 in the local group 24-2 is illustrated as being in the street at the edge of the respective parking spaces 50. This sensor location ensures that the sensor transmission signals will not be blocked by a vehicle parked in the parking space 50. In one embodiment, the parking sensors 51-53 transmit to any of the parking meters 10 utilizing a mesh network protocol, as illustrated by the connections 58.

[0099] In one embodiment, the parking sensors 51, 52, 53 use shielding in order to detect an arrival event when a vehicle enters the associated parking space 50 and to avoid a false arrival event detection, e.g. due to vehicle traffic in the street or parking lot where the parking space 50 is located. The shielding can include physical shielding that prevents detection in one or more directions. For example, the parking sensors 51 in FIG. 5 could be shielded from detecting vehicles in the street. The shielding can also be implemented in software where signals emanating from one or more directions are not considered indicative of an arrival event.

[0100] Referring to FIG. 6, a flowchart of an embodiment of a process 600 for automatic location reporting performed by a meter such as the parking meters 10 of FIGS. 1A, 1B, and/or 1C in the system of FIG. 3 is illustrated. In one embodiment, where a removable meter unit 6 is contained in a housing 2 that includes a tag 3, e.g., the removable meter unit 6-2 and tag unit 3 illustrated in FIG. 2B, the process 600 starts at block 602 where the short range interface 11 of the meter unit 6-2 receives a data signal including tag information from the tag 3. The tag information includes a tag ID that is uniquely identified with the location where the tag is permanently attached.

[0101] Upon receiving the tag information at the block 602, the process 600 continues at block 604 where the radio transceiver 12 transmits the tag information and a meter ID to the a data manager such as the local data manager 22 or the central data manager 26. The data manager can then associate the meter ID with the tag ID which is associated with the location where the tag is fixedly located. The receiving and transmit steps 602 and 604 can be performed when the removable meter unit 6-2 is first inserted in the housing 2. The blocks 602 and 604 are optional in that they are omitted if the housing 2 does not contain a tag 3. The optional nature of these operations 602, 604 is indicated in FIG. 6 by dashed lines for these two blocks.

[0102] At block 606, the short range interface 11 receives an indication of an arrival event at the location, e.g., a parking space 50, that is associated with the parking meter. In one embodiment, the indication of the arrival event is a signal received from a parking sensor such as one of the parking sensors 51-53 illustrated in FIGS. 4 and 5. In another embodiment, the indication of the arrival event is a manually initiated interaction with the user interface 18 of the removable meter unit 6. For example, a person inserting a coin, bill or credit/debit card into the removable meter unit 6 or pushing a button of the user interface 18 thereby triggering the receipt of the indication of the arrival event at the block 606.

[0103] The arrival event can also be a vehicle leaving the parking space 10 at the location of the meter 10. Upon detecting that a vehicle has departed a parking space 50, the parking sensor transmits a data signal indicating that the parking space 50 is unoccupied. In one embodiment, the control module 16 of the meter 10 is configured to zero out the paid time period in response to receiving the data signal indicating that a vehicle has left leaving the parking space 50 unoccupied.

[0104] Upon receiving the indication of the arrival event at the block 606, the process 600 continues to block 608 where the meter produces an occupancy indication in response to the arrival event at the location with which the meter is associated. The occupancy indication can be a flashing light of the user interface 18. The occupancy indication could also be an alert signal transmitted to the data manager including an ID associated with the parking sensor and/or tag that is associated with the parking space at the location. In one embodiment, the color of the light is one color if the arrival event resulted from a vehicle

entering the parking space 50 and another color if the arrival event resulted from a vehicle exiting the parking space 50.

[0105] The occupancy indication produced at the block 608 serves as a notification to external parties (e.g., data managers, parking attendants, the person that parked in the parking space 50, etc.) that a parking fee payment should be received imminently. The process 600 includes a decision block 606 where the control module 16 determines if a payment has been received within a time period after the arrival event indication signal was received at the block 606. The time period could be, for example, on the order of one to two minutes. If at the block 606 it is determined that a payment was not received within the time period, the process 600 continues to block 612 where the control module 16 generates a location report indicating an alert signal. The location report indicating the alert signal includes an alert notification and information associated with the location where the arrival event was detected. The information associated with the location is either the tag ID, if the meter 10 includes a tag 3, or the parking sensor ID or the meter ID.

[0106] If at the block 606 it is determined that a payment was received within the time period, the process 600 continues to block 614 where the control module 16 generates a location report indicating a received payment at the meter 10. The location report indicating the received payment can include an amount of currency received at the meter 10 or credit/debit card or payment token information. In addition, the location report indicating the received payment includes a tag ID, a parking sensor ID or a meter ID, any of which can be used to identify the location where the arrival event occurred.

[0107] Upon generating either of the location reports at the blocks 612 or 614, the process 600 continues to block 616 where the radio transceiver 12 transmits the location report to the data manager. The data manager can be either the local data manager 22 or the central data manager 26 or both, depending on the embodiment.

[0108] Upon receiving payment at the meter 10, a predetermined amount of parking time is provided. The parking time may be counted down locally at the meter and can be alternatively or additionally tracked at a local and/or central data manager. If the parking time lapses, the process 600 continues to block 618, where the control module 16 generates another location report indicating an alert signal. This location report and alert signal contains information indicating that the paid time period has lapsed and also

contains a tag ID, a parking sensor ID, and/or a meter ID that can be used to identify the location where the lapsed time period occurred.

[0109] Upon generating the location report at the block 618, the process 600 continues to block 620, where the radio transceiver 12 transmits the location report to the data manager. Again, the data manager can be either the local data manager 22 or the central data manager 26 or both.

[0110] The functions at the blocks 602-620 of the process 600 continue as needed, depending on the events that occur (e.g., whether the removable meter unit 6 is replace, whether an arrival event occurs or whether alert events occur). It should be noted that the functions of the blocks 602 to 620 of the process 600 can be combined, rearranged or omitted. The operations depicted in FIG. 6 can be carried out by the control modules of the various devices described herein, in accordance with the description.

[0111] Referring to FIG. 7, a flowchart of an embodiment of a process 700 for operating a meter such as the parking meters 10 of FIGS. 1A, 1B and/or 1C in the system of FIG. 3 is illustrated. The process 700 is an embodiment of a process of operating a meter 10 to receive configuration updates and/or to report meter operating data. Preferably, the meter 10 includes a radio transceiver 12 that is awake continuously to monitor for messages received from other meters 10 or the local data manager 22 of a local group 24. It is also preferable that the local group 24 utilizes a low power LAN. In this way, the meters 10 can continuously monitor for messages and not significantly deplete a self contained power source such as a battery with a solar cell backup. Higher power radio transceivers such as cellular transceivers wake up only occasionally to receive messages or wake up when a user interacts with the meter 10. By monitoring for messages continuously, the meter 10 can be assured of receive a message that is initiating a communication session such as a configuration update or a parking arrival notification.

[0112] The process 700 starts at block 702 where the radio transceiver 12 monitors the LAN to identify a message directed to the meter 10. The message can be from another meter 10 or from the data manager 22. The message is an initial message in a communication session. As used herein, a communication session is a finite series of messages that are performed to complete a task. The messages of a communication session are exchanged between the meter 10 and one or more other remote devices, e.g., the data manager 22, a parking sensor and/or another meter 10. The task associated with a

communication session can be, for example, updating operational parameters of the meter 10, updating firmware of the meter 10, reporting an arrival event (see process 600 in FIG. 6) or performing a remote payment authorization for a non-cash payment (e.g., a payment authorization that was processed remote to the meter 10 in response to a payment authorization request initiated by another remote device such as a cell phone using a credit card, smart card and/or debit card). The initial message identified at block 702 includes information indicating what the task associated with the communication session entails. In some embodiments, the initial message also includes other information related to the task such as, for example, operational parameters (e.g., a parking rate, a geographic location, parking rules, an amount of currency in a cash box or times when parking rates or rules apply), firmware, parking sensor identification, remote payment authorization information, etc.

[0113] Not all messages that the meter 10 identifies at block 702 are directed to the meter 10 that is performing the process 700. The messages received at block 702 can be directed to other meters 10 or to the data manager 22. The messages identified at block 702 include an addressee field that indicates the meter 10 or data manager to which the message is directed. In a mesh network, the messages received at a meter that are directed to other meters 10 or the data manager 22 can be forwarded on by the meter 10 performing the process 700. As described below, such forwarding operations can be included in the "NO" outcome processing of the decision box 704.

[0114] Upon identifying a message at block 702, the process 700 continues to block 704, where the control module 16 determines if the addressee of the message is the meter 10 performing the process 700. If it is determined that the message is not directed to the meter 10 performing the process 700, the process 700 returns to block 702 (with optional forwarding operation). If it is determined the message is directed to the meter 10 performing the process 700, the process 700 continues to block 706 where the radio transceiver 12 establishes the communication session with the data manager 22. Establishing the communication session at block 706 includes transmitting an acknowledgement message to the data manager 22. The acknowledgement message contains information identifying the initial message (e.g., a message serial number) that was received at the block 702. The acknowledgement message can also include other information relevant to the task associated with the communication session.

[0115] Upon establishing the communication session at block 706, the process continues to block 708, where the radio transceiver 12 receives configuration information from the data manager 22. The configuration information is associated with the operation of the meter 10. The configuration information is also uniquely associated with the location of the meter 10. The type of configuration information received at the block 708 depends on the task being performed in the communication session. For example, in the case of a remote payment authorization, the received configuration information includes an amount of time for which payment has been authorized and which will be displayed on the user interface 18 of the meter. In the case of a firmware and/or operating software update, the configuration information includes the updated firmware and/or operating software to be stored in a memory of the meter 10. In the case of updated operational parameters, the configuration information may include operating parameters such as, for example, a parking rate for the meter 10, a geographic location, parking rules such as maximum terms or meter resetting rules, an amount of currency in a cash box of the meter, and times when different parking rates or rules apply. As with other configuration information, the operating parameters received at block 708 are stored in memory of the meter 10. Additionally, the configuration information can include information used to change the display information on the display of the meter 10, information used to change the way lights (e.g., expiration indicating lights) operate, and updated coin validation criteria (e.g., criteria that allows acceptance of new coins or tokens or modifies validation algorithms to identify invalid coins or slugs known to cause problems).

[0116] At block 710, the radio transceiver 12 transmits meter operating data to the data manager 22. The type of meter operating data transmitted at block 710 depends on the task being performed in the communication session. The transmitted meter operating data can include a payment authorization request, a report of payment received at the meter, location reports as discussed in reference to FIG. 6, or tag information. The meter operating data can also include an acknowledgement that the meter 10 received the configuration information at block 708.

[0117] At block 712, the control module 16 determines if the communication session is over, or completed. The communication session is over when the task associated with the communication session is completed. If it is determined that the communication session is over, the functions at the blocks 702-712 of the process 700 continue as needed,

depending on the events that occur (e.g., whether an initial message directed to the meter 10 is received at block 702). If it is determined at block 712 that the communication session is not over, the process 700 returns to perform the functions at blocks 708-712 until the communication session is completed. It should be noted that the functions of the blocks 702-712 of the process 700 can be combined, rearranged or omitted. The operations depicted in FIG. 7 can be carried out by the control modules of the various devices described herein, in accordance with the description.

[0118] Referring to FIG. 8, a flowchart of an embodiment of a process 800 for operating a meter such as the parking meters 10 of FIGS. 1A, 1B and/or 1C in the system of FIG. 3 is illustrated. The process 800 is an embodiment of a process performed by the data manager 22 for purposes of causing a meter 10 to receive configuration updates and/or receive meter operating data from the meter 10. Similarly to the process 700, it is preferable that the meter 10 includes a radio transceiver 12 that is awake continuously to monitor for messages received from other meters 10 or the local data manager 22 of a local group 24. It is also preferable that the local group 24 utilizes a low power LAN.

[0119] The process 800 starts at block 802 where the radio transceiver 36 or the modem 30 receives information from the central manager 26, one of the meters 10 and/or from a remote device such as a cell phone. The information received at the block 802 can be an authorization of payment that was processed remotely from the meters 10, updated firmware for one of the meters 10 or updated operational parameters for one of the meters 10.

[0120] Upon receiving the information at block 802, the process 800 continues at block 804, where the control module 32 determines if a communication session with one of the meters 10 should be initiated. If it is determined that a communication session is not needed, the process 800 returns to block 802. If it is determined that a communication session is needed, the process 800 continues to block 806, where the radio transceiver 36 transmits an initial message of the communication session toward one or more of the meters 10. The initial message transmitted at block 806 includes information indicating what the task associated with the communication session entails. In some embodiments, the initial message also includes other information related to the task such as, for example, operational parameters (e.g., a parking rate, a geographic location, parking rules, an amount of currency in a cash box or times when parking rates or rules apply), firmware,

parking sensor identification, remote payment authorization information, and the like. Thus, changes in any of these values can be efficiently communicated to the parking meters. The initial message transmitted at block 806 also includes an addressee field that indicates the meter(s) 10 to which the initial message is directed. In a mesh network, the initial message can be received by any of the meters 10, and the meter 10 that receives the message can forward the message to the meter 10 to which the initial message is directed.

[0121] The communication session is established at block 806 when the meter 10 to which the initial message was directed responds with an acknowledgement message. Upon the communication session being established, the process 800 continues at block 808, where the radio transceiver 36 transmits configuration information to the meter 10. The configuration information is associated with the operation of the meter 10. The configuration information is also uniquely associated with the location of the meter 10. The configuration information can include any of the types of configuration information discussed above in reference to block 708 of FIG. 7.

[0122] At block 810, the radio transceiver 36 receives meter operating data from the meter 10. The type of meter operating data transmitted at block 810 depends on the task being performed in the communication session. The meter operating data can include a payment authorization request, a report of payment received at the meter, location reports as discussed in reference to FIG. 6 or tag information. The meter operating data can also include an acknowledgement that the meter 10 received the configuration information at block 808.

[0123] At block 812, the control module 32 determines if the communication session is over. The communication session is over when the task associated with the communication session is completed. If it is determined that the communication session is over, the functions at the blocks 802-812 of the process 800 continue as needed, depending on the events that occur. If it is determined at block 812 that the communication session is not completed, the process 800 returns to perform the functions at blocks 808-812 until the communication session is completed. It should be noted that the functions of the blocks 802-812 of the process 800 can be combined, rearranged or omitted. The operations depicted in FIG. 8 can be carried out by the control modules of the various devices described herein, in accordance with the description.

[0124] Referring to FIG. 9, a parking meter management system 900 for monitoring and updating a parking meter system includes a central management server 910. The central management server 910 can be located at the central data manager 26 illustrated in FIG. 3. The central management server 910 includes a processor 925, memory 930, a radio transceiver 935, a parking management module 940 and a modem 945. The central management server 910 executes software programming that provides the functionality described herein to perform the parking meter management tasks for reporting and maintenance. The parking management module 940 provides an interactive system that allows an end user 920 having an end user system 915 (e.g., a personal computer, a PDA, a smart phone, etc.) to program a set of parking meters. The end user system 915 connects to the parking management server 910 via the internet, for example.

[0125] The parking management system 900 also includes one or more local groups 24 that include a local data manager 24 and multiple meters 10. The radio transceiver 935 and/or the modem 945 communicates with the local data manager 22 either directly, or via the base station 28. Alternatively, the radio transceiver 935 can communicate directly with the meters 10. The radio transceiver 935 and/or the modem 945 is used to transmit information to the local group 24 and receive information from the local group 24.

[0126] The end user 920 interacts via the Internet 60 with the central management server 910 to program and/or monitor the meters 10 of the local group 24 using the interactive system provided by the parking management module 940. The parking management module 940 communicates information to and from the local group 24 via the radio transceiver 935 and/or the modem 945. The radio transceiver 935 can comprise a cellular telephone transceiver, a MAN transceiver, a satellite transceiver, or other type of transceiver that communicates over a wireless network to the local data manager 22. The modem 945 can also communicate via the internet 60 to the local data manager 22.

[0127] The parking management module 940 presents the end user 920 with a set of web pages or user interface screens that the end user navigates through in order to monitor and program the meters 10 and/or the data manager 22 of the local group 24. The end user 920 can be a city employee, for example. Interacting with the user interface screens of the parking management module 940, the end user 920 can monitor the currency collected, credit card transactions, status of the meters 10, occupancy states of the parking spots, etc.

In addition, the end user 920 can change the configuration of the meters 10 either individually or as a group.

[0128] As noted above, the central management server 910 can include a processor 925 and memory 930. The parking management module 940 can be provided as software programming that is executed by the processor to perform the data management and maintenance operations described herein. A user of the central management server can provide input via user input devices such as keyboards and computer mice and can receive output such as systems messages and reports via user output devices such as displays and the like. Additional details of the central management server 910 are described below.

[0129] FIGS. 10A and 10B show examples of user interface screens regarding meter locations generated by the parking management system 900 of FIG. 9. The user interface screens can be displayed, for example, on user output devices of the central management server 910. FIG. 10A is a road map view showing locations of parking meters. FIG. 10B is a "bird's eye view" from a satellite photograph. The meters are illustrated at their actual geographic locations by icons. The end user 920 can position the computer mouse cursor over one of the icons and obtain information regarding the status of the individual meter 10. For example, the amount of money collected in the cash box can be displayed.

[0130] FIGS 11A and 11B show examples of user interface screens regarding financial data generated by the parking management system 900 of FIG. 9. The user interface screens can be displayed, for example, on user output devices of the central management server. The screen illustrated in FIG. 11A shows monthly statistics for a group of meters, e.g., a local group 24. The financial data presented to the end user 920 includes cash amounts, credit amounts, total revenue, number of transactions as well as statistical data including cash per meter (pole), credit per meter, etc. FIG. 11B shows a summary of cash and credit collected for all the meters of a geographic area. The area that FIG. 11B represents can be various levels, such as city level, street level, zip code, etc.

[0131] FIG. 12 shows an example of a user interface screen regarding credit card transactions generated by the parking management system 900 of FIG. 9. The information in FIG. 12 includes transaction date, transaction reference number, machine reference, last four digits of a credit card, card scheme and transaction amount.

[0132] FIGS. 13A and 13B show examples of user interface screens regarding coin collection data generated by the parking meter management system 900 of FIG. 9. The information in these screens include the number of each type of coin collected and the total amount of currency collected for each meter. In this way, the end user 920 can keep track of how much money should be collected when the cash box of a given meter is collected. When coins are collected from a meter 10, the person collecting the currency inserts an identification card into the meter10 to signal to the meter 10 that the cash box is being emptied. The meter 10 then resets the coin count to zero and transmits the coin collection information back to the central management server 910.

[0133] FIG. 14 shows an example of a user interface screen regarding battery voltage data generated by the parking meter management system 900 of FIG. 9. The voltage level is used to indicate the health of the battery. When a voltage level falls below a healthy (operational) threshold level, the voltage is displayed in red in order to alert the end user 920 that a new battery should be installed at the meter 10.

[0134] FIG. 15 shows an example of a user interface screen regarding terminal events at a meter 10 generated by the parking meter management system 900 of FIG. 9. Terminal events include fault states of the meter 10 including, for example, coin path blockages and jammed credit card readers. This information allows the end user to identify problem areas and alert law enforcement officers to better monitor the problem areas to reduce vandalism.

[0135] FIGS. 16A, 16B, and 16C show examples of user interface screens regarding meter configuration information generated by the parking meter management system 900 of FIG. 9. The end user 920 can program individual meters or groups of meters using the screens of FIGS. 16A, 16B, 16C. The configuration information includes parking rates, parking time limits, parking rules and meter display messages. The display messages include four lines of text to allow the end user 920 to cause the meter display to display any message such as, for example, No Parking, Tow Away, allowable parking times, and the like. The user interface screens illustrated above in FIGS. 10-16 can be displayed, for example, on user output devices of the central management server 910.

[0136] Referring to FIG. 17, a flowchart of an embodiment of a process 950 for operating a meter with the parking meter management system 900 is illustrated. The process 950 is an embodiment of a process performed by the central management server

910 for enabling an end user 920 to reconfigure a meter 10 including providing updated configuration information and for retrieving meter operating data. Similarly to the processes 700 and 800, it is preferable that the meter 10 includes a radio transceiver 12 that is awake continuously to monitor for messages received from other meters 10 or the local data manager 22 of a local group 24. It is also preferable that the local group 24 utilizes a low power LAN.

[0137] The process 950 starts at block 952 where the radio transceiver 935 or the modem 945 communicates user interface screen data to a computer of the end user 920. The information communicated at the block 802 can be any of the screens illustrated in FIGS. 10-16.

[0138] Upon communicating the information at block 952, the process 950 continues at block 954, where the radio transceiver 935 or the modem 945 receive configuration information from the computer of the end user. The configuration information can include, for example, operational parameters (e.g., a parking rate, a geographic location, parking rules, an amount of currency in a cash box or times when parking rates or rules apply), firmware, parking sensor identification, remote payment authorization information, etc.

[0139] The process 950 continues to block 956, where the radio transceiver 935 or the modem 945 communicates an initial message of the communication session toward one or more of the meters 10. The initial message transmitted at block 956 includes information indicating what the task associated with the communication session entails. In some embodiments, the initial message also includes other information related to the task such as, for example, operational parameters (e.g., a parking rate, a geographic location, parking rules, an amount of currency in a cash box or times when parking rates or rules apply), firmware, parking sensor identification, remote payment authorization information, etc. The initial message transmitted at block 956 also includes an addressee field that indicates which meter(s) 10 the initial message is directed to. Preferably, the initial message is communicated to the local data manger 22. In a mesh network, the initial message can be forwarded by the local data manager 22 to any of the meters 10 and the meter 10 that receives the message forwards the message to the meter 10 to which the initial message is directed.

[0140] The communication session is established at block 956 when the meter 10 to which the initial message was directed responds with an acknowledgement message. Upon the communication session being established, the process 950 continues at block 958, where the radio transceiver 935 or the modem 945 communicates the configuration information toward the meter 10. The configuration information is associated with the operation of the meter 10. The configuration information is also uniquely associated with the location of the meter 10. The configuration information can include any of the types of configuration information discussed above in reference to block 708 of FIG. 7.

[0141] At block 960, the radio transceiver 935 or the modem 940 receives meter operating data from the meter 10. The type of meter operating data transmitted at block 810 depends on the task being performed in the communication session. The meter operating data can include a payment authorization request, a report of payment received at the meter, location reports as discussed in reference to FIG. 6 or tag information. The meter operating data can also include an acknowledgement that the meter 10 received the configuration information communicated at block 958. Preferably, the meter operating data is received from the local data manager 22. The radio transceiver 935 or the modem 945 can receive the meter operating data at block 960.

[0142] At block 962, the control module parking management module 940 determines if the communication session is over. The communication session is over when the task associated with the communication session is completed. If it is determined that the communication session is over, the functions at the blocks 952-962 of the process 950 continue as needed, depending on the events that occur. If it is determined at block 962 that the communication session is not completed, the process 950 returns to perform the functions at blocks 958-962 until the communication session is completed. It should be noted that the functions of the blocks 952-962 of the process 950 can be combined, rearranged or omitted. The operations depicted in FIG. 17 can be carried out by the processor of the central management server 910.

[0143] FIG. 18 is a block diagram of a computer system 1800 that may incorporate embodiments in accordance with the disclosure for performing the operations described herein, including operations of the parking meter management system 900 and the central management server 910. In the present embodiment, the computer system 1800 typically includes one or more processors 1805, a system bus 1810, storage subsystem 1815 that

includes memory subsystem 1820 and file storage subsystem 1825, user interface output devices 1830, user interface input devices 1835, a communications subsystem 1840, and the like.

[0144] In various embodiments, the computer system 1800 typically includes conventional computer components such as the one or more processors 1805, and memory storage devices such as a read only memory (ROM) 1845 and random access memory (RAM) 1850 in the memory subsystem 1820, and disk drives in the file storage subsystem 1825.

[0145] In the illustrated embodiment, the user interface output devices 1830 can comprise a variety of devices including computer displays, viewing screens, indicator lights, loudspeakers, tactile output, and the like. The user interface input devices 1835 can comprise a variety of devices including a computer mouse, a trackball, a track pad, a joystick, wireless remote, drawing tablet, voice command system, eye tracking system, and the like. The user interface input devices 1835 typically allow a user to select objects, icons, text and the like that appear on the user interface output devices 1830 via a command such as a click of a button or the like.

[0146] Embodiments of the communication subsystem 1840 typically include an Ethernet card, a modem (telephone, satellite, cable, ISDN), (asynchronous) digital subscriber line (DSL) unit, FireWire interface, USB interface, and the like. For example, the communications subsystem 1840 may be coupled to the communications networks and other systems 1855 (e.g., the Internet communications network 60 of FIGS. 4 and 5), to a FireWire bus, or the like. In other embodiments, the communications subsystem 1840 be physically integrated on the motherboard of computer system 1800, may be a software program, such as soft DSL, or the like.

[0147] The RAM 1850 and the file storage subsystem 1825 are examples of tangible media configured to store data such as payment collection, meter rates, including executable computer code, human readable code, or the like. Other types of tangible media include floppy disks, removable hard disks, optical storage media such as CD-ROMS, DVDs and bar codes, semiconductor memories such as flash memories, read-only-memories (ROMS), battery-backed volatile memories, networked storage devices, and the like.

[0148] In the present embodiment, the computer system 1800 may also include software that enables communications over a network (e.g., the communications network 60 of FIG. 4 and FIG. 5) such as the DNS, TCP/IP, UDP/IP, and HTTP/HTTPS protocols, and the like. In alternative embodiments of the present invention, other communications software and transfer protocols may also be used, for example IPX, or the like.

[0149] It will be readily apparent to one of ordinary skill in the art that many other hardware and software configurations are suitable for use with the present invention. For example, the computer system 1800 may be a desktop, portable, rack-mounted, or tablet configuration. Additionally, the computer system 1800 may be a series of networked computers. Further, the use of other microprocessors are contemplated, such as Pentium™ microprocessors; Opteron™ or AthlonXP™ microprocessors from Advanced Micro Devices, Inc; and the like. Further, other types of operating systems are contemplated, such as Windows®, WindowsXP®, WindowsNT®, or the like from Microsoft Corporation, Solaris from Sun Microsystems, LINUX, UNIX, and the like. In still other embodiments, the techniques described above may be implemented upon a chip or an auxiliary processing board (e.g., a programmable logic device or graphics processor unit).

[0150] FIG. 19 shows a block diagram illustrating examples of various electrical and other components of a parking meter device 10. The parking meter device 10 has a coin accepting and validating assembly 1916, a card reading device 1920, a display 1926, touch keys 1940, and a solar panel 1928. In addition there is a power management facility 1946, a rechargeable, replaceable battery 1948, random access memory 1950, a central controller 1952, flash memory 1954 for code, a real time clock 1956, a coin validator interface 1958, a card reader interface 1960 for cards having chips and magnetic strips and for RF electronic purses, a receiver 1962 for signals from such RF electronic purses, I/O hardware 1964, sensors, switches and reset 1966, an expiry indicator 1968, a display driver 1970 for the display 1926, a communications subsystem 1972, a cellular phone engine 1974 with its antenna 1976, a Wi-Fi engine 1978 and its antenna 1980, a GPS unit 1982 and its antenna 1984 and a serial/USB/IrDA port 1986.

[0151] The controller 1952 controls operation of the meter 10. An integrated device is used, providing RAM, ROM, and some I/O capabilities. Power down features are desirable when selecting the microcontroller, as the meter can be put in the idle or sleep

mode. A serial port is provided for debug as well as connection to an external management system.

[0152] To minimize power consumption, special power management circuitry can be provided to allow application of power to only the necessary peripherals at only the necessary times. The power management facility also provides battery status to the microcontroller to allow changes in operation based on available power, as well as health reporting to the management system.

[0153] An AMP card reader will be used as the external electrical/mechanical credit/smart card solution. One of two interfaces to the AMP device is the card head interface. A Magtek Triple Track ASIC can be used to convert the analog head signals to serial bit streams, readable by the microcontroller. The second interface to the external AMP card connector is the smart card interface. This block will provide necessary level shifting and synchronization to allow the microcontroller to bit-bang the smart card interface.

[0154] The coin validator interface 1958 is an analog/digital block that connects to 3 coils in the coin validator 1916. The coils are energized, and the change in inductance is measured as the coin passes through each of the coils. This profile can then be correlated by the microcontroller to a database of known coins to determine the type of coin present.

[0155] The parking meter device 10 contains a number of switches such as touch keys for user input, presence detection in the card reader, and door switches. The I/O hardware 1964 allows the microcontroller to sense the state of the switches.

[0156] An expansion interface may be provided that will allow a daughter card assembly to be connected to the controller board. The communication protocol over the interface will support a minimum throughput of 20KB/s. The expansion interface is intended to allow the addition of a communication device to the meter. Possible device types are: cellular, WiFi, Zigbee, and IrDA. Both communication signals and power will be provided through the expansion connector.

[0157] The following can be displayed on the display 26:- which of the 4 user buttons are pressed; information from a credit card; information from a smart card; which coins are passed through the coin validator.

[0158] A motorist can approach the meter and insert either a coin or card into the meter. Either method will wake up the electronic componentry and it will then either validate that it is a coin, credit card, debiVATM card or a Smart Card. By inserting either the required number of valid coins or by inserting a card and manipulating the controls on the touch pad the motorist can determine the amount of parking time he wishes to purchase. The amount of time purchased is then displayed on the electronic display. The parking meter device will communicate with the credit card company wirelessly and authorize the payment using that card.

[0159] Payment via an electronic tag or electronic toll road pass can be as follows. The device will either sense or be advised by an electronic sensor that a motor vehicle has parked in the parking space. It will then identify the electronic tag in the vehicle and after the vehicle has been in that parking space for a predetermined time will then deduct time from the vehicles electronic tag for a predetermined length of time and display that time on the electronic device's LCD Display. After that time has been used up and the vehicle is still parked in that same parking space the device will again deduct the required amount of money from the vehicles electronic tag and display that amount of time on the device's LCD display. This process will repeat itself until the vehicle has stayed in the parking space for the maximum amount of time allowed for that parking zone or area.

[0160] At a time determined by the owner or the controller of the parking area, the device will communicate with a management system. This can be done wirelessly or through a hand held device.

[0161] Embodiments in accordance with the disclosure can be implemented in the form of control logic in software or hardware or a combination of both. The control logic may be stored in an information storage medium as a plurality of instructions adapted to direct an information-processing device to perform a set of steps disclosed in embodiments of the present invention. Based on the disclosure and teachings provided herein, a person of ordinary skill in the art will appreciate other ways and/or methods to implement embodiments in accordance with the disclosure.

[0162] The systems and methods discussed above involved the use of parking meters located and associated with specific parking space locations. However, the above methods and systems are applicable to monitor other scenarios where a measurable quantity of product or an amount of measurable time that a product is being consumed is associated

with a unique physical location. For example, an arrival event could be a person moving up to a walk-up space in a queue, or a package arriving at a certain point on a conveyor, e.g., in a production process.

[0163] Specific details are given in the above description to provide a thorough understanding of the embodiments. However, it is understood that the embodiments may be practiced without these specific details. For example, circuits may be shown in block diagrams in order not to obscure the embodiments in unnecessary detail. In other instances, well-known circuits, processes, algorithms, structures, and techniques may be shown without unnecessary detail in order to avoid obscuring the embodiments.

[0164] Implementation of the techniques, blocks, steps and means described above may be achieved in various ways. For example, these techniques, blocks, steps and means may be implemented in hardware, software, or a combination thereof. For a hardware implementation, the processing units may be implemented within one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), processors, controllers, micro-controllers, microprocessors, other electronic units designed to perform the functions described above, and/or a combination thereof.

[0165] Also, it is noted that the embodiments may be described as a process which is depicted as a flowchart, a flow diagram, a data flow diagram, a structure diagram, or a block diagram. Although a flowchart may describe the operations as a sequential process, many of the operations can be performed in parallel or concurrently. In addition, the order of the operations may be re-arranged. A process is terminated when its operations are completed, but could have additional steps not included in the figure. A process may correspond to a method, a function, a procedure, a subroutine, a subprogram, etc. When a process corresponds to a function, its termination corresponds to a return of the function to the calling function or the main function.

[0166] Furthermore, embodiments may be implemented by hardware, software, scripting languages, firmware, middleware, microcode, hardware description languages, and/or any combination thereof. When implemented in software, firmware, middleware, scripting language, and/or microcode, the program code or code segments to perform the necessary tasks may be stored in a machine readable medium such as a storage medium.

A code segment or machine-executable instruction may represent a procedure, a function, a subprogram, a program, a routine, a subroutine, a module, a software package, a script, a class, or any combination of instructions, data structures, and/or program statements. A code segment may be coupled to another code segment or a hardware circuit by passing and/or receiving information, data, arguments, parameters, and/or memory contents. Information, arguments, parameters, data, etc. may be passed, forwarded, or transmitted via any suitable means including memory sharing, message passing, token passing, network transmission, etc.

[0167] For a firmware and/or software implementation, the methodologies may be implemented with modules (e.g., procedures, functions, and so on) that perform the functions described herein. Any machine-readable medium tangibly embodying instructions may be used in implementing the methodologies described herein. For example, software codes may be stored in a memory. Memory may be implemented within the processor or external to the processor. As used herein the term "memory" refers to any type of long term, short term, volatile, nonvolatile, or other storage medium and is not to be limited to any particular type of memory or number of memories, or type of media upon which memory is stored.

[0168] Moreover, as disclosed herein, the term "storage medium" may represent one or more memories for storing data, including read only memory (ROM), random access memory (RAM), magnetic RAM, core memory, magnetic disk storage mediums, optical storage mediums, flash memory devices and/or other machine readable mediums for storing information.

[0169] While the principles of the disclosure have been described above in connection with specific apparatuses and methods, it is to be clearly understood that this description is made only by way of example and not as limitation on the scope of the disclosure.

What is claimed is:

1. A method of operating a meter, the method comprising:

a. establishing a network communication session with a meter, the meter having an electronic display, the meter being uniquely associated with a physical location;

b. transmitting configuration information toward the meter over the network during the established network communication session, the configuration information associated with operation of the meter and uniquely associated with the physical location of the meter, the configuration information comprising meter display message updates, and one or more of: coin validation criteria updates, firmware updates, meter display message updates, and operating software updates;

c. receiving meter operating data from the meter, the meter operating data comprising an acknowledgement of receipt of the configuration information;

d. providing a web-based administrative user interface comprising a meter revenue summary, wherein the meter revenue summary comprises cash amounts, credit amounts, and total revenue collected by the meter; and

e. providing a web-based administrative user interface comprising a tool, wherein an administrative end user uses the tool to remotely configure the meter display message on the display of the meter via the network.

2. The method of claim 1, further comprising:

a. receiving a payment authorization message from a remote device, the payment authorization being associated with the meter, the remote device being different than the meter; and

b. transmitting the message to initiate establishment of the communication session in response to receiving the payment authorization,

wherein transmitting the configuration information comprises transmitting the payment authorization toward the meter.

3. The method of claim 2, further comprising, subsequent to transmitting the payment authorization, receiving acknowledgment of receipt of the payment authorization from the meter.

4. The method of any one of claims 1 to 3, further comprising:

a. receiving an indication of an arrival event at the physical location uniquely associated with the meter; and

b. transmitting the message to initiate establishment of the communication session in response to receiving the indication of the arrival event;

wherein receiving the meter operating data comprises receiving a location report from the meter, the location report comprising an alert signal in response to completion of a predetermined time period without receiving a payment at the meter, or the location report otherwise comprising an indication of a received payment at the meter.

5. The method of any one of claims 1 to 4, wherein the configuration information comprises operating parameters, the operating parameters including a parking rate, a geographic location, parking rules, an amount of currency in a cash box or times when parking rates or rules apply, or any combination thereof, and transmitting the configuration information comprises transmitting the operating parameters toward the meter.

6. The method of any one of claims 1 to 5, wherein the transmitting step is performed prior to the receiving step.

7. The method of any one of claims 1 to 6, wherein establishing the communication session comprises transmitting an initial message of the communication session to the meter.

8. The method of any one of claims 1 to 7, wherein the network comprises the Internet.

9. The method of any one of claims 1 to 7, wherein the network comprises a cellular telephone network.

10. The method of any one of claims 1 to 7, wherein the configuration information is stored in memory of the meter and comprises information for processing a payment at the meter.

11. A method of operating a meter, the method comprising:

a. communicating data representing web-based administrative user interface screens to a computer of an administrative end user via a network, wherein the administrative user interface screens comprise:

i. a meter revenue summary, wherein the meter revenue summary comprises cash amounts, credit amounts, and total revenue collected by the meter; and

ii. a tool, wherein the administrative end user uses the tool to remotely configure the meter display message on an electronic display of the meter via the network;

b. receiving configuration information from the administrative end user via the network, the configuration information associated with operation of a meter and uniquely associated with a physical location of the meter, the configuration information comprising meter display message updates, and one or more of: coin validation criteria updates, firmware updates, meter display message updates, operating software updates, or any combination thereof;

c. establishing a network communication session with the meter, the meter being uniquely associated with the physical location;

d. communicating the configuration information from the management server toward the meter over the network during the established communication session;

e. updating a message on the electronic display of the meter based on the remote configuration; and

f. receiving meter operating data from the meter, the meter operating data comprising an acknowledgement of receipt of the configuration information.

12. The method of claim 11, wherein communicating the configuration information toward the meter comprises communicating the configuration information to a data manager associated with the meter.

13. The method of claim 11 or 12, wherein the configuration information comprises operating parameters, the operating parameters including a parking rate, a geographic location, parking rules, an amount of currency in a cash box, times when parking rates or rules apply, or any combination thereof, and wherein communicating the configuration information comprises communicating the operating parameters toward the meter.

14. The method of any one of claims 11 to 13, wherein communicating the configuration information is performed prior to receiving the meter operating data.

15. The method of any one of claims 11 to 14, wherein establishing the communication session comprises transmitting an initial message of the communication session to the meter.

16. A device for operating a plurality of meters, the device comprising:

a. a radio configured to communicate with at least one meter, the at least one meter having an electronic display, the at least one meter being uniquely associated with a physical location; and

b. a processor coupled to the radio and configured to:

i. establish a network communication session with the at least one meter,

ii. transmit configuration information toward the meter over the network during the established communication session via the radio, the configuration information associated with operation of the meter and uniquely associated with the physical location of the meter, the configuration information comprising meter display

message updates, and one or more of: coin validation criteria updates, firmware updates, meter display message updates, and operating software updates;

iii. receive meter operating data from the meter via the radio, the meter operating data comprising an acknowledgement of receipt of the configuration information;

iv. provide a web-based administrative user interface comprising a meter revenue summary, wherein the meter revenue summary comprises cash amounts, credit amounts, and total revenue collected by each meter and by physical location; and

v. provide a web-based administrative user interface comprising a tool, wherein the tool is configured for an administrative end user to remotely configure the meter display message on the display of each meter or a group of meters via the network.

17. The device of claim 16, wherein the processor receives a payment authorization message from a remote device, the payment authorization being associated with the meter, the remote device being different than the meter, the processor transmits the message to initiate the communication session in response to receiving the payment authorization, and the configuration information transmitted toward the meter comprises the payment authorization.

18. The device of claim 16 or 17, wherein the configuration information is transmitted prior to the meter operating data being received.

19. The device of any one of claims 16 to 18, wherein the processor is configured transmit an initial message of the communication session to the meter.

20. A device for operating a meter, the device comprising: a processor coupled to a network configured to:

a. communicate data representing web-based administrative user interface screens to a computer of an administrative end user via the network, wherein the administrative user interface screens comprise:

i. a meter revenue summary, wherein the meter revenue summary comprises cash amounts, credit amounts, and total revenue collected by the meter; and

ii. a tool, wherein the tool is configured for the administrative end user to remotely configure the meter display message on an electronic display of the meter via the network;

b. receive configuration information from the administrative end user via the network, the configuration information associated with operation of a meter and uniquely associated with a physical location of the meter, the configuration information comprising meter display message updates, and one or more of: coin validation criteria updates, firmware updates, meter display message updates, operating software updates, or any combination thereof;

c. establish a communication session with the meter, the meter being uniquely associated with the physical location;

d. communicate the configuration information toward the meter over the network during the established communication session;

e. update a message on the electronic display of the meter based on the remote configuration; and

f. receive meter operating data from the meter, the meter operating data comprising an acknowledgement of receipt of the configuration information.

21. The device of claim 20, wherein the processor is further configured to communicate the configuration information to a data manager associated with the meter.

22. The device of claim 20 or 21, wherein the configuration information comprises operating parameters, the operating parameters including a parking rate, a geographic location, parking rules, an amount of currency in a cash box, times when parking rates

or rules apply, or any combination thereof, and wherein the processor is configure to communicate the operating parameters toward the meter.

23. The device of any one of claims 20 to 22, wherein the configuration information is communicated toward the meter prior to the meter operating data being received.

24. The device of any one of claims 20 to 23, wherein the processor is configured to transmit an initial message of the communication session to the meter.

25. The device of any one of claims 20 to 24, wherein the network comprises the Internet.

26. The device of any one of claims 20 to 24, wherein the network comprises a cellular telephone network.

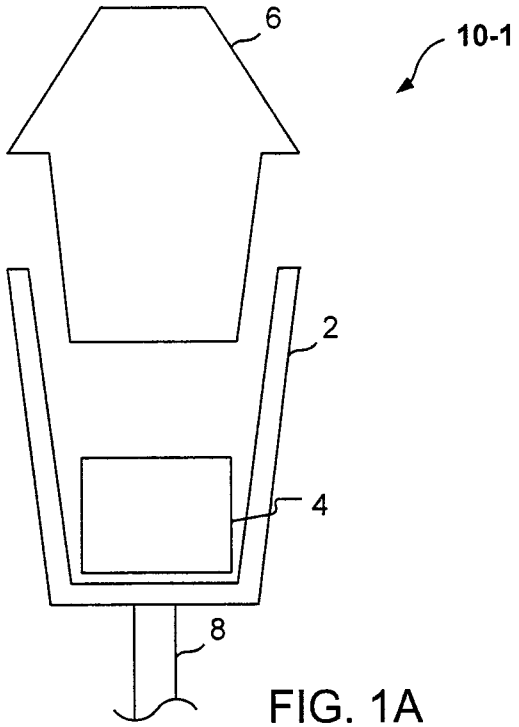


FIG. 1A

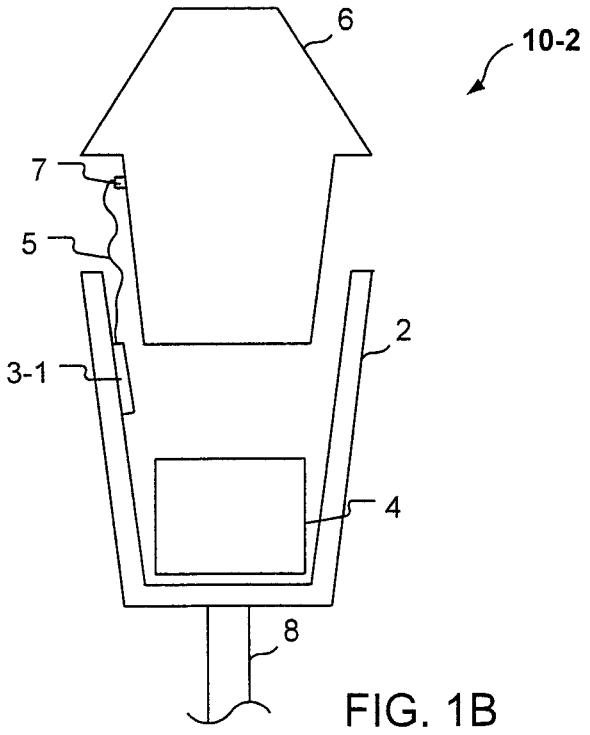


FIG. 1B

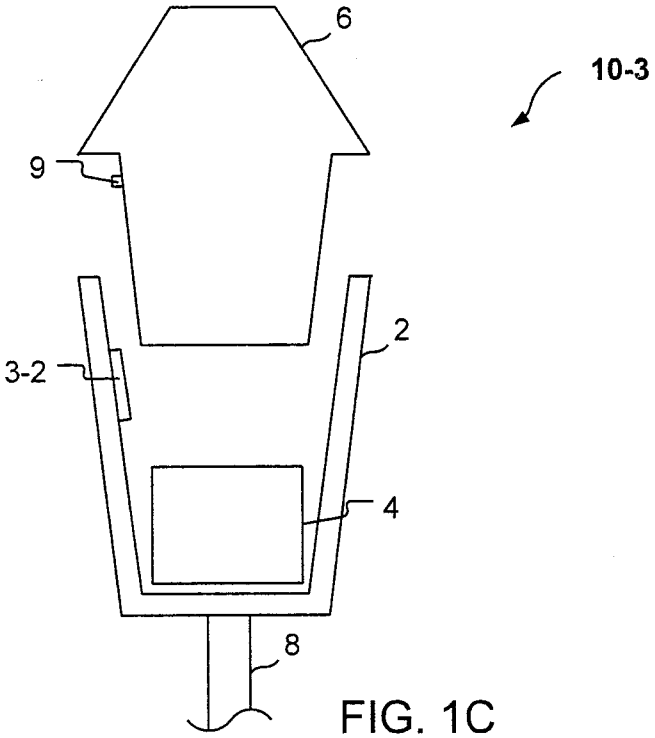


FIG. 1C

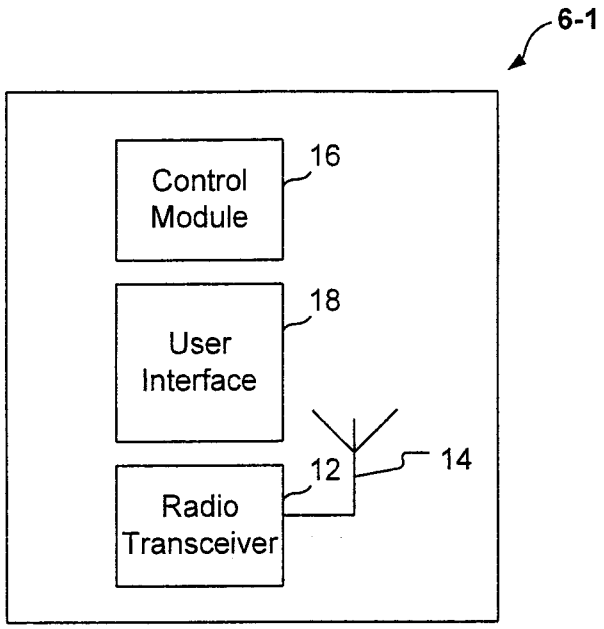

6-1
Control Module
16
User Interface
18
Radio Transceiver
12
14

FIG. 2A

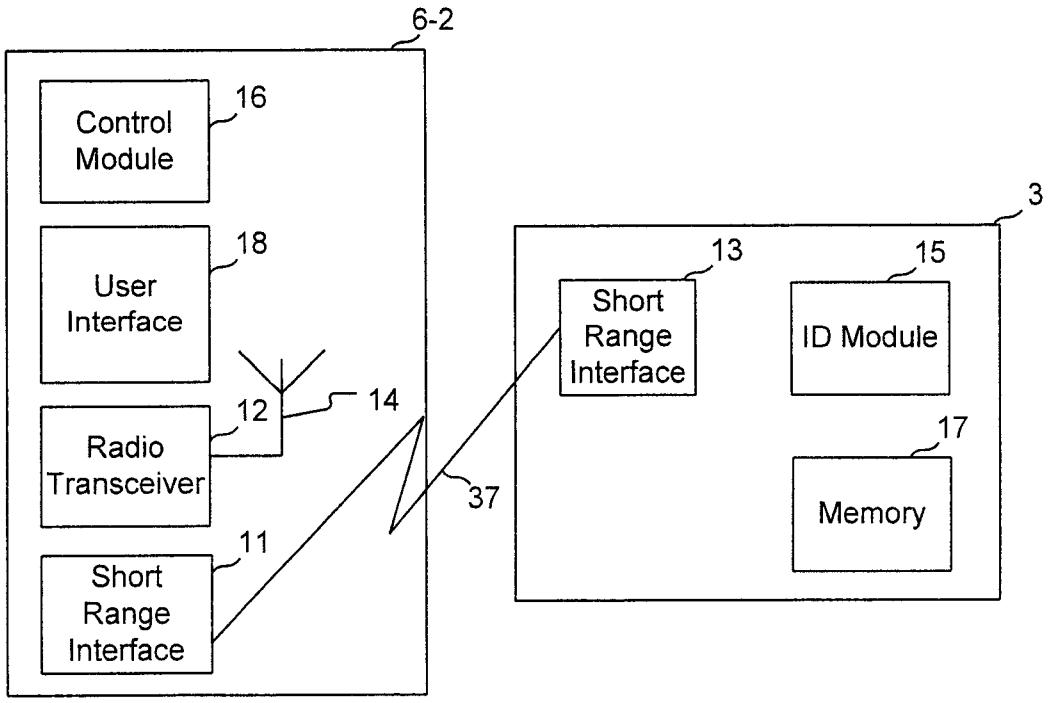

6-2
Control Module
16
User Interface
18
Radio Transceiver
12
14
Short Range Interface
11
37
3
Short Range Interface
13
ID Module
15
Memory
17

FIG. 2B

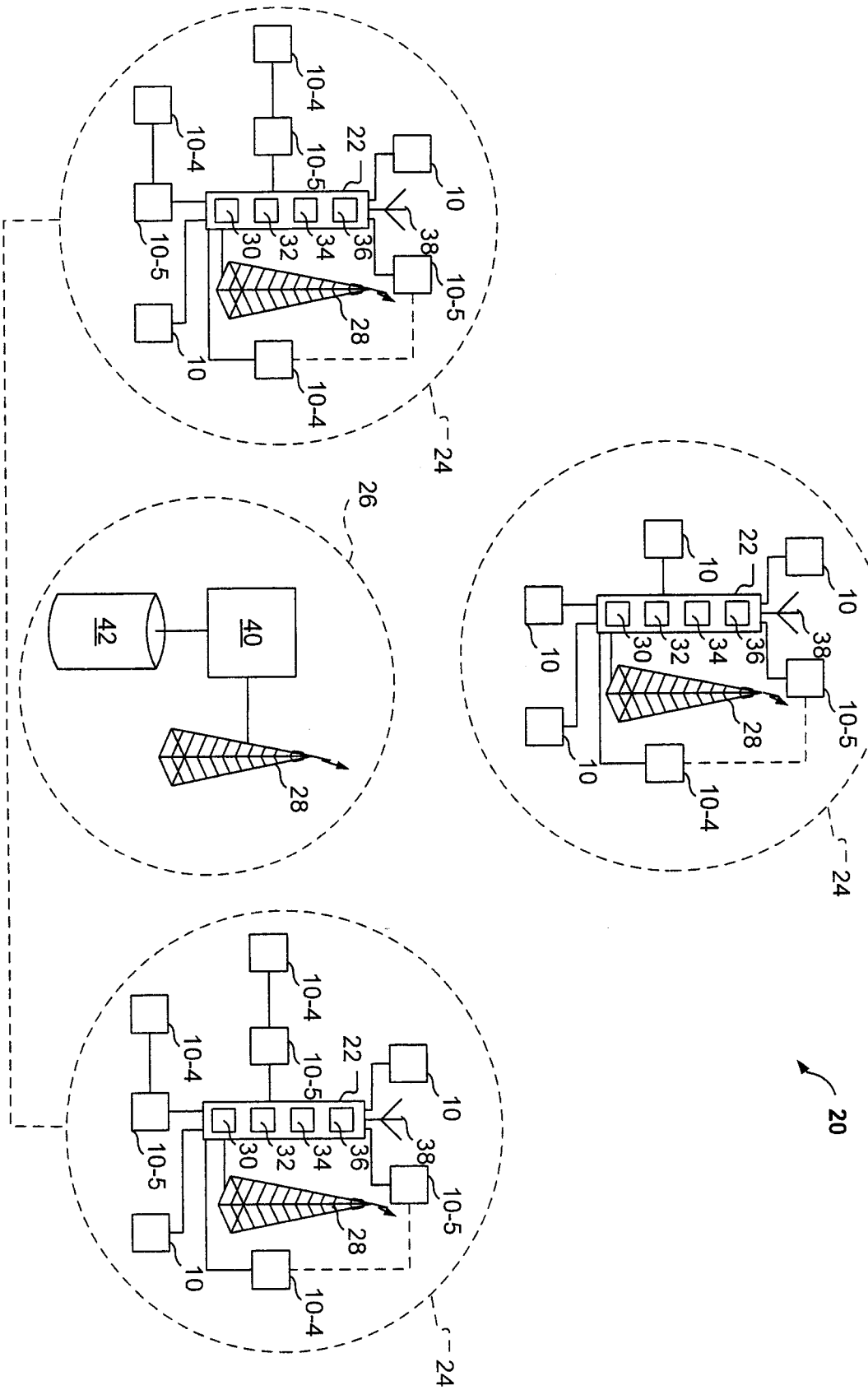


FIG. 3

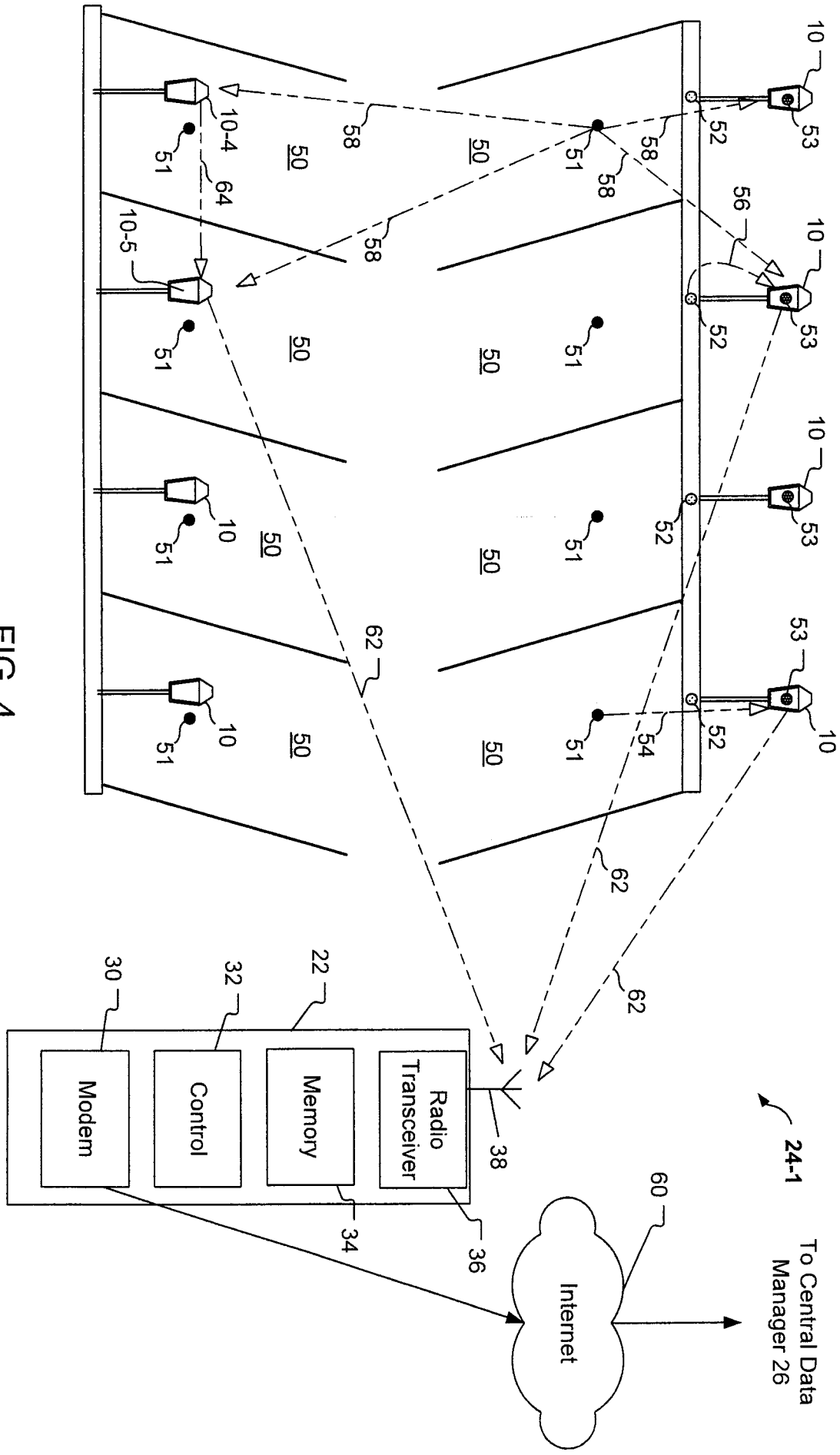

10
53
52
58
51
50
56
10-4
64
10-5
54
62
22
30
32
Modem
Control
Memory
Radio Transceiver
38
36
34
24-1
60
Internet
To Central Data Manager 26

FIG. 4

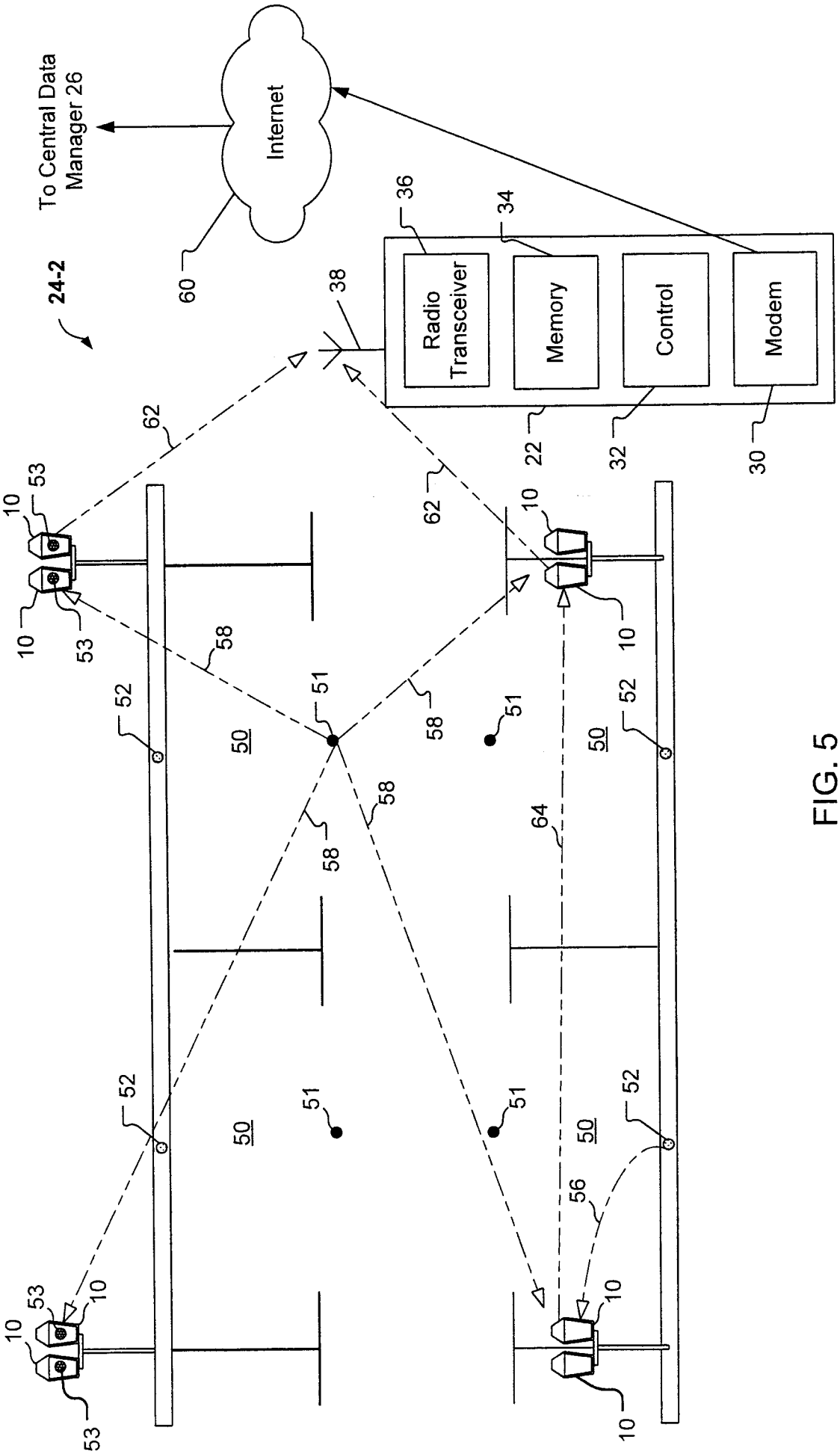

To Central Data Manager 26
Internet
60
24-2
36
34
38
Radio Transceiver
Memory
Control
Modem
22
32
30
62
10
53
58
52
51
50
64
56

FIG. 5

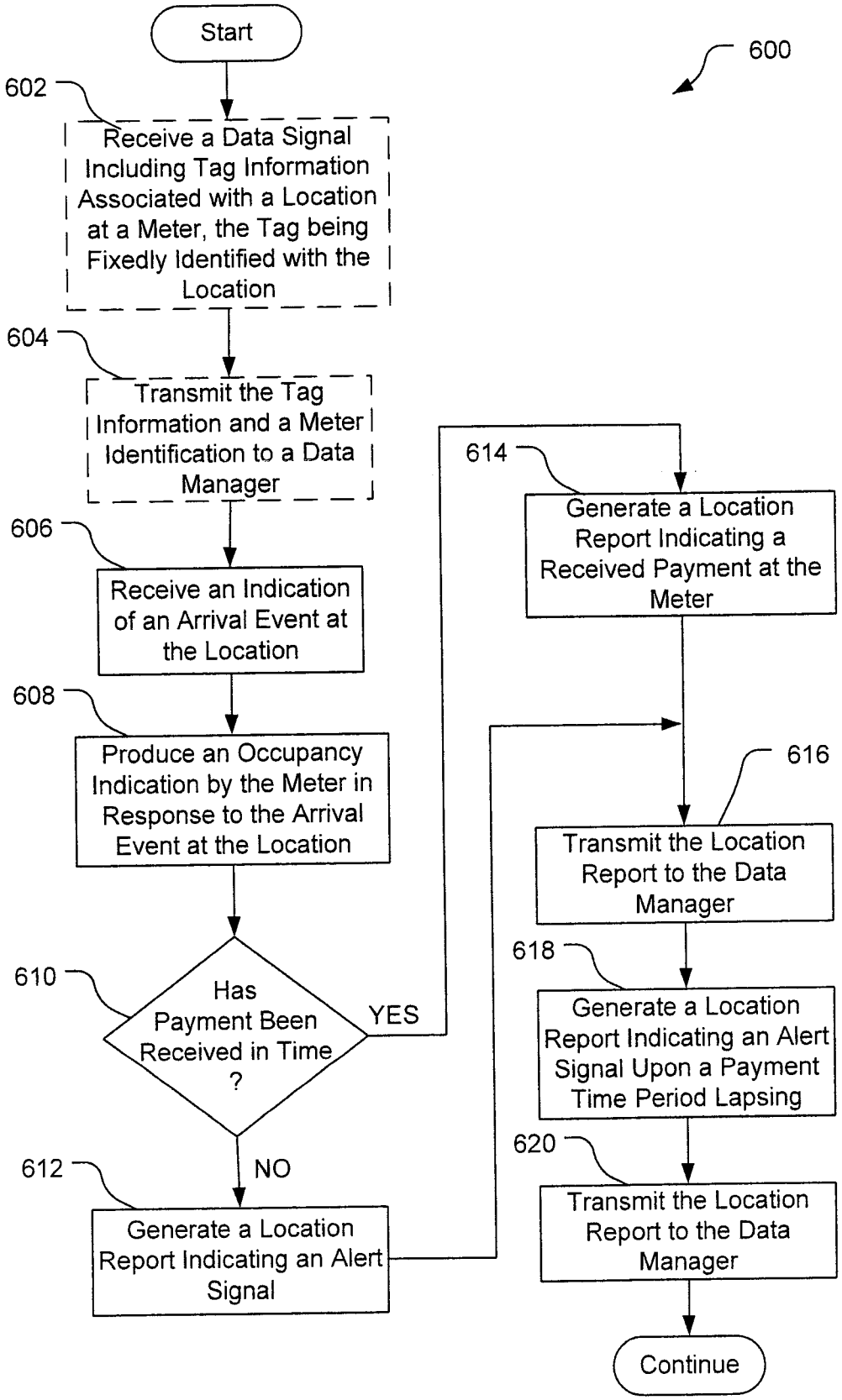

Start
600
602
Receive a Data Signal Including Tag Information Associated with a Location at a Meter, the Tag being Fixedly Identified with the Location
604
Transmit the Tag Information and a Meter Identification to a Data Manager
606
Receive an Indication of an Arrival Event at the Location
608
Produce an Occupancy Indication by the Meter in Response to the Arrival Event at the Location
610
Has Payment Been Received in Time ?
YES
NO
612
Generate a Location Report Indicating an Alert Signal
614
Generate a Location Report Indicating a Received Payment at the Meter
616
Transmit the Location Report to the Data Manager
618
Generate a Location Report Indicating an Alert Signal Upon a Payment Time Period Lapsing
620
Transmit the Location Report to the Data Manager
Continue

FIG. 6

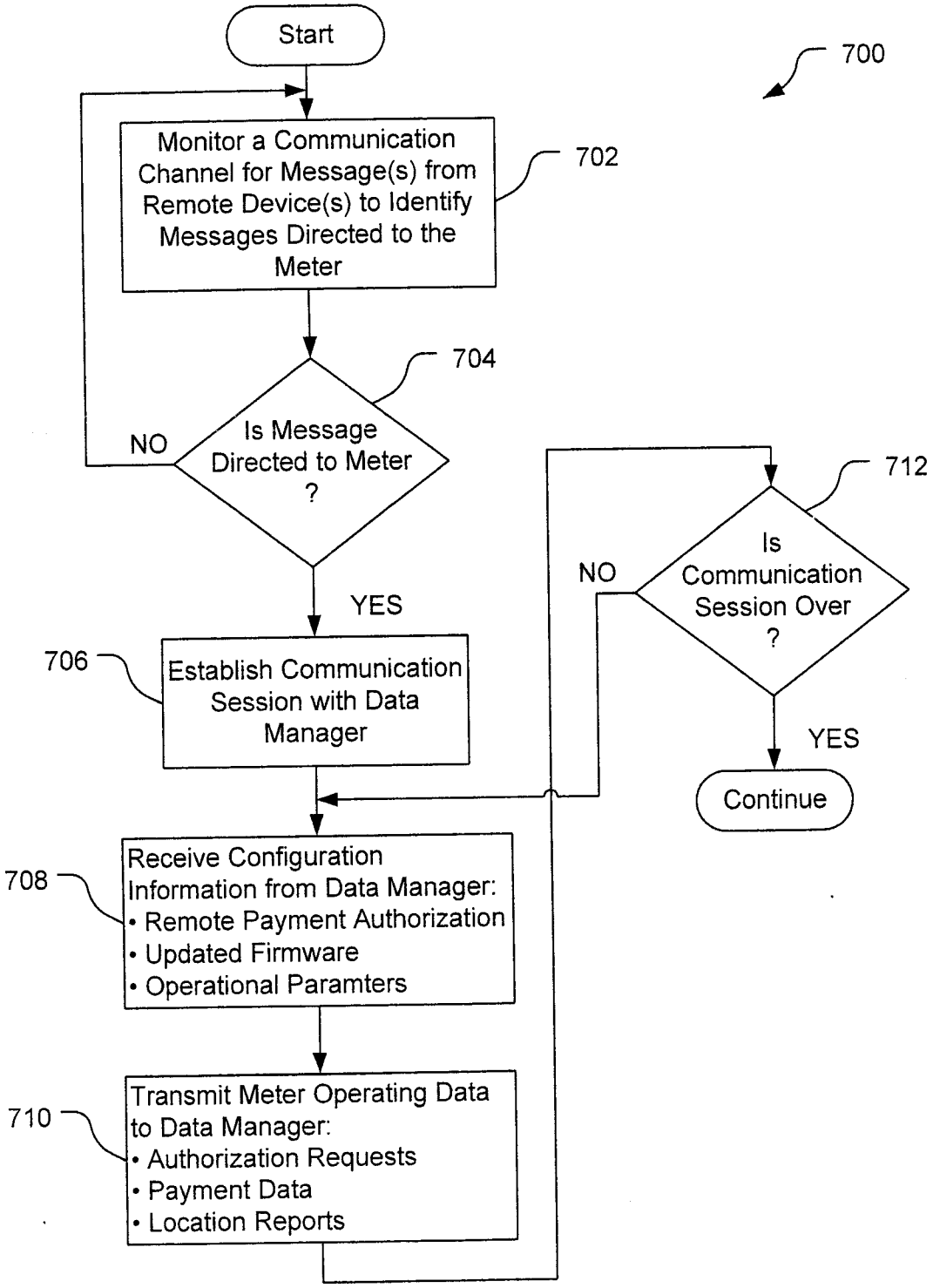

Start
700
Monitor a Communication Channel for Message(s) from Remote Device(s) to Identify Messages Directed to the Meter
702
704
Is Message Directed to Meter ?
NO
YES
706
Establish Communication Session with Data Manager
712
Is Communication Session Over ?
NO
YES
Continue
Receive Configuration Information from Data Manager:
• Remote Payment Authorization
• Updated Firmware
• Operational Paramters
708
Transmit Meter Operating Data to Data Manager:
• Authorization Requests
• Payment Data
• Location Reports
710

FIG. 7

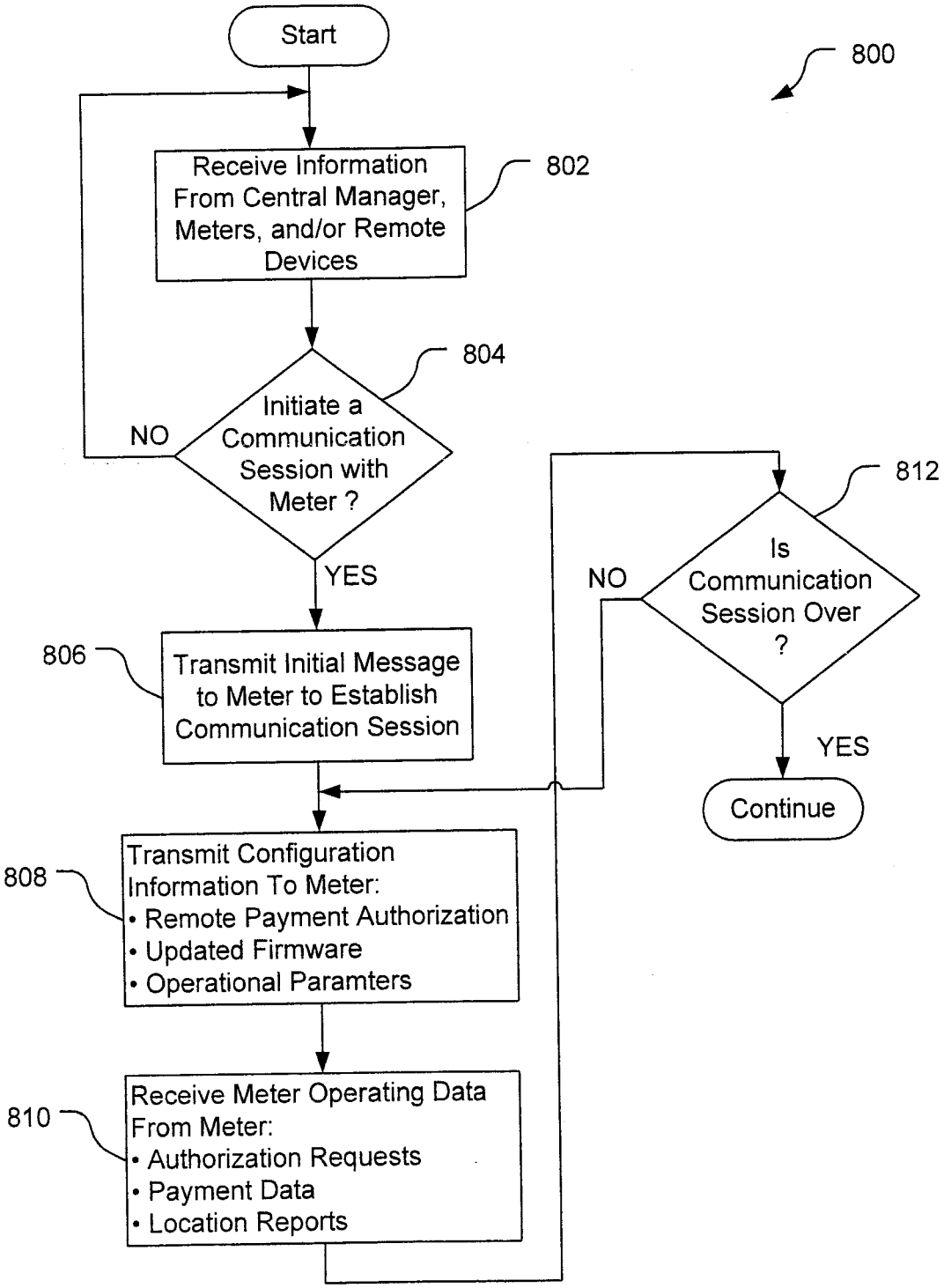

Start
800
Receive Information From Central Manager, Meters, and/or Remote Devices
802
804
Initiate a Communication Session with Meter ?
NO
YES
806
Transmit Initial Message to Meter to Establish Communication Session
812
Is Communication Session Over ?
NO
YES
Continue
808
Transmit Configuration Information To Meter:
• Remote Payment Authorization
• Updated Firmware
• Operational Paramters
810
Receive Meter Operating Data From Meter:
• Authorization Requests
• Payment Data
• Location Reports

FIG. 8

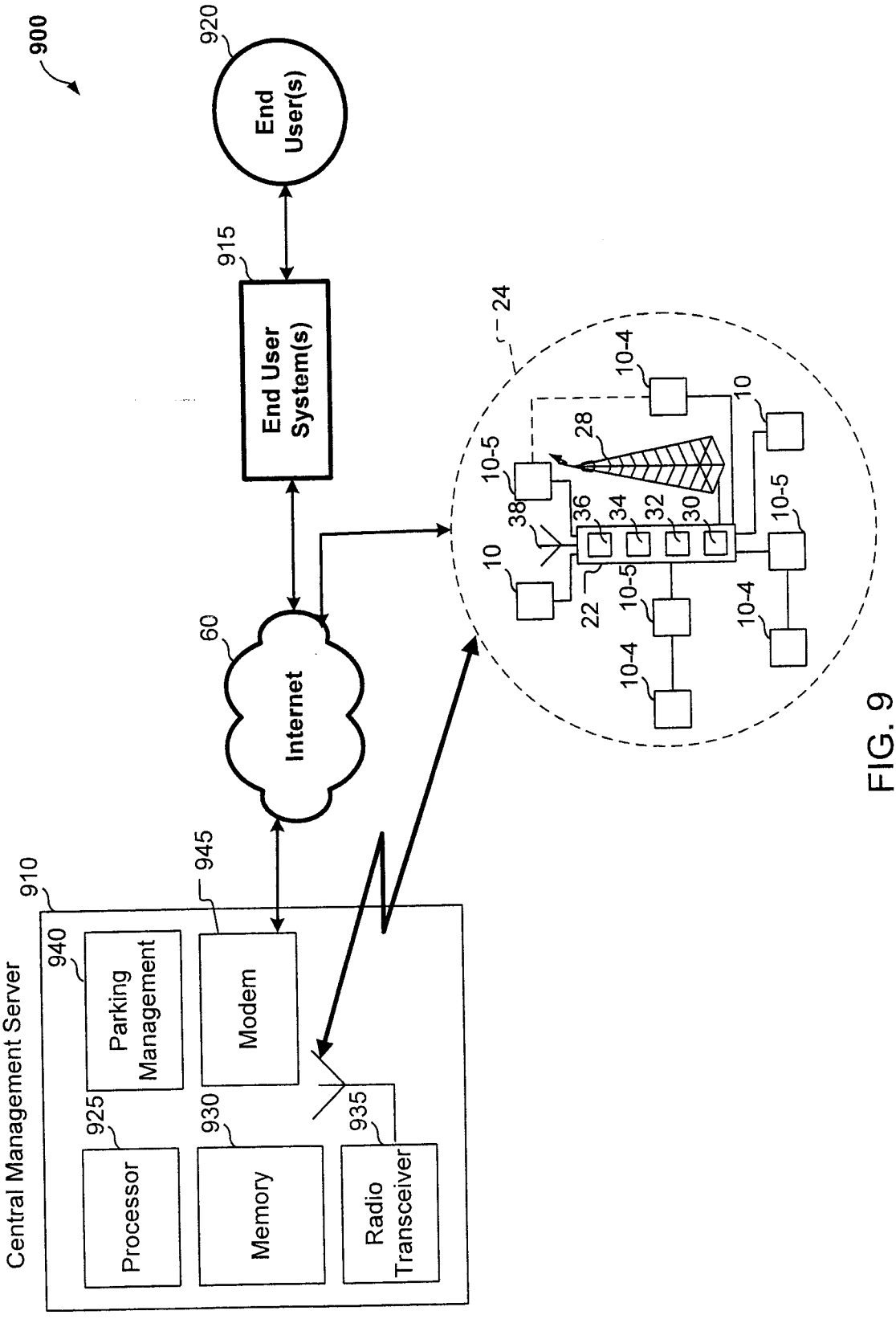

900
920
End User(s)
915
End User System(s)
24
10-4
10
28
10-5
38
36
34
32
30
10-5
10
22
10-5
10-4
10-4
60
Internet
945
910
940
Parking Management
Modem
925
930
935
Central Management Server
Processor
Memory
Radio Transceiver

FIG. 9

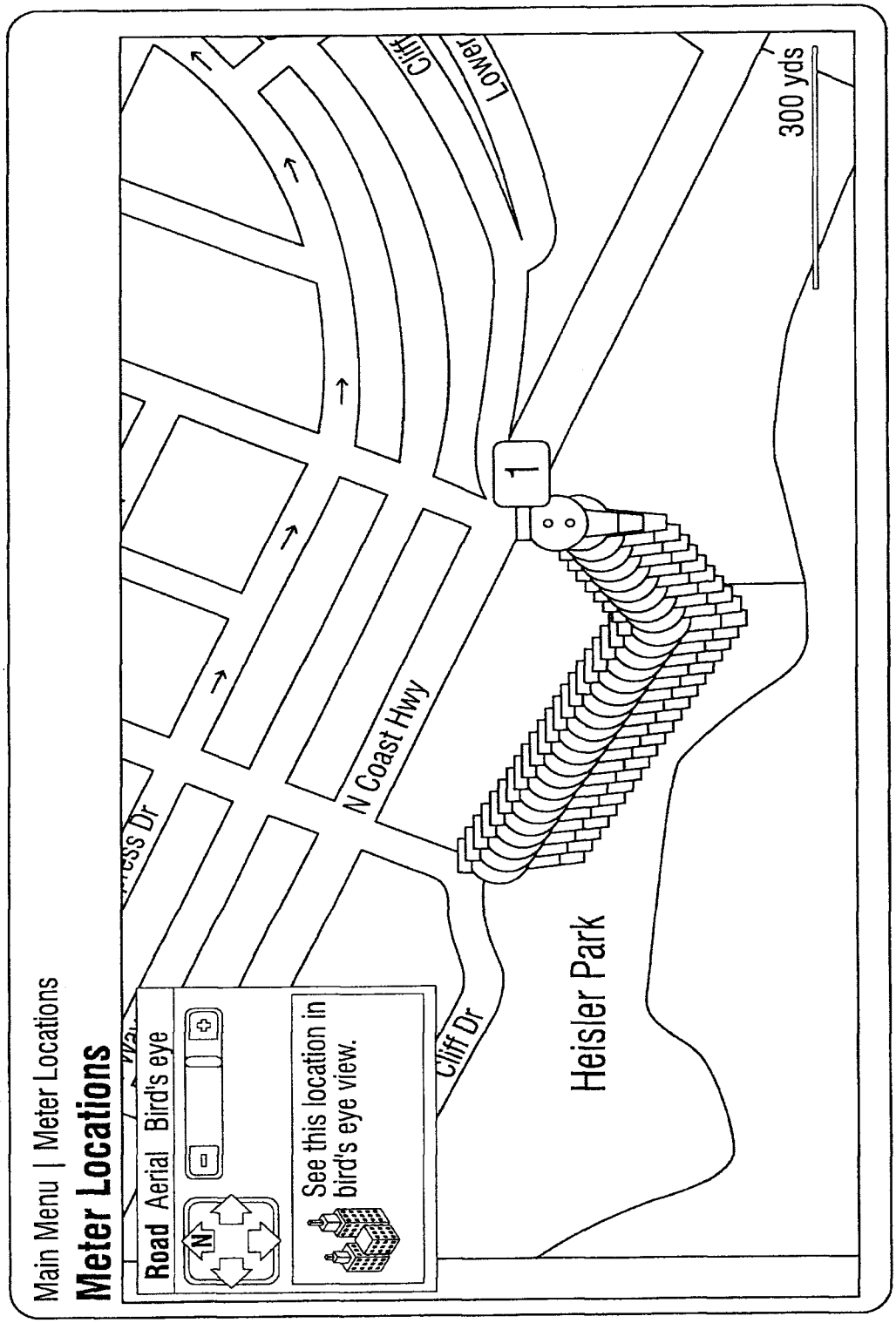

Main Menu | Meter Locations
Meter Locations
Road Aerial Bird's eye
See this location in bird's eye view.
N Coast Hwy
Cliff Dr
Heisler Park
Cliff
Lower
300 yds
1

FIG. 10A

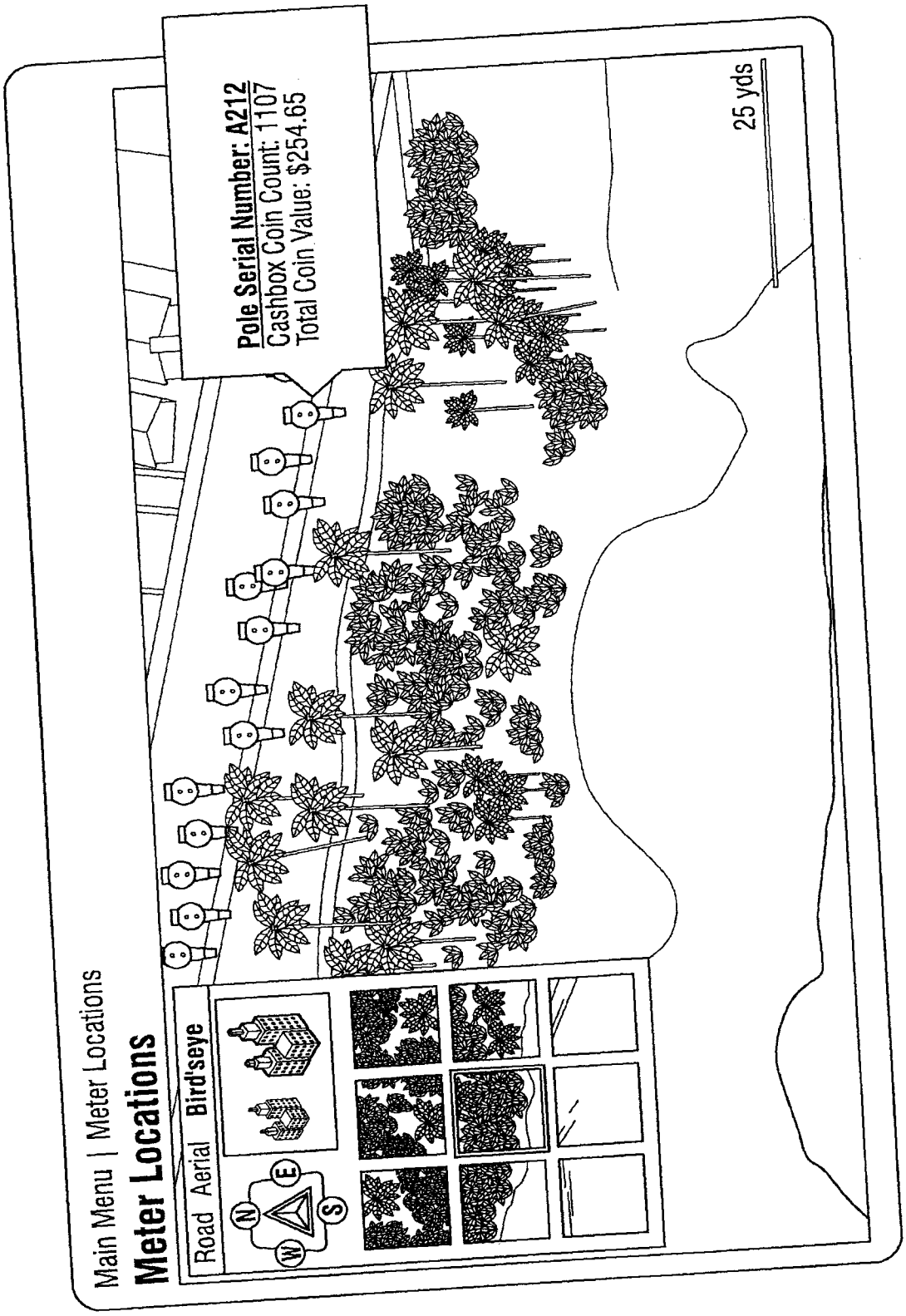

Main Menu | Meter Locations
Meter Locations
Road Aerial Bird'seye
N
E
S
W
Pole Serial Number: A212
Cashbox Coin Count: 1107
Total Coin Value: $254.65
25 yds

FIG. 10B

Main Menu | Monthly Statistics

Monthly Statistics

Year: 2008 **Refresh**

As of 4/13/2008

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Active Poles	27	55	46	46								
Total Cash	$265	$4,172	$7,537	$2,996								
Total Credit	$63	$1,215	$2,372	$1,000								
Total Revenue	$328	$5,387	$9,909	$3,996								
Avg Cash/Pole	$10	$76	$164	$65								
Avg Credit/Pole	$2	$22	$52	$22								
Avg Revenue/Pole	$12	$98	$216	$87								
# Cash	295	5,399	9,705	3,847								
# Credit	46	768	1,443	556								
# Total	341	6,167	11,148	4,403								
Avg # Cash/Pole	11	98	211	84								
Avg # Credit/Pole	2	14	31	12								
Avg # Total/Pole	13	112	242	96								
Avg Cash Trans	$0.90	$0.77	$0.78	$0.78								
Avg Credit Trans	$1.37	$1.58	$1.64	$1.80								
Avg Trans	$0.96	$0.87	$0.89	$0.91								

FIG. 11A

Main Menu | Zone Revenue | Area Revenue

Area Revenue

From Date: 3/14/2008 **From Time:** 00:00:00

To Date: 4/13/2008 **To Time:** 23:59:59 **Refresh**

Zone: Laguna Beach Route 1

Area	Cash	Credit	Cash %	Credit %	Total
Laguna Street	$7,733.40	$2,493.25	76%	24%	$10,226.65
Grand Total	**$7,733.40**	**$2,493.25**	**76%**	**24%**	**$10,226.65**

FIG. 11B

Main Menu | Daily Bank Recon

Daily Bank Recon

Settlement Date: 4/12/2008 **Refresh**

Settlement Date	Transaction Reference	Machine Reference	Last 4 Digits	Card Scheme	Amount
4/12/2008	d8fca3a1-bc08-dd11-a48c-00123f67eea8	0020159	4645	Mastercard	$1.00
4/12/2008	dcfca3a1-bc08-dd11-a48c-00123f67eea8	0020155	4697	Visa	$1.75
4/12/2008	defca3a1-bc08-dd11-a48c-00123f67eea8	0020159	7310	Mastercard	$1.00
4/12/2008	60dc210c-be08-dd11-a48c-00123f67eea8	0020176	3228	Visa	$3.00
4/12/2008	74295075-bf08-dd11-a48c-00123f67eea8	0020180	1201	Mastercard	$1.50
4/12/2008	7a295075-bf08-dd11-a48c-00123f67eea8	0020151	7676	Visa	$1.00
4/12/2008	7d295075-bf08-dd11-a48c-00123f67eea8	0020180	8202	Visa	$4.00
4/12/2008	19fdefd9-c008-dd11-a48c-00123f67eea8	0020185	9832	Visa	$1.00
4/12/2008	d2c66de0-c008-dd11-a48c-00123f67eea8	0020179	5733	Visa	$1.00
4/12/2008	d3c66de0-c008-dd11-a48c-00123f67eea8	0020179	5733	Visa	$1.00
4/12/2008	dac66de0-c008-dd11-a48c-00123f67eea8	0020179	5733	Visa	$1.00
4/12/2008	dbc66de0-c008-dd11-a48c-00123f67eea8	0020179	5733	Visa	$1.00
4/12/2008	ddc66de0-c008-dd11-a48c-00123f67eea8	0020185	9832	Visa	$1.00

FIG. 12

Main Menu | Coin Collection

Coin Collection

Collection Date: 12/13/2007 **Refresh**

Pole Serial Number	Collection Time	1¢	5¢	10¢	25¢	$1	Invalid	Cash
DB0016	09:46:17	7	11	10	48	0	0	$13.62
DB0017	09:47:06	0	24	44	80	0	0	$25.60
DB0018	09:46:46	0	12	12	89	0	2	$24.05
DB0019	09:46:48	0	23	15	70	0	0	$20.15

FIG. 13A

Main Menu | Coin Revenue

Coin Revenue

This report shows the cumulative coin count (since the last collection) for each meter on a given day.

Date: 4/12/2008 Refresh

Pole Serial Number	1¢	5¢	10¢	25¢	$1	Invalid	Total
A195	5	64	109	881	2	10	1,071
A196	10	82	111	843	1	8	1,055
A197	7	73	113	816	2	12	1,023
A198	26	56	89	753	0	41	965
A199	4	40	78	699	0	18	839
A200	25	71	119	714	6	9	944
A201	8	57	69	776	0	5	915
A202	6	39	121	783	2	4	955
A203	22	46	112	832	0	13	1,025
A204	15	42	62	696	1	20	836
A205	8	44	88	985	0	16	1,141
A206	23	95	155	1,021	0	23	1,317
A207	6	53	121	903	2	40	1,125
A208	49	61	60	649	9	8	835

FIG. 13B

Main Menu | Battery Voltages

Battery Voltages

Zone: Laguna Beach Route 1 Change

Area: Laguna Street Change

Detail | Summary

Terminal Serial No	4/7/08	4/8/08	4/9/08	4/10/08	4/11/08	4/12/08	4/13/08
0020150	6905	6787	6827	6766	6701	6714	6683
0020151	6621	6440	6598	6389	6422	6389	6382
0020152	6477	6467	6517	6392	6369	6377	6329
0020153	6759	6726	6696	6648	6631	6608	6578
0020154	6759	6819	6774	6731	6709	6709	6683
0020155	6419	6424	6427	6341	6301	6304	6284
0020156	6779	6792	6829	6789	6776	6779	6751

FIG. 14

Main Menu | Terminal Events

Terminal Events

Terminal: 0020075

From Date: 7/27/2007 From Time: 00:00:00

To Date: 8/26/2008 To Time: 23:59:59 Refresh

Date	Time	Event Code	Event Description	Event Type
5/19/2008	10:31:38	2	LOG_EVENT_COIN_PATH_BLOCKED	2
3/27/2008	13:26:29	2	LOG_EVENT_COIN_PATH_BLOCKED	0
3/27/2008	13:26:28	2	LOG_EVENT_COIN_PATH_BLOCKED	2
2/20/2008	17:08:04	7	LOG_EVENT_CARD_STUCK_ERROR	0
2/20/2008	17:08:01	7	LOG_EVENT_CARD_STUCK_ERROR	64

FIG. 15

Main Menu | Configurations | Edit Configuration

Edit Configuration

Please click the Update button on each tab after making any changes.

Days And Months | Main Control | Parking Rates | Special Days | General Rates | Mag Card

Logging | Display Strings | Blacklist

Page: 00 Meter Idle and waiting for coin or card Refresh View Special Functions

First Page
---- Expired ----
COINS or ^N CREDIT CARD
^A

Alternate Page
IPS GROUP INC
Rate Per Hour: $2.00
Maximum 4 Hours
^A

---- EXPIRED ----
CARDS ONLY
NO COINS
Tue 26 Aug 2008 17:07

IPS GROUP INC
Rate Per Hour: $2.00
Maximum 4 Hours
Tue 26 Aug 2008 17:07

Update

FIG. 16A

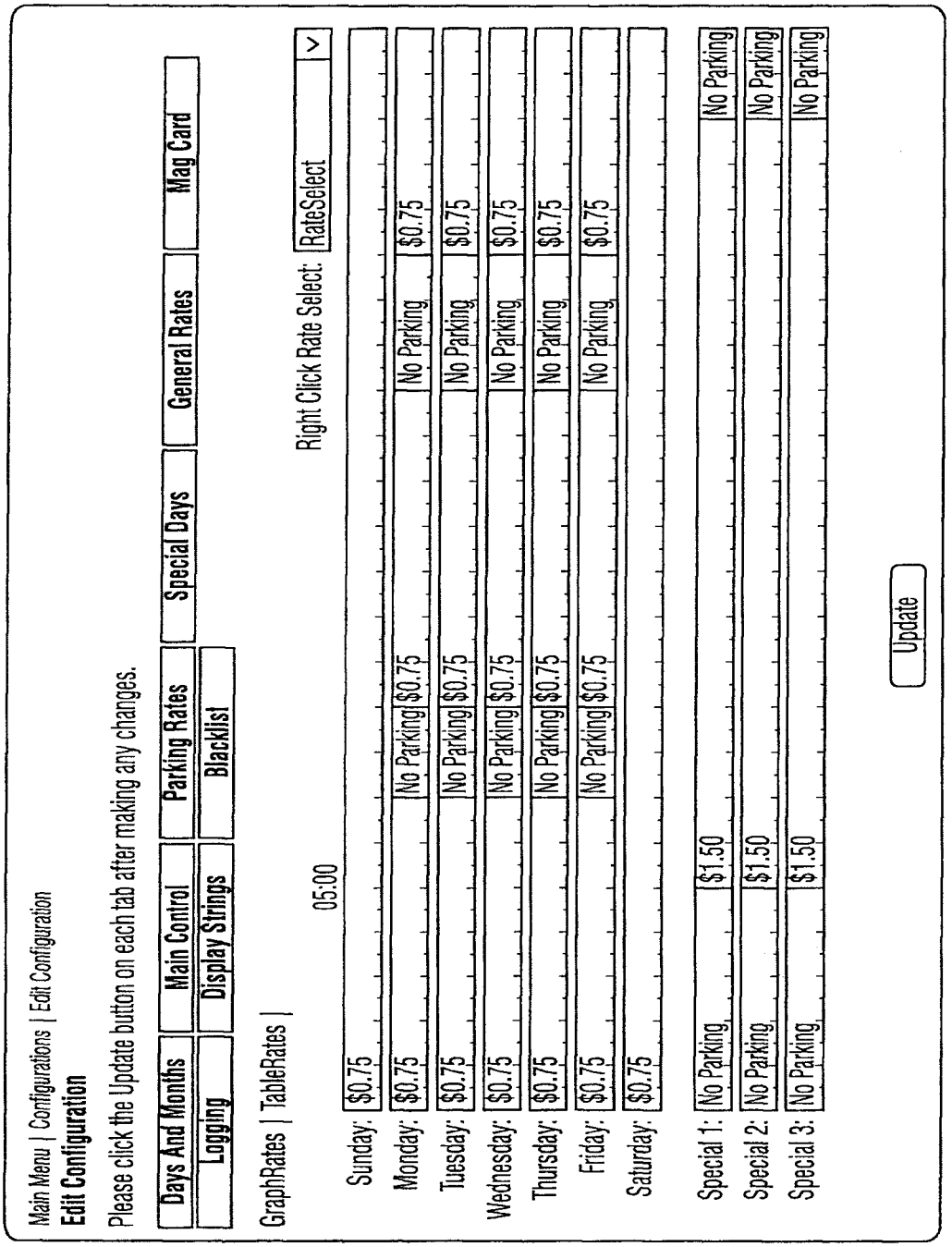

Main Menu | Configurations | Edit Configuration
Edit Configuration
Please click the Update button on each tab after making any changes.
Days And Months
Main Control
Parking Rates
Special Days
General Rates
Mag Card
Logging
Display Strings
Blacklist
GraphRates | TableRates |
Right Click Rate Select:
RateSelect
05:00
Sunday: $0.75
Monday: $0.75 No Parking $0.75 No Parking $0.75
Tuesday: $0.75 No Parking $0.75 No Parking $0.75
Wednesday: $0.75 No Parking $0.75 No Parking $0.75
Thursday: $0.75 No Parking $0.75 No Parking $0.75
Friday: $0.75 No Parking $0.75 No Parking $0.75
Saturday: $0.75
Special 1: No Parking $1.50 No Parking
Special 2: No Parking $1.50 No Parking
Special 3: No Parking $1.50 No Parking
Update

FIG. 16B

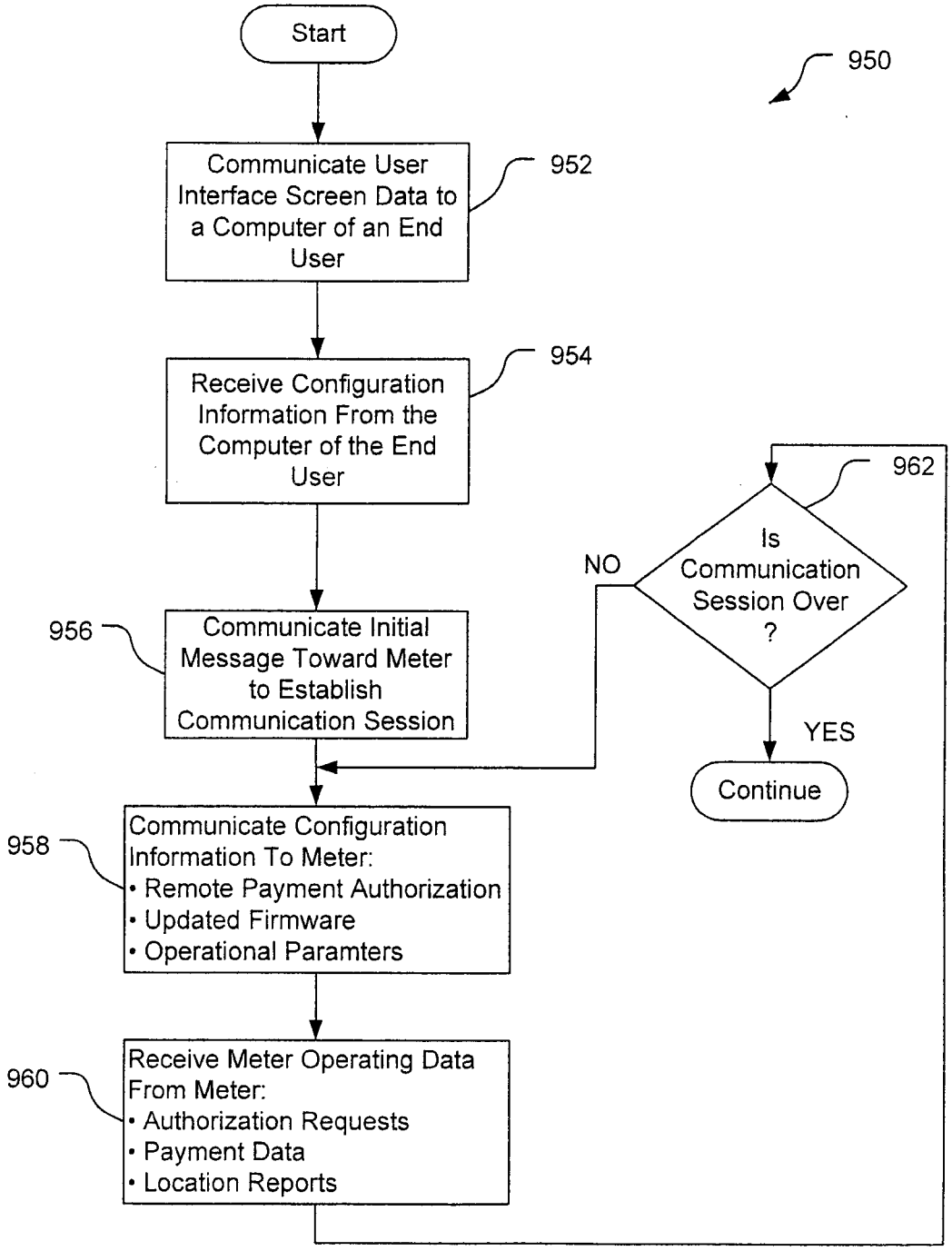

Start
950
Communicate User Interface Screen Data to a Computer of an End User
952
Receive Configuration Information From the Computer of the End User
954
962
Is Communication Session Over ?
NO
YES
Continue
956
Communicate Initial Message Toward Meter to Establish Communication Session
958
Communicate Configuration Information To Meter:
• Remote Payment Authorization
• Updated Firmware
• Operational Paramters
960
Receive Meter Operating Data From Meter:
• Authorization Requests
• Payment Data
• Location Reports

FIG. 17

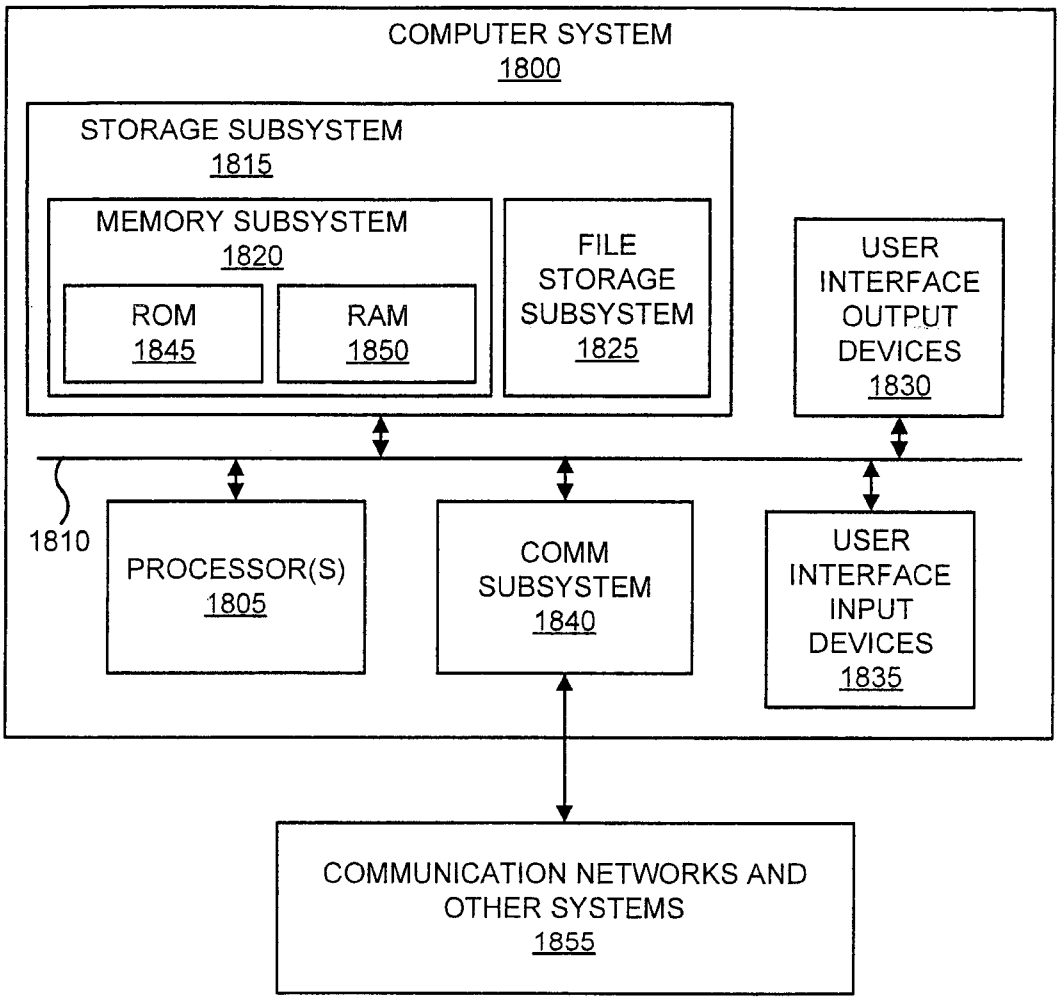

COMPUTER SYSTEM
1800
STORAGE SUBSYSTEM
1815
MEMORY SUBSYSTEM
1820
ROM
1845
RAM
1850
FILE
STORAGE
SUBSYSTEM
1825
USER
INTERFACE
OUTPUT
DEVICES
1830
1810
PROCESSOR(S)
1805
COMM
SUBSYSTEM
1840
USER
INTERFACE
INPUT
DEVICES
1835
COMMUNICATION NETWORKS AND
OTHER SYSTEMS
1855

FIG. 18

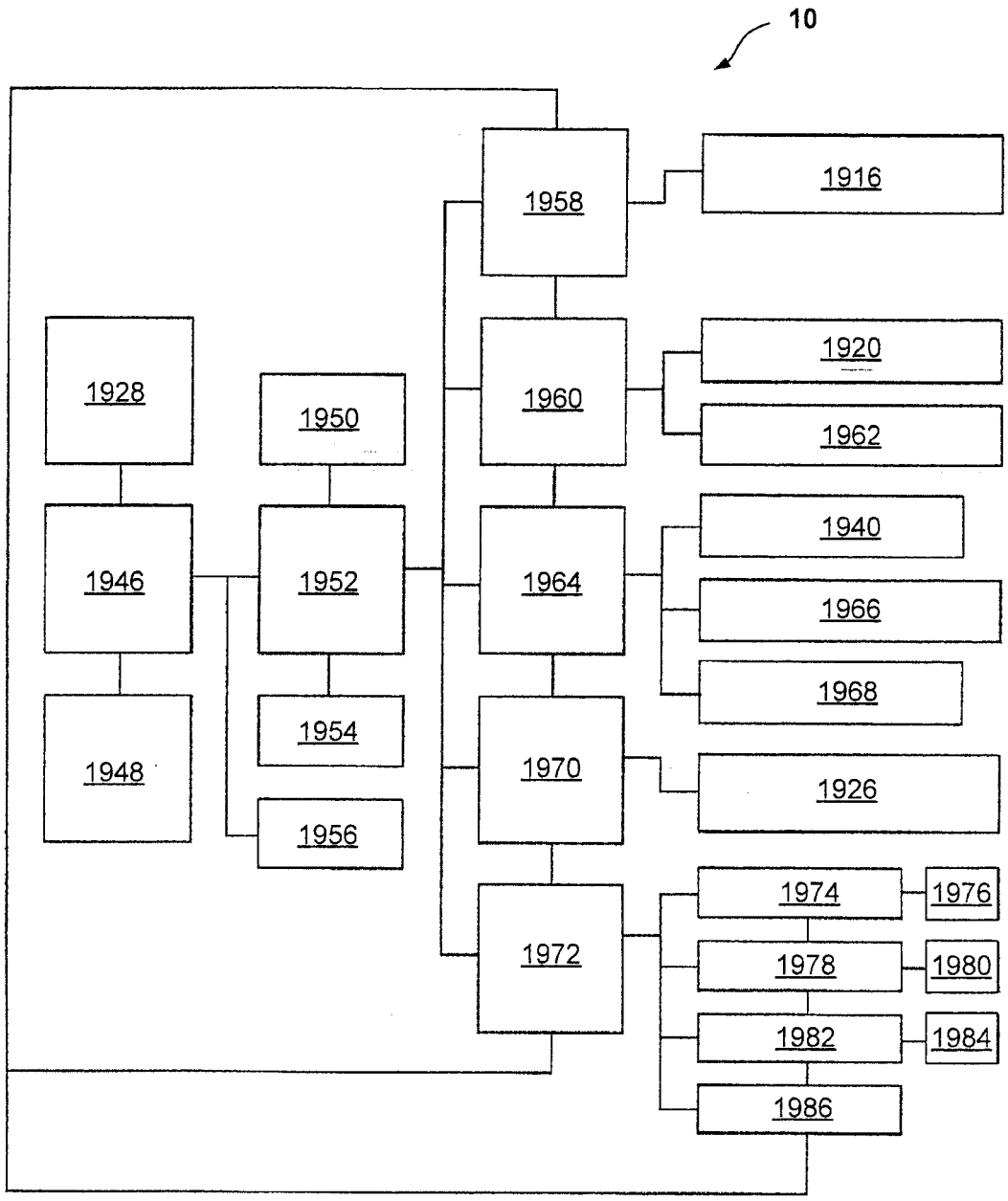
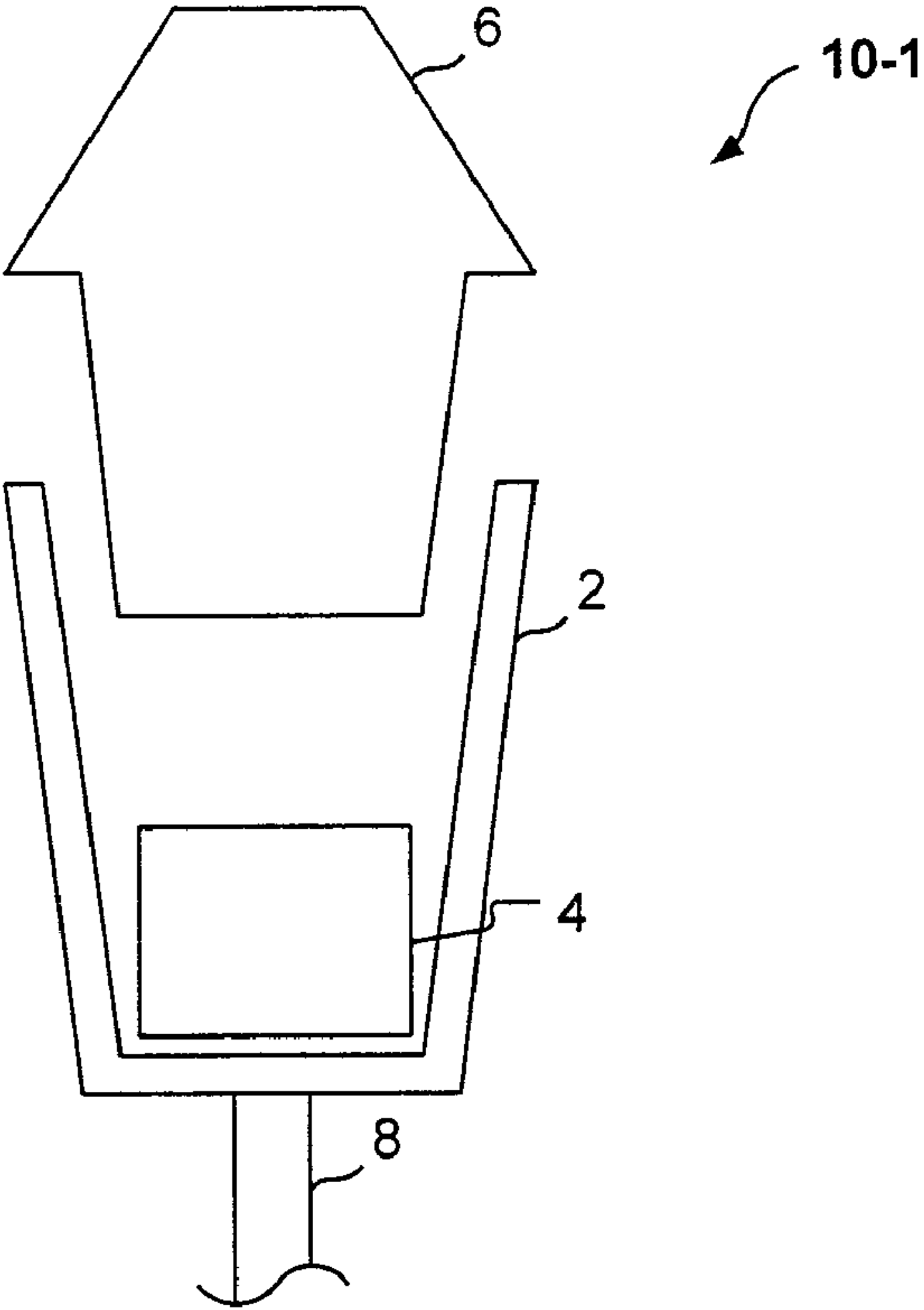

10
1958
1916
1928
1950
1960
1920
1962
1946
1952
1964
1940
1966
1968
1948
1954
1970
1926
1956
1974
1976
1972
1978
1980
1982
1984
1986

FIG. 19


6
10-1
2
4
8