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(54) **SPLIT ELECTRONIC VOLUME CORRECTOR (EVC)**

GETEILTER ELEKTRONISCHER VOLUMENKORREKTOR (EVC)

CORRECTEUR DE VOLUME ÉLECTRONIQUE (EVC) DIVISÉ

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(73) Proprietor: **Honeywell International Inc.**
Morris Plains, NJ 07950 (US)

(72) Inventor: **KN, Dinesh, Kumar**
Morris Plains, NJ 07950 (US)

(74) Representative: **Houghton, Mark Phillip**
Patent Outsourcing Limited
1 King Street
Bakewell, Derbyshire DE45 1DZ (GB)

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EP 3 504 522 B1

Description

FIELD

[0001] Disclosed embodiments relate to electronic volume correctors.

BACKGROUND

[0002] Fluids, such as natural gas, are transported, distributed, and sold to end-users (e.g., consumers) through a distribution system. For example, a furnace in an industrial plant may receive natural gas through a gas line. The gas consumption rate by the end user is known to vary over time.

[0003] A gas meter is generally installed on the gas line to measure the amount of gas consumed by the user. One type of gas meter is a rotary (mechanical) gas meter. Gas is typically sold by price per volume and is billed in price (e.g., $)/unit volume at base reference conditions of pressure and temperature as per applicable standards. Proper gas billing, as well as other functions, depends on accurate gas metering. Such conventional gas meters which measure the volume of flowing gas by mechanical means require correction because they do not take into account the effect of pressure (P), temperature (T) and super compressibility (Z) on the volume so that the measured volume lacks accuracy. P, T and Z corrections are applicable even for non-mechanical flow meters such as ultrasonic flow meters.

[0004] Gas meters are generally communicably coupled to a gas data downloading device for downloading consumption and gas meter readings generally being uncorrected gas volume data (UGVD), and the state variables (P, T) received from the gas meters. In the case of EVCs, each gas meter will be coupled to an EVC, and a separate dedicated EVC is generally provided at each service location to service a plurality of gas meters.

[0005] Most gas meters whether electronic or mechanical provide a pulsed output having a pulse count that corresponds to a particular UGVD generally referred to as an "uncorrected volume". The gas density is recognized to change as a function P and T (as well as for composition changes for gas mixtures such as natural gas), and variations in these variables can result in differences in energy content for like volumes of gas. Hence the UGVD is generally compensated for P, T (and if applicable and available the composition) variations and is represented as CGVD at standard conditions of P and T. The output data from the primary gas meter is also referred to as "interval data". Some gas meters have a local memory which enables the capability to provide accumulated gas meter readings for a particular interval of time, such as corresponding to a day, week or a month.

[0006] The EVC generally performs the P and T (and optionally for composition) correction to generate CGVD from the UGVD received from the gas meters or directly from gas pipe. The EVC has a local memory that enables the capability to store gas meter data for a particular duration, accumulated gas meter data (UGVD and CGVD) from a start and end time along with time stamps (typically time of use, ToU), and the EVC generates alarms in case of a detected error condition. Each EVC in the system will generally have a serial number (S/N) to enable a unique identification by the associated Meter Data Management (MDM) system.

[0007] ES2170652A1 discloses a Gas volume correction system designed to independently manage one or more distinct measurement units dispersed geographically, and give users all of the necessary information via various access methods. The system includes a remote station/correction that collects from the measurement units the measuring and consumption information and processes and stores it in the historical archives. For its part, the control centre requests all the necessary data from the remote station/corrector to can update its databases. The user can query these databases locally using a local, personal computer.

[0008] US20110074598A1 discloses an apparatus and related methodologies for transmitting data related to utility conditions between monitoring locations and a central and/or data collection facility using a meter reading system. Collection of both corrected and uncorrected data from meters is achieved to thereby provide backup data in case of corrector failure. The apparatus and methodologies also provide for the collection of telemetry data and alarms from correctors and recorders over a meter reading system. Two-way communications over a meter reading system is also provided to permit data transmission to selected endpoint devices.

SUMMARY

[0009] The present invention in its various aspects is as set out in the appended claims. This Summary is provided to introduce a brief selection of disclosed concepts in a simplified form that are further described below in the Detailed Description including the drawings provided. This Summary is not intended to limit the claimed subject matter's scope.

[0010] Disclosed embodiments recognize known EVCs have numerous problems. For example, such EVCs lack resources as most EVCs are battery powered and thus must run at low processing power and have a small memory. Also the ON time of EVCs are controlled to maximize battery life. Adding advanced software features such as the latest communication/networking schemes, and an advanced human machine interface (HMI) are not possible with known EVC system architectures. Moreover, added software will demand more hardware and the EVC will become more complex making it difficult to pass required certification.

[0011] Disclosed EVCs solve the above problems by providing a distributed hardware (split) EVC, where the EVC is split to 2 different physical subsystems, an EVC sensor interface unit and an EVC processing unit. The

split EVC includes a plurality of EVC sensor interface units each for collecting a plurality of sensed sensor parameters including uncorrected gas volume data (UGVD) from a gas meter, a gas pressure from a gas pressure sensor, and gas temperature from a gas temperature sensor. An EVC processing unit is communicably connected to the plurality of EVC sensor interface units for performing volume correction for generating corrected GVD (CGVD) from the UGVD received from the plurality of EVC sensor interface units, data logging, and networking functions. The EVC sensor interface units and the EVC processing unit are configured independent including being physically separate from one another.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 shows a portion of a gas metering and telemetry system including an example split EVC having a plurality of sensor interface units in a hazardous zone and an EVC processing unit installed in a safe zone communicably coupled to the sensor interface units by an example wireless link, according to an example embodiment.

FIG. 2 is an example wireless smart gas metering and telemetry system schematic which includes an example split EVC, according to an example embodiment.

DETAILED DESCRIPTION

[0013] Disclosed embodiments are described with reference to the attached figures, wherein like reference numerals are used throughout the figures to designate similar or equivalent elements. The figures are not drawn to scale and they are provided merely to illustrate certain disclosed aspects. Several disclosed aspects are described below with reference to example applications for illustration. It should be understood that numerous specific details, relationships, and methods are set forth to provide a full understanding of the disclosed embodiments.

[0014] One having ordinary skill in the relevant art, however, will readily recognize that the subject matter disclosed herein can be practiced without one or more of the specific details or with other methods. In other instances, well-known structures or operations are not shown in detail to avoid obscuring certain aspects. This Disclosure is not limited by the illustrated ordering of acts or events, as some acts may occur in different orders and/or concurrently with other acts or events. Furthermore, not all illustrated acts or events are required to implement a methodology in accordance with the embodiments disclosed herein.

[0015] Also, the terms "coupled to" or "couples with" (and the like) as used herein without further qualification are intended to describe either an indirect or direct electrical connection. Thus, if a first device "couples" to a second device, that connection can be through a direct electrical connection where there are only parasitics in the pathway, or through an indirect electrical connection via intervening items including other devices and connections. For indirect coupling, the intervening item generally does not modify the information of a signal but may adjust its current level, voltage level, and/or power level.

[0016] The sensor interface units and EVC processing units of disclosed split EVCs are self-sufficient, physically separate and separately configurable units. For example, the sensor interface units can be configured according to the type of gas flow meters (mechanical or ultrasonic), periodicity at which it should push sensor data to the EVC processing unit, and alarm limits of its battery that it generally has which can be specific to the particular gas meter and metering needs. The EVC processing unit is generally configured with a different set of data, such as the EVC sensor interface unit IDs which are associated with the EVC processing unit, and network interface related configuration data. However, an operator can generally push all this configuration data in one configuration activity to go to the EVC processing unit as well as its associated EVC sensor interface units from locally or from a remote location.

[0017] The EVC sensor interface units can be physically installed in a hazardous location (Hazloc). Hazlocks are defined as places where fire or explosion hazards may exist due to the presence of flammable gases, flammable liquid-produced vapors, combustible liquid-produced vapors, combustible dusts, or ignitable fibers/flyings present in the air in quantities sufficient to produce explosive or ignitable mixtures. Electrical equipment installed in such locations should be specially designed and tested to ensure it does not initiate an explosion, due to arcing contacts or high surface temperature of equipment. One may need to have ATEX/IEC Ex/ CSA certification and approvals to install an EVC in Hazloc. Hazolc is classified to zones (z2, z1, z0 - z0 is most severe) and class and divisions in the US.

[0018] FIG. 1 shows a portion shows a gas metering system 100 including an example split EVC 130a, 130b having a plurality of sensor interface units 130b in a hazardous zone and an EVC processing unit 130a installed in a safe zone, according to an example embodiment. The plurality of sensor interface units 130b are communicably coupled to the EVC processing unit 130a by a wireless link 145. However, wired communication links are also possible. The sensor interface units 130b are installed for collection of a plurality of sensed sensor parameters including a gas flow in a gas line from a gas flow meter (gas meter) 105, 106, 107 installed on respective pipe sections 105a, 106a, 107a with flanges 109 on the ends of the pipe section for connecting in the pipe section to a pipeline to enable its gas volume to be measured. The sensor interface units 130b's are each shown including a processing unit $130b_1$ and a memory $130b_2$.

[0019] The gas meters are 105, 106, 107 are shown

including an outer gas meter body 138 where a sensor interface unit 130b is also shown physically embedded in the gas meter body 138. The dashed line shown between the respective gas meters 105, 106, 107 and its associated EVC sensor interface unit 130b is shown to indicate the gas meters are 105, 106, 107 and EVC sensor interface units 130b can also have separate bodies, such as shown in FIG. 2 described below

[0020] The sensor interface units 130b receive a gas pressure (P) from a P sensor 112 (e.g., pressure sensor-transducer) and gas temperature (T) from a T sensor 111 (e.g., temperature sensor-transducer) on or in the pipe section so that they are exposed to the flowing gas. As known in the art, the outputs of the P and T sensors 111, 112 can each be calibrated by appropriate circuits to produce respective output signals which are linearly and proportionately responsive to the absolute values of the measured temperature and pressure. In some cases one can use relative P referred to as gauge pressure sensors which measure differential P between the atmospheric pressure and gas P. Another sensor type that can be included is a gas chromatograph which can provide the details of the gas composition (e.g., for natural gas applications) to the sensor interface units 130b.

[0021] The sensor interface units 130b can be directly installed in hazardous location as the companion module meaning the sensor interface units 130b can be an add-on to gas meters 105-107 from any gas meter source or vendor. The sensor interface units 130b alone can be battery powered (EVC processing unit 130a being mains powered) which will help to offer higher battery life compared to a known EVC battery powering both the sensor unit and a processing unit. The sensor interface units 130b can also be mains powered. The sensor interface units 130b can be packaged in miniature form factor which helps to reduce its cost as well as ease of handling in field. The sensor interface unit 130b alone can be packaged in a miniature size as compared to current EVC packaging where the combination of the EVC processing unit 130a, HMI, sensor interface unit 130b and battery makes it larger in size.

[0022] As described above, the sensor interface units 130b can be embedded into the body of the gas meter 105-107 directly, with options for performing energy harvesting directly from the pipe (power can be from the gas flow, differential pressure or from solar). This ensures close to a passive solution for EVC sensing and the field maintenance can also be simplified.

[0023] The EVC processing unit 130a is shown including a memory $130a_2$. The EVC processing unit 130a as described above performs volume correction for generating CGVD from the UGVD received from each of the plurality of EVC sensor interface units 130b, data logging, as well as networking functions. Each EVC processing unit 130a being connected to a plurality of EVC sensor units 130b thus performs volume correction for multiple gas meters generally installed on multiple pipelines (respective pipelines are each associated with pipe sections 105a, 106a, 107a shown in FIG. 1) which are independent of one another. The EVC processing unit 130a is installed in a safe zone communicably coupled as shown in FIG. 1 to the sensor interface units 130b by a short range wireless link 145 (Bluetooth or Bluetooth low energy (BLE), Wifi, Zigbee, ISA100 enabled wireless link). However, as noted above a wired connection can also be used. The EVC processing unit 130a can be a generic embedded device which can handle communications to the plurality of sensor interface unit 130b on one side and on the other side an uplink towards other systems such as a server and/or cloud-based systems. EVC processing unit 130a can perform EVC calculations, controls (if needed), and communication functions. Specialized hardware is not needed. The EVC processing unit 130a can include a display (e.g. LCD display) and other user interfaces.

[0024] As noted above the EVC processing unit 130a can be mains powered, and can be provided with ample processing power (e.g., processor 130al comprising a microprocessor), memory $130a_2$, and network connectivity. As noted above, the EVC processing unit 130a performs volume correction for T and P to generate CGVD from the UGVD from a plurality of EVC sensor interface units 130b, data logging (i.e., can create log measurement and event information and store it for long term, this is a requirement for some of the certifications) and networking functions. For example EVC processing unit 130a can be connected to higher level systems or peer systems and exchange measurement, controls, and status information. Also, the EVC processing unit 130a can participate in functions including firmware and application upgrades at run time.

[0025] An Automatic Meter Reading (AMR) unit 135 is shown coupled to EVC processing unit 130a Although the AMR unit 135 is shown as an outside unit, the EVC processing unit 130a and AMR unit 135 can be provided as a single physical unit as well. AMR technology allows for consistent and accurate collection of information from a gas meter. Collected data is transferred by the AMR unit 135 to a centralized database shown as cloud-based analytics 170 for billing purposes and/or usage analysis including big data applications where the data from several EVC processing units 130a are pulled in to a central location and analytics run on this data and generate meaningful information such as trend and usage information. The data can be used to optimize operations and for supply chain calculations. Analytics 170 can be a web-based application as well.

[0026] The communicable connection between the EVC sensor interface unit 130b and the EVC processing unit 130a can also be a wired connection, as an alternative to a wireless connection. For example, to address possible challenges in obtaining Measuring Instruments (MID) directive - IEC12405 certifications for a split EVC with a EVC sensor interface unit 130b and EVC processing unit 130a that are physically separated from one another there are at least 2 options. MID was adopted by

the European Parliament and Council on 31 March 2004, for application by EU Member States from 30 October 2006. MID seeks to harmonize many aspects of legal metrology across all member states of the EU, including water meters and gas meters. There are also there are several geographical variants of this standard and one of the most important one is Measurement Canada (MC). Disclosed embodiments are not limited those satisfying MID.

[0027] Option 1. The sensor interface unit 130b can collect pressure and temperature data from the sensors 111, 112 and pulse information from the flow meters 105-107 and send this information to the EVC processing unit 130a through short range wired or wireless interface. Optionally, the sensor interface units 130b can perform some of the sensor data corrections, filtering, and compensations to ensure a large chunk of raw sensor data is not transferred to EVC processing unit 130a.

[0028] Option 2. The sensor interface units 130b can collect P, T and pulse information and perform MID calculation in local and send this to the EVC processing unit 130a in the safe zone through short range wireless or wired communications. This arrangement would be analogous to MID type 1 where the whole unit is certified for MID. In this case the additional processing unit (EVC processing unit 130a does not need to perform gas calculations, corrected and uncorrected information can come from sensor unit itself) would simply act like a gateway which would still add value but will have less impact in terms of product cost reduction. Doing all gas calculations and the calculations in the sensor interface units 130b makes it bulky but still additional functions such as communication, HMI etc. can be part of EVC processing unit 130a so that the split EVC is viable and cost competitive even in this form.

[0029] FIG. 2 is an example schematic for a wireless metering telemetry MDM system 200 which can include at least one disclosed split EVC 130a, 130b, according to an example embodiment. MDM server 240 is shown including a MDM database and application server 240_1 having a processor 240c with an associated first memory $240a_1$ of the MDM database and application server 240_1, and a separate MDM communications server 240_2. The MDM database in the second memory $240a_2$ in application server 240_1 is where the gas meter data generally resides and includes uncorrected GVD, CGVD, and the state variables of temperature and pressure for particular intervals of time which collectively provides a historical database which can be stored and processed for use for billing and other applications. Although the first memory $240a_1$ and second memory $240a_2$ are shown in FIG. 2 as separate memories, they can be provided by a single memory. The MDM database and application server 240_1 is shown in FIG. 2 coupled to a billing, operations and other enterprise applications system 260.

[0030] Gas meter data from gas meters shown as gas meter 105 associated with service location 101 and gas meter 106 associated with service location 102 reaches the MDM communications server 240_2 of MDM server 240 over a communications path including a wireless communications network.

[0031] Gas meters 105 and 106 are shown communicably coupled split EVC (130a, 130b) for downloading consumption and gas meter readings generally including uncorrected GVD, and the state variables received from sensors (not shown), the split EVC is generally at each service location, where that can receive meter data from a plurality of gas meters each having unique remote unit identifier (RUID). Gas consumption related information generally comes in the form of pulses or as a rotary shaft coupling, in the form of current or in the form of voltage or in the form of data in hard real time mode to the sensor interface unit 130b. Sensor interface units 130b can perform a sensor data aggregator function and provide this information to EVC processing unit 130a at a comparatively lower rate/long time interval.

[0032] Split EVC 130a, 130b performs temperature and pressure correction to generate CGVD from the UGVD and state variable data (typically temperature and pressure) received. The gas volume at standard conditions is generally measured in standard cubic feet per minute (scfm) and is referred to as CGVD for a fixed duration of time (e.g., 15 minutes).

[0033] Regarding the communication link used in system 200, the communications network shown in FIG. 2 following split EVC 130a, 130b comprises cellular tower 215 over a wireless medium 218 shown by example to a cellular operations center 220, then through a secure connection 222 to a utility operations center 230 which can include the MDM server 240 shown in FIG. 2. As noted above, although shown as being a wireless network connecting split EVC (130a, 130b) to utility operation center 230, the split EVC (130a, 130b) depending on the type and configuration may also have the capability to transmit gas meter data over a telephone network or Internet protocol (IP) network to utility operation center 230. There are thus multiple possible modes of communication (including mixed modes) which can be used for transferring data from gas meters 105 and 106 to the MDM server 240. Each of these communication modes offers different bandwidth, reliability and cost of communication. Cloud-based analytics 170 is also shown coupled (e.g., by an IP connection) to the EVC processing unit 130a, mobile device 265 (e.g., a mobile phone) and the MDM server 240.

[0034] System 200 can also include a direct interface of the EVC processing unit 130a to the mobile device 265. With the help of a suitable mobile application a customer is able to establish either a direct data connection with EVC processing unit 130a or through the MDM server 240 and obtain all gas related information and diagnostics and status information of EVC processing unit 130a and sensor interface unit 130b on this mobile device 265 (or other mobile platform).

[0035] Regarding the data transfer mechanism, gas meter data (temperature, pressure, UGVD and CGVD)

from the split EVC 130a, 130b is generally transferred to the MDM communications server 240_2 based on a schedule defined by a call scheduler application that typically resides in MDM server 240. As in FIG. 1, in FIG. 2 the EVC processing unit 130a is shown including an AMR 135 coupled thereto for fetching all relevant data from the EVC processing unit 130a and consuming it or transferring it to the network through the cellular tower 215 shown in FIG. 2.

[0036] Generally, the interval data (both UGVD and CGVD), pressure, temperature, monthly data and additional information including device level diagnostics (e.g., alarm information) regarding the devices the MDM system involved transferring the gas meter data to the MDM server, as configured by the user in MDM application, which generally gets transferred once/twice or more frequently in each day. The duration of a 24hr period is defined as "gas day" and the start and end times set (e.g., 8 am to 8 am next day) as per user' configuration. Similar is the case with monthly data also, if monthly gas data is accumulated and available at the split EVC 130a, 130b, it can be read once in a month as per the billing calendar configurable by the user of MDM application.

[0037] EVC processing unit 130a can allow dynamic configuration of sensor interface unit 130b and can enable some limited control functions. For example if EVC processing unit 130a receives information from a customer that one of the gas pipes will not be in use for few days the respective sensor interface unit can be brought down to power down to save battery power. Data can be shared between the EVC processing unit 130a and the sensor interface unit 130b, for example for a cluster of sensor interface units 130b installed in a site one generally only needs one sensor attached to one of the 130b for sensing ambient temperature, where this information can be shared across all sensor interface units 130b's through EVC processing unit 130a.

[0038] In case the EVC processing unit 130a goes down for some time, the sensor interface units 130b's retain gas information in their memory $130b_2$ which is made available to the EVC processing unit 130a once it comes back on-line. The EVC processing unit 130a can be provided with functional redundancy to reduce down time. The EVC processing unit 130a can be part of other subsystems such as AMR 135. Data from the EVC processing unit 130a or AMR 135 can be brought to cloud shown as analytics 170, MDM 240 or to a mobile device 265 directly.

[0039] Disclosed embodiments can be applied to generally accurately measure any fluid flow For example, for natural gas or propane sales.

Claims

1. A gas metering telemetry system (200) including;

a Meter Data Management server (240) including a Meter Data Management database and application server (240_1) having a processor (240_c) with an associated first memory (240_{a1}) of the MDM database and application server (240_1), and a separate MDM communications server (240_2);

at least one split Electronic Volume Corrector, EVC, (130a, 130b), said at least one split Electronic Volume Corrector (130a, 130b) comprising:

a plurality of split EVC sensor interface units (130b) for collecting a plurality of sensed sensor parameters including uncorrected gas volume data (UGVD) from a gas meter (105, 106, 107), a gas pressure from a gas pressure sensor (112) and gas temperature from a gas temperature sensor (111), and a split EVC processing unit (130a) communicably connected to said plurality of split EVC sensor interface units (130b) for performing volume corrections for generating corrected gas volume data (CGVD) from said UGVD received from each of said plurality of split EVC sensor interface units (130b), data logging, and networking functions;

wherein said split EVC sensor interface units (130b) and said split EVC processing unit (130a) are configured independent including being physically separate from one another; wherein the Meter Data Management database and application server (240_1) includes a second memory (240_2), in which resides the gas meter data including uncorrected Gas Volume Data, Corrected Gas Volume Data, and the state variables of temperature and pressure for particular intervals of time which collectively provides a historical database which can be stored and processed for use for billing and other applications;

Characterized in that: the gas metering telemetry system (200) is a wireless gas metering telemetry system (200); and gas meter data from gas meters reaches the Meter Data Management communications server (240_2) of the Meter Data Management server (240) over a communications path including a wireless communications network; and said plurality of split EVC sensor interface units (130b) include a memory ($130b_2$) for retaining information regarding said gas, wherein in the case the split EVC processing unit (130a) goes down for some time, the split EVC sensor interface units (130b) retain gas information in said memories ($130b_2$), further comprising following recov-

ery from said split EVC processing unit (130a) from being down from service, said gas information is being made available to the split EVC processing unit (130a) by said split EVC sensor interface units.

2. The wireless gas metering telemetry system (200) of claim 1, wherein said split EVC processing unit (130a) independently processes said volume corrections corresponding to each of said plurality of said split EVC sensor interface units (130b).

3. The wireless gas metering telemetry system (200) of claim 1, wherein said communicably connected comprises a wireless connection (145).

4. The wireless gas metering telemetry system (200) of claim 1, further comprising a plurality of gas meter bodies (138), wherein said EVC sensor interface units are physically embedded in said gas meter bodies.

5. The wireless gas metering telemetry system (200) of claim 1, wherein said split EVC sensor interface unit (130b) is exclusive of an external power source, and is powered using at least one of a battery, harvested power from physical properties of said flow of said gas, wind or solar energy.

6. A method of volume correction for a gas flow in a gas line, comprising:
providing a gas metering telemetry system (200) including:

at least one split Electronic Volume Corrector, EVC, (130a, 130b) comprising a plurality of split EVC sensor interface units (130b), a Meter Data Management server (240), and a split EVC processing unit (130a) that are configured independent including being physically separate from one another;
said plurality of split EVC sensor interface units (130b) collecting a plurality of sensed sensor parameters including uncorrected gas volume data (UGVD) from a gas meter (105, 106, 107), and a gas pressure from a gas pressure sensor (112) and gas temperature from a gas temperature sensor (111), and
said Meter Data Management, MDM, server (240) including a Meter Data Management database and application server (240_1) having a processor (240_c) with an associated first memory (240_{a1}) of the MDM database and application server (240_1), and a separate MDM communications server (240_2); wherein the MDM database and application server (240_1) includes a second memory (240_2), in which resides the gas meter data including uncorrected Gas Volume Data, Corrected Gas Volume Data, and the state variables of temperature and pressure for particular intervals of time which collectively provides a historical database which can be stored and processed for use for billing and other applications
said split EVC processing unit (130a) communicably connected to said plurality of split EVC sensor interface units (130b) for performing volume corrections for generating corrected gas volume data (CGVD) from said UGVD received from each of said plurality of split EVC sensor interface units (130b), data logging and networking functions;
Characterized in that:
the gas metering telemetry system (200) is a wireless gas metering telemetry system (200); and gas meter data from gas meters reaches the Meter Data Management communications server (240_2) of the Meter Data Management server (240) over a communications path including a wireless communications network; and said plurality of split EVC sensor interface units (130b) include a memory ($130b_2$) for retaining information regarding said gas, wherein in the case the split EVC processing unit (130a) goes down for some time, the split EVC sensor interface units (130b) retain gas information in said memories ($130b_2$), further comprising following recovery from said split EVC processing unit (130a) from being down from service, said gas information is being made available to the split EVC processing unit (130a) by said split EVC sensor interface units (130b).

7. The method of claim 6, wherein said split EVC processing unit (130a) independently processes said volume corrections corresponding to each of said plurality of said split EVC sensor interface units (130b).

8. The method of claim 6, wherein said split EVC processing unit (130a) is in a safe zone and said split EVC sensor interface units (130b) are in a hazardous zone.

9. The method of claim 6, wherein said communicably connected comprises a wireless connection (145).

10. The method of claim 6, wherein said split EVC sensor interface units (130b) are exclusive of an external power source, and is powered using at least one of a battery of harvested power from physical properties of said gas flow, wind or solar energy.

11. The method of claim 6, wherein said split EVC processing unit (130a) and said plurality of split EVC sensor interface units (130b) are both installed at a

common site, further comprising sharing data between said plurality of split EVC sensor interface units (130b) and said split EVC processing unit.

Patentansprüche

1. Gasmess-Telemetriesystem (200), einschließend;

einen Messdatenverwaltungsserver (240), einschließend einen Messdatenverwaltungsdatenbank- und Anwendungsserver (240_1), der einen Prozessor (240_c) mit einem zugehörigen ersten Speicher (240_{a1}) des MDM-Datenbank- und Anwendungsservers (240_1) aufweist, und einen separaten MDM-Kommunikationsserver (240_2) ;
mindestens einen geteilten elektronischen Volumenkorrektor, EVC, (130a, 130b), wobei mindestens ein geteilter elektronischer Volumenkorrektor (130a, 130b) umfasst:
eine Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b) zum Sammeln einer Vielzahl von erfassten Sensorparametern, einschließlich unkorrigierter Gasvolumendaten (UGVD) von einem Gasmesser (105, 106, 107), eines Gasdrucks von einem Gasdrucksensor (112) und einer Gastemperatur von einem Gastemperatursensor (111), und
eine geteilte EVC-Verarbeitungseinheit (130a), die kommunikativ mit der Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b) verbunden ist, um Volumenkorrekturen zum Erzeugen von korrigierten Gasvolumendaten (CGVD) aus den UGVD, die von jeder der Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b) empfangen werden, Datenprotokollierung und Netzwerkfunktionen durchzuführen;

wobei die geteilten EVC-Sensorschnittstelleneinheiten (130b) und die geteilte EVC-Verarbeitungseinheit (130a) unabhängig konfiguriert sind, einschließlich der physischen Trennung voneinander; wobei der Messdatenverwaltungsdatenbank- und Anwendungsserver (240_1) einen zweiten Speicher (240_2) einschließt, in dem die Gasmessdaten einschließlich der unkorrigierten Gasvolumendaten, der korrigierten Gasvolumendaten und der Zustandsvariablen von Temperatur und Druck für bestimmte Zeitintervalle gespeichert sind, die gemeinsam eine historische Datenbank bereitstellen, die zur Verwendung für die Abrechnung und andere Anwendungen gespeichert und verarbeitet werden kann;
dadurch gekennzeichnet, dass:
das Gasmess-Telemetriesystem (200) ein drahtloses Gasmess-Telemetriesystem (200) ist; und Gasmessdaten von Gasmessern den Messdatenverwaltungskommunikationsserver (240_2) des Messdatenverwaltungsservers (240) über einen Kommunikationspfad erreichen, der ein drahtloses Kommunikationsnetzwerk einschließt; und die Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b) einen Speicher ($130b_2$) zum Aufbewahren von Informationen bezüglich des Gases einschließen, wobei in dem Fall, dass die geteilte EVC-Verarbeitungseinheit (130a) für einige Zeit ausfällt, die geteilten EVC-Sensorschnittstelleneinheiten (130b) Gasinformationen in dem Speicher ($130b_2$) aufbewahren, ferner umfassend, dass die Gasinformationen der geteilten EVC-Verarbeitungseinheit (130a) nach der Wiederherstellung der geteilten EVC-Verarbeitungseinheit (130a) nach dem Ausfall durch die geteilten EVC-Sensorschnittstelleneinheiten verfügbar gemacht werden.

2. Drahtloses Gasmess-Telemetriesystem (200) nach Anspruch 1, wobei die geteilte EVC-Verarbeitungseinheit (130a) die Volumenkorrekturen, die jeder der Vielzahl der geteilten EVC-Sensorschnittstelleneinheiten (130b) entsprechen, unabhängig verarbeitet.

3. Drahtloses Gasmess-Telemetriesystem (200) nach Anspruch 1, wobei die kommunikativ verbundene eine drahtlose Verbindung (145) umfasst.

4. Drahtloses Gasmess-Telemetriesystem (200) nach Anspruch 1, ferner umfassend eine Vielzahl von Gasmesskörpern (138), wobei die EVC-Sensorschnittstelleneinheiten physisch in die Gasmesskörper eingebettet sind.

5. Drahtloses Gasmess-Telemetriesystem (200) nach Anspruch 1, wobei die geteilte EVC-Sensorschnittstelleneinheit (130b) ausschließlich über eine externe Energiequelle verfügt und unter Verwendung von mindestens einer von einer Batterie, von aus den physikalischen Eigenschaften des Gasstroms gewonnener Energie, von Wind- oder Sonnenenergie betrieben wird.

6. Verfahren zur Volumenkorrektur für einen Gasstrom in einer Gasleitung, umfassend:

Bereitstellen eines Gasmess-Telemetriesystems (200), einschließend:
mindestens einen geteilten elektronischen Volumenkorrektor, EVC, (130a, 130b), der eine Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b), einen Messdatenverwal-

tungsserver (240) und eine geteilte EVC-Verarbeitungseinheit (130a) umfasst, die unabhängig konfiguriert sind, einschließlich der physischen Trennung voneinander;
die Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b) zum Sammeln einer Vielzahl von erfassten Sensorparameter, einschließlich unkorrigierter Gasvolumendaten (UGVD) von einem Gasmesser (105, 106, 107) und eines Gasdrucks von einem Gasdrucksensor (112) und einer Gastemperatur von einem Gastemperatursensor (111), und
wobei der Messdatenverwaltungs-Server, MDM-Server, (240) einen Messdatenverwaltungsdatenbank- und Anwendungsserver (240_1), der einen Prozessor (240_c) mit einem zugehörigen ersten Speicher (240_{a1}) des MDM-Datenbank- und Anwendungsservers (240_1) aufweist, und einen separaten MDM-Kommunikationsserver (240_2) einschließt; wobei der MDM-Datenbank- und Anwendungsserver (240_1) einen zweiten Speicher (240_2) einschließt, in dem die Gasmesserdaten einschließlich der unkorrigierten Gasvolumendaten, der korrigierten Gasvolumendaten und der Zustandsvariablen von Temperatur und Druck für bestimmte Zeitintervalle gespeichert sind, die gemeinsam eine historische Datenbank bereitstellen, die zur Verwendung für die Abrechnung und andere Anwendungen gespeichert und verarbeitet werden kann
die geteilte EVC-Verarbeitungseinheit (130a), die kommunikativ mit der Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b) verbunden ist, um Volumenkorrekturen zum Erzeugen von korrigierten Gasvolumendaten (CGVD) aus den UGVD, die von jeder der Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b) empfangen werden, Datenprotokollierung und Netzwerkfunktionen durchzuführen;
dadurch gekennzeichnet, dass:
das Gasmess-Telemetriesystem (200) ein drahtloses Gasmess-Telemetriesystem (200) ist; und Gasmessdaten von Gasmessern den Messdatenverwaltungskommunikationsserver (240_2) des Messdatenverwaltungsservers (240) über einen Kommunikationspfad erreichen, der ein drahtloses Kommunikationsnetzwerk einschließt; und die Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b) einen Speicher ($130b_2$) zum Aufbewahren von Informationen bezüglich des Gases einschließen, wobei in dem Fall, dass die geteilte EVC-Verarbeitungseinheit (130a) für einige Zeit ausfällt, die geteilten EVC-Sensorschnittstelleneinheiten (130b) Gasinformationen in dem Speicher ($130b_2$) aufbewahren, ferner umfassend, dass die Gasinformationen der geteilten EVC-Verarbeitungseinheit (130a) nach der Wiederherstellung der geteilten EVC-Verarbeitungseinheit (130a) nach dem Ausfall durch die geteilten EVC-Sensorschnittstelleneinheiten (130b) verfügbar gemacht werden.

7. Verfahren nach Anspruch 6, wobei die geteilte EVC-Verarbeitungseinheit (130a) die Volumenkorrekturen, die jeder der Vielzahl der geteilten EVC-Sensorschnittstelleneinheiten (130b) entsprechen, unabhängig verarbeitet.

8. Verfahren nach Anspruch 6, wobei sich die geteilte EVC-Verarbeitungseinheit (130a) in einer sicheren Zone und die geteilten EVC-Sensorschnittstelleneinheiten (130b) in einer gefährlichen Zone befinden.

9. Verfahren nach Anspruch 6, wobei die kommunikativ verbundene eine drahtlose Verbindung (145) umfasst.

10. Verfahren nach Anspruch 6, wobei die geteilten EVC-Sensorschnittstelleneinheiten (130b) ausschließlich über eine externe Energiequelle verfügen und unter Verwendung von mindestens einer von einer Batterie, von aus den physikalischen Eigenschaften des Gasstroms gewonnener Energie, von Wind- oder Sonnenenergie betrieben werden.

11. Verfahren nach Anspruch 6, wobei die geteilte EVC-Verarbeitungseinheit (130a) und die Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b) beide an einem gemeinsamen Standort installiert sind, ferner umfassend das Teilen von Daten zwischen der Vielzahl von geteilten EVC-Sensorschnittstelleneinheiten (130b) und der geteilten EVC-Verarbeitungseinheit.

Revendications

1. Système de télémétrie de mesure de gaz (200) comprenant ;

un serveur de gestion de données de compteur (240) comprenant une base de données de gestion de données de compteur et un serveur d'application (240_1) comportant un processeur (240_c) avec une première mémoire associée (240_{a1}) de la base de données MDM et du serveur d'application (240_1), ainsi qu'un serveur de communication MDM distinct (240_2) ;
au moins un correcteur de volume électronique, EVC, divisé (130a, 130b), ledit au moins un correcteur de volume électronique divisé (130a, 130b) comprenant :
une pluralité d'unités d'interface de capteur

d'EVC divisé (130b) pour collecter une pluralité de paramètres de capteur détectés comprenant des données de volume de gaz non corrigées (UGVD) provenant d'un compteur de gaz (105, 106, 107), une pression de gaz provenant d'un capteur de pression de gaz (112) et une température de gaz provenant d'un capteur de température de gaz (111) et

une unité de traitement d'EVC divisé (130a) connectée en communication à ladite pluralité d'unités d'interface de capteur d'EVC divisé (130b) pour effectuer des corrections de volume pour générer des données de volume de gaz corrigées (CGVD) à partir desdites UGVD reçues de chaque unité de ladite pluralité d'unités d'interface de capteur d'EVC divisé (130b), des fonctions de journalisation de données et de mise en réseau ;

dans lequel lesdites unités d'interface de capteur d'EVC divisé (130b) et ladite unité de traitement d'EVC divisé (130a) sont configurées indépendamment, notamment en étant physiquement séparées l'une de l'autre ; dans lequel la base de données de gestion de données de compteur et le serveur d'application (240_1) comprennent une seconde mémoire (240_2), dans laquelle se trouvent les données de compteur de gaz, y compris les données de volume de gaz non corrigées, les données de volume de gaz corrigées et les variables d'état de température et de pression pour des intervalles de temps particuliers qui fournissent collectivement une base de données historique qui peut être stockée et traitée en vue d'être utilisée pour la facturation et d'autres applications ;

caractérisé en ce que :

le système de télémétrie de mesure de gaz (200) est un système de télémétrie de mesure de gaz (200) sans fil ; et des données de compteur de gaz provenant de compteurs de gaz atteignent le serveur de communication de gestion de données de compteur (240_2) du serveur de gestion de données de compteur (240) sur une voie de communication comprenant un réseau de communication sans fil ; et ladite pluralité d'unités d'interface de capteur d'EVC divisé (130b) comprend une mémoire ($130b_2$) pour conserver des informations concernant ledit gaz, dans lequel, dans le cas où l'unité de traitement d'EVC divisé (130a) tombe en panne pendant un certain temps, les unités d'interface de capteur d'EVC divisé (130b) conservent les informations sur le gaz dans ladite mémoire de mémoires ($130b_2$), comprenant en outre par la suite la récupération de ladite unité de traitement d'EVC divisé (130a) après la mise hors service, lesdites informations sur le gaz sont mises à la disposition de l'unité de traitement d'EVC divisé (130a) par lesdites unités d'interface de capteur d'EVC divisé.

2. Système de télémétrie de mesure de gaz sans fil (200) selon la revendication 1, dans lequel ladite unité de traitement d'EVC divisé (130a) traite indépendamment lesdites corrections de volume correspondant à chaque unité de ladite pluralité desdites unités d'interface de capteur d'EVC divisé (130b).

3. Système de télémétrie de mesure de gaz sans fil (200) selon la revendication 1, dans lequel ladite connectée en communication comprend une connexion sans fil (145).

4. Système de télémétrie de mesure de gaz sans fil (200) selon la revendication 1, comprenant en outre une pluralité de corps de compteur de gaz (138), dans lequel lesdites unités d'interface de capteur d'EVC sont physiquement incorporées dans lesdits corps de compteur de gaz.

5. Système de télémétrie de mesure de gaz sans fil (200) selon la revendication 1, dans lequel ladite unité d'interface de capteur d'EVC divisé (130b) est exclusive d'une source d'alimentation externe et est alimentée au moyen d'au moins un élément parmi une batterie, de l'énergie récupérée à partir de propriétés physiques dudit flux de ladite énergie gazeuse, éolienne ou solaire.

6. Procédé de correction de volume pour un flux de gaz dans une conduite de gaz, comprenant :

la fourniture d'un système de télémétrie de mesure de gaz (200) comprenant : au moins un correcteur de volume électronique, EVC, divisé (130a, 130b) comprenant une pluralité d'unités d'interface de capteur d'EVC divisé (130b), un serveur de gestion de données de compteur (240) et une unité de traitement d'EVC divisé (130a) qui sont configurés indépendamment, notamment en étant physiquement séparés les uns des autres ;

ladite pluralité d'unités d'interface de capteur d'EVC divisé (130b) collectant une pluralité de paramètres de capteur détectés comprenant des données de volume de gaz non corrigées (UGVD) provenant d'un compteur de gaz (105, 106, 107) et une pression de gaz provenant d'un capteur de pression de gaz (112) et une température de gaz provenant d'un capteur de température de gaz (111) et

ledit serveur de gestion de données de compteur, MDM, (240) comprenant une base de données de gestion de données de compteur et un serveur d'application (240_1) comportant un processeur (240_c) avec une première mémoire associée (240_{a1}) de la base de données MDM et du serveur d'application (240_1) et un serveur de communication MDM distinct (240_2) ; dans lequel la base de données MDM et le serveur d'application (240_1) comprennent une seconde mémoire (240_2), dans laquelle se trouvent les données de compteur de gaz, y compris des données de volume de gaz non corrigées, des données de volume de gaz corrigées et les variables d'état de température et de pression pour des intervalles de temps particuliers qui fournissent collectivement une base de données historique qui peut être stockée et traitée en vue d'être utilisée pour la facturation et d'autres applications ladite unité de traitement d'EVC divisé (130a) connectée en communication à ladite pluralité d'unités d'interface de capteur d'EVC divisé (130b) pour effectuer des corrections de volume pour générer des données de volume de gaz corrigées (CGVD) à partir desdites UGVD reçues de chaque unité de ladite pluralité d'unités d'interface de capteur d'EVC divisé (130b), des fonctions de journalisation de données et de mise en réseau ; **caractérisé en ce que** :
le système de télémétrie de mesure de gaz (200) est un système de télémétrie de mesure de gaz sans fil (200) ; et des données de compteur de gaz provenant de compteurs de gaz atteignent le serveur de communication de gestion de données de compteur (240_2) du serveur de gestion de données de compteur (240) sur une voie de communication comprenant un réseau de communication sans fil ; et ladite pluralité d'unités d'interface de capteur d'EVC divisé (130b) comprend une mémoire ($130b_2$) pour conserver des informations concernant ledit gaz, dans lequel, dans le cas où l'unité de traitement d'EVC divisé (130a) tombe en panne pendant un certain temps, les unités d'interface de capteur d'EVC divisé (130b) conservent des informations de gaz dans lesdites mémoires ($130b_2$), comprenant en outre, après la récupération de la panne de ladite unité de traitement d'EVC divisé (130a), lesdites informations de gaz sont mises à la disposition de l'unité de traitement d'EVC divisé (130a) par lesdites unités d'interface de capteur d'EVC divisé (130b).

7. Procédé selon la revendication 6, dans lequel ladite unité de traitement d'EVC divisé (130a) traite indépendamment lesdites corrections de volume correspondant à chaque unité de ladite pluralité desdites unités d'interface de capteur d'EVC divisé (130b).

8. Procédé selon la revendication 6, dans lequel ladite unité de traitement d'EVC divisé (130a) est dans une zone sécurisée et lesdites unités d'interface de capteur d'EVC divisé (130b) sont dans une zone dangereuse.

9. Procédé selon la revendication 6, dans lequel ladite connectée en communication comprend une connexion sans fil (145).

10. Procédé selon la revendication 6, dans lequel lesdites unités d'interface de capteur d'EVC divisé (130b) sont exclusives d'une source d'alimentation externe et sont alimentées au moyen d'au moins l'une d'une batterie d'énergie récupérée à partir de propriétés physiques dudit flux de gaz, d'énergie éolienne ou solaire.

11. Procédé selon la revendication 6, dans lequel ladite unité de traitement d'EVC divisé (130a) et ladite pluralité d'unités d'interface de capteur d'EVC divisé (130b) sont toutes deux installées sur un site commun, comprenant en outre le partage de données entre ladite pluralité d'unités d'interface de capteur d'EVC divisé (130b) et ladite unité de traitement d'EVC divisé.

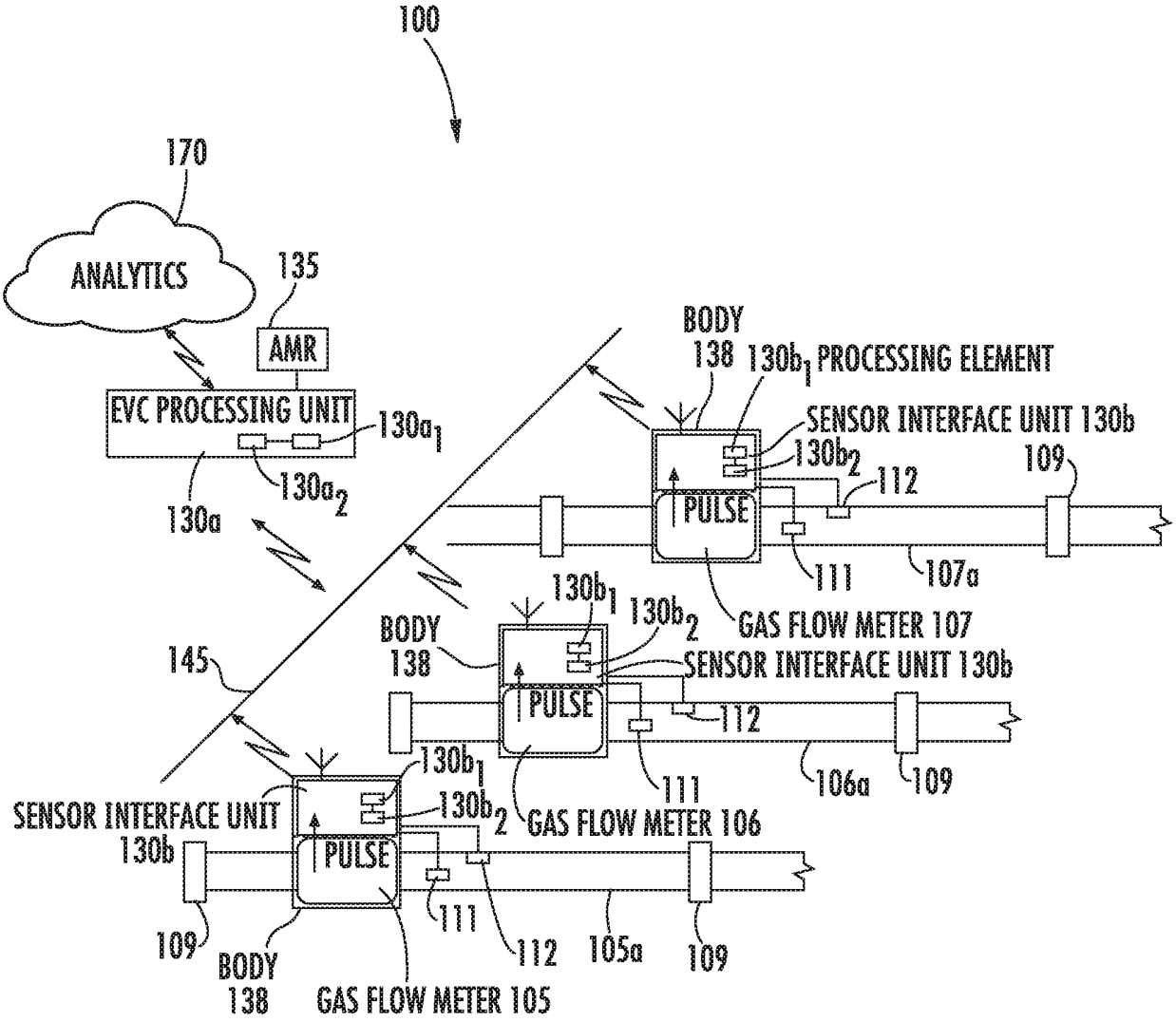
100
170
ANALYTICS
135
AMR
EVC PROCESSING UNIT
130a1
130a2
130a
BODY
138
130b1
PROCESSING ELEMENT
SENSOR INTERFACE UNIT 130b
130b2
112
109
PULSE
111
107a
GAS FLOW METER 107
145
BODY
138
130b1
130b2
SENSOR INTERFACE UNIT 130b
PULSE
112
106a
109
111
SENSOR INTERFACE UNIT
130b
130b1
130b2
GAS FLOW METER 106
PULSE
109
111
112
105a
109
BODY
138
GAS FLOW METER 105

FIG. 1

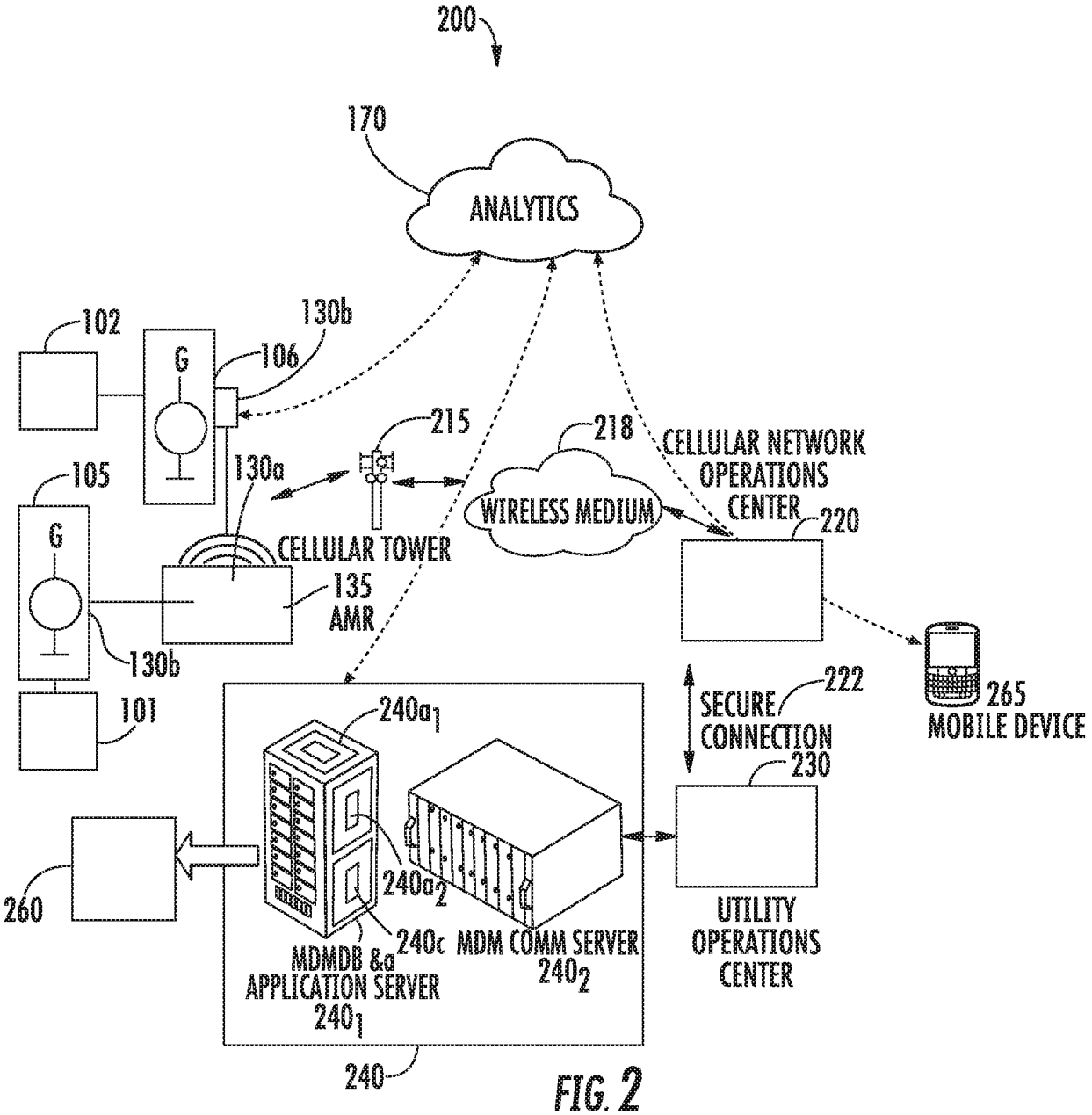
200
170
ANALYTICS
102
130b
106
G
215
218
CELLULAR NETWORK OPERATIONS CENTER
105
130a
WIRELESS MEDIUM
220
CELLULAR TOWER
135
AMR
130b
101
240a1
222
SECURE CONNECTION
265
MOBILE DEVICE
230
240a2
260
240c
MDM COMM SERVER
2402
UTILITY OPERATIONS CENTER
MDMDB &a
APPLICATION SERVER
2401
240

FIG. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 20110074598 A1 **[0008]**