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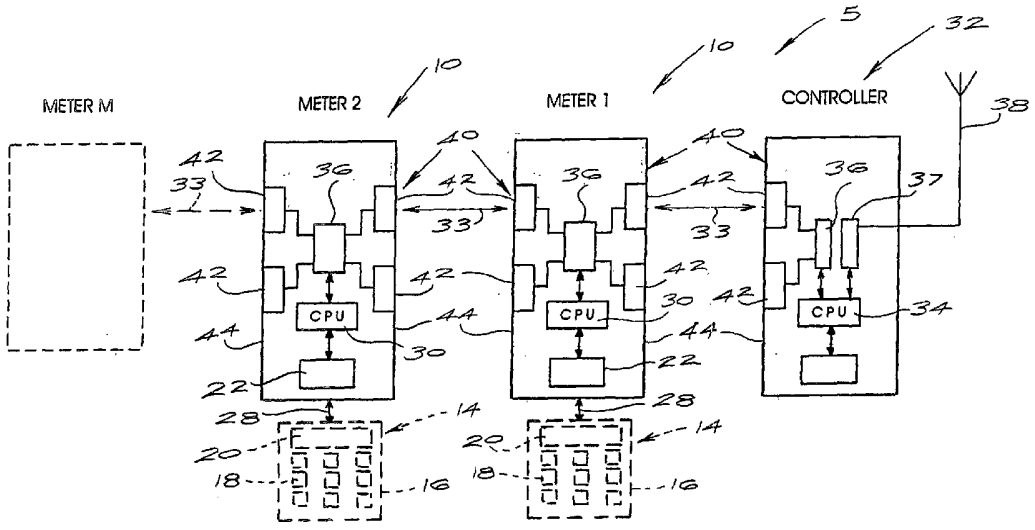
(54) **Title:** DATA COMMUNICATION NETWORK FOR UTILITY METERS



(57) **Abstract:** A meter for the metering of a utility, the meter having data communication means for the wireless close proximity transmission of data relating to use of the utility between the meter and at least one other device in close proximity thereto. The invention extends to a communications control means for wireless close proximity transmission of data to and from the meter and to a data communication network comprising a communications control means and one, or more, meters. Further, the invention extends to a method for transmitting data to and from a meter.

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DATA COMMUNICATION NETWORK FOR UTILITY METERS

FIELD OF THE INVENTION

This invention relates to data communication. In particular, the invention relates to a data communication network. More particularly, the invention relates to a data communication network for use in utility metering. In a preferred embodiment, the invention relates to a data communication network for use in utility metering in a prepayment metering environment. The invention extends to a utility meter and a communications control means for use in the data communication network, and to a method for transmitting data to and from a meter for the metering of a utility.

BACKGROUND TO THE INVENTION

The use of prepayment systems for the dispensing of a utility, such as water, electricity, or the like, is known. It is also known to provide for the remote downloading of metering information from a utility meter, i.e. automatic meter reading. Many methods for remote meter reading are available, including the use of GSM, power line communications, radio WAN, and the like.

In the field of prepayment metering, many different variants of prepayment meters for the dispensing of utilities are available. One particular system incorporates a split metering technology, whereby a user interface is provided for operation by an end-user (consumer) at the end-user's premises. The user interface generally permits the end-user to enter prepayment tokens of varying sorts to recharge the meter. The user interface also generally provides a visible display, allowing the end-user to ascertain at any time the available balance

remaining from a quantity of the utility previously purchased by means of prepayment. The available balance may be given in terms of the quantity of the utility, e.g. kilowatt hours of electricity or liters of water. Instead the value in money of the available utility may be reflected. Further, in split meter prepayment systems, the meter and control components of the meter system are located remotely from the user interface, for example, in the case of electricity, at the top of a street pole or pylon. This has the advantage that switches or valves are located out of harm's way and are less liable to be tampered with. It will be appreciated that in such a split meter system, a communications link interconnects the user interface with the meter components of the system. In the case of electricity dispensing, the communications link comprises an electrical cable. In urban environments, it is economical and common to house a number of such meter components within a single housing atop a street pole, each of the meters in the housing serving a respective dwelling or other facility.

Although it will be appreciated that the invention is not restricted to such environments, it is in such split meter utility metering environments that the present invention finds a major application.

It is advantageous to be able to establish remote communication with, and control of, utility meters generally, and particularly prepayment meters of the split meter type described above. It is also advantageous to be able to establish local control over the provision of the utility, so that, for example, the supply of the utility to a selected user may be interrupted remotely, if required. However, the provision of a dedicated remote channel of communication separately to each utility meter is costly and uneconomical. Also, the wiring of a number of such meters together to form a local network leads to problems of electrical isolation and buffering, requiring relatively complex and costly circuitry to overcome.

OBJECT OF THE INVENTION

It is an object of the invention to provide a new data communication network, utility meter, communications control means and a method for communicating data that will, at least partially, alleviate some of the abovementioned disadvantages.

SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided a meter for the metering of a utility, the meter having data communication means for the wireless close proximity transmission of data relating to use of the utility between the meter and at least one other device in close proximity thereto.

The utility may be electricity, water, gas, a heated heating fluid, television or other entertainment, or the like.

In one embodiment, the meter comprises an electricity power meter of an electricity prepayment meter system of the split meter type, the electricity prepayment meter system including a user interface and a power meter for metering electricity consumption by a consumer, the power meter being remote from the user interface and connected thereto via a communications channel. The user interface may be locatable at a location of an end-user of the utility and operable to display information relating to the utility. Then, the communications channel may comprise an electrical conductor cable.

The meter may have a data processing means for processing data. Further, the meter may have a data storage means operatively connected to the data processing means and operable to store data relating to the use of the utility in

respect of that meter. The data processing means may be a central processing unit (CPU), operable under control of a computer program to process data relating to use of the utility in respect of that meter. The CPU may also control the storage of such data.

The data communication means may be connected to, and under the control of, the data processing means of the meter. The data communication means may be a modem. Further, the data communication means may include data input and data output means for inputting data to and outputting data from the meter. Then, the data input and data output means of the meter may comprise an electrical capacitance device operable to couple capacitively with a corresponding capacitive device of the, or one of the, other devices to permit the meter and the said other device to be capacitively coupled for data communication therebetween. The electrical capacitance device may comprise a pair of capacitor plates operably connected to the data communication means and arranged adjacent a wall of a housing of the meter, thereby to enable the capacitor plates to register operatively with corresponding capacitor plates of the said other device. Instead, the data input and data output means of the meter may comprise an electrical inductive device operable to couple inductively with a corresponding inductive device of the, or one of the, other devices to permit the meter and the said other device to be inductively coupled for data communication therebetween. Then, the electrical inductive device may comprise a coil operably connected to the data communication means and arranged adjacent a wall of a housing of the meter, thereby to enable the coil to register operatively with a corresponding coil of the said other device. Further instead, the data input and data output means of the meter may comprise an optical device operable to couple optically with a corresponding optical device of the, or one of the, other devices to permit the meter and the said other device to be optically coupled for data communication therebetween. Then, the optical device may comprise light sensing and light emitting means optically connected to a light guide, the light guide terminating at an aperture in a wall of a housing of the meter, thereby to

enable the light guide to register operatively with a corresponding light guide of the said other device. Yet further instead, the data input and data output means of the meter may comprise a sonic device operable to couple sonically with a corresponding sonic device of the, or one of the, other devices to permit the meter and the said other device to be sonically coupled for data communication therebetween. Then, the sonic device may comprise sound sensing and sound emitting means operably connected to the data communication means and arranged adjacent a wall of a housing of the meter, thereby to enable the sound sending and sound emitting means to register operatively, respectively, with corresponding sound emitting and sound sensing means of the said other device.

The, or one of the, at least one other devices with which the meter is operable to communicate may be another similar utility meter. Further, the, or one of the, at least one other devices with which the meter is operable to communicate may be a communications control means. In a preferred embodiment, the meter is operable to communicate with a plurality of other devices, at least one of which is a communications control means, the remainder of which being similar meters.

The communications control means may be a network controller.

According to a second aspect of the invention there is provided a communications control means having data communication means for the wireless close proximity transmission of data relating to use of a utility between the communications control means and at least one utility meter in close proximity thereto.

The communications control means may be operable to communicate information relating to the use of the utility. Preferably, the network controller is adapted for installation within the housing of the remote utility dispensing means. In the case of an electricity metering system, the network controller is shaped and configured for installation in a remotely mounted meter box.

The communications control means may comprise a network controller. The network controller may have a data processing means for processing data and a data storage means operatively connected to the data processing means. The data processing means may comprise a central processing unit (CPU) and is operable under control of a computer program to process data relating to the utility as metered by the at least one utility meter and to control the storage and transmission of such data.

The communications control means may include a communications device to enable communication between the network controller and a master station. Then, the communications device may comprise one of a GSM, radio or power line carrier modem. A plurality of network controllers may be connected via a communications network to a single master station. The master station, to which the network controller and similar network controllers are networked, may periodically poll the, or each, network controller and download stored data. The data may be used for a variety of purposes, including remote or automatic meter reading. It will be appreciated that, in addition, this configuration will facilitate the monitoring of tamper detection, power profiling, meter connection status information, credit monitoring, as well as many other functions.

The network controller may be operable periodically to poll the, or each, individual meter to which it is interconnected and to download predetermined data from the meter. Further, the communications control means may be operable for two-way wireless close proximity transmission with the at least one utility meter in close proximity thereto. Then, the communications control means may be operable to receive from the master station a signal containing a pre-payment token for use of the utility and transmitting the said token to the, or a preselected one of the, at least one utility meters for loading into the said meter to enable use of the utility.

The data communication means of the communications control means may be connected to, and under the control of, the data processing means of the communications control means. The data communication means may be a modem. Further, the data communication means may include data input and data output means for inputting data to and outputting data from the communications control means. Then, the data input and data output means may comprise an electrical capacitance device operable to couple capacitively with a corresponding capacitive device of the, or one of the, at least one utility meters to permit the communications control means and the said meter to be capacitively coupled for data communication therebetween. The electrical capacitance device may comprise a pair of capacitor plates operably connected to the data communication means and arranged adjacent a wall of a housing of the communications control means, thereby to enable the capacitor plates to register operatively with corresponding capacitor plates of the said at least one meter. Instead, the data input and data output means may comprise an electrical inductive device operable to couple inductively with a corresponding inductive device of the, or one of the, at least one meters to permit the communications control means and the said at least one meter to be inductively coupled for data communication therebetween. Then, the electrical inductive device may comprise a coil operably connected to the data communication means and arranged adjacent a wall of a housing of the communications control means, thereby to enable the coil to register operatively with a corresponding coil of the said at least one meter. Further instead, the data input and data output means may comprise an optical device operable to couple optically with a corresponding optical device of the, or one of the, at least one meter to permit the communications control means and the at least one meter to be optically coupled for data communication therebetween. Then, the optical device may comprise light sensing and light emitting means optically connected to a light guide, the light guide terminating at an aperture in a wall of a housing of the communications control means, thereby to enable the light guide to register operatively with a corresponding light guide of the said at least one meter. Yet further instead, the data input and data output

means may comprise a sonic device operable to couple sonically with a corresponding sonic device of the, or one of the, at least one meters to permit the communications control means and the said at least one meter to be sonically coupled for data communication therebetween. Then, the sonic device may comprise sound sensing and sound emitting means operably connected to the data communication means and arranged adjacent a wall of a housing of the communications control means to enable the sound sending and sound emitting means to register operatively, respectively, with corresponding sound emitting and sound sensing means of the said at least one meter.

According to a third aspect of the invention there is provided a data communication network including a plurality of meters for the metering of a utility as hereinbefore described, the meters being wirelessly interconnected for the close proximity transmission therebetween of data relating to the use of the utility metered by the respective meters.

The data communication network may include a communications control means, as hereinbefore described, wirelessly interconnected to the utility meters of the network for the close proximity transmission therebetween of data relating to the use of the utility metered by the respective meters.

As described above, the communications control means and the meters may be capacitively inter-coupled for wireless close proximity data transmission therebetween. Instead, the communications control means and the meters may be inductively inter-coupled for wireless close proximity data transmission therebetween. Further instead, the communications control means and the meters may be optically inter-coupled for wireless close proximity data transmission therebetween. Yet further instead, the communications control means and the meters may be sonically inter-coupled for wireless close proximity data transmission therebetween.

In a preferred embodiment of the invention, the meters and the network controller are housed within a single housing and are in close proximity to one another, preferably side-by-side.

According to a fourth aspect of the invention there is provided a method for transmitting data to and from a meter for the metering of a utility, the method including

wirelessly interconnecting the meter to at least one other device in close proximity therewith to form a data communication network; and

transmitting data to and from the said meter via the network.

The, or each, other device may be a utility meter similar to the meter, and each of the meters may be as hereinbefore described. Further, the, or one of the, at least one other devices with which the meter is operable to communicate may be a communications control means.

In a preferred embodiment of the method, the meter is operable to communicate with a plurality of other devices, at least one of which is a communications control means, the remainder of which being similar meters, and the method includes

wirelessly interconnecting the meter to a plurality of other devices in close proximity therewith to form a data communication network; and

transmitting data to and from the said meter via the network.

The meter and the plurality of other devices may be connected in series. Instead, the meter and the plurality of other devices may be connected in parallel.

As described above, the meter and the plurality of other devices may be capacitively inter-coupled for wireless close proximity data transmission therebetween. Instead, the meter and the plurality of other devices may be inductively inter-coupled for wireless close proximity data transmission therebetween. Further instead, the meter and the plurality of other devices may

be optically inter-coupled for wireless close proximity data transmission therebetween. Yet further instead, the meter and the plurality of other devices may be sonically inter-coupled for wireless close proximity data transmission therebetween.

The method may include the steps of, for each meter, storing data relating to the use of the utility in respect of that meter.

One of the plurality of other devices may comprise a communications control means and the method may include the steps of periodically polling each individual meter by means of the communications control means and downloading predetermined data from the respective meters to the communications control means. Further, the method may include transmitting the downloaded data to a master station.

The method may include receiving at the communications control means a signal containing a pre-payment token for use of the utility and transmitting the said token to a preselected one of the utility meters for loading into the said meter to enable use of the utility.

Importantly, it is an aspect of the invention that the meter system described will permit the loading of credit tokens directly from a vending station into a respective meter, without the necessity of manual intervention by an end-user via his user interface. This has the advantage of significantly simplifying the vending infrastructure required to perform vending. The system therefore facilitates the control and monitoring of utility meters, from the vending of tokens and loading of a fund of credit, to remote disconnection and meter data access.

Although a number of examples of methods of inter-coupling of the components of the communication network, such as capacitive, inductive, optical and sonic coupling, have been described above, it is to be understood that the invention is

not limited to these methods and that any suitable wireless coupling between the components for communication of data, of a close proximity or short range nature, such as, for example, short range radio frequency transmission, will fall within the scope of the invention. In typical applications, the components (i.e. meters and/or communications control means) may be arranged so that proximate components are in abutment with one another or in close proximity of up to about 10cms between neighbouring components, and not more than about 1 meter. The maximum length of the communication bus of the network, i.e. the communication distance between the most distant components, will typically not be longer than about 2 meters, and not more than about 3 meters.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is now described, by way of example, with reference to the accompanying diagrammatic drawings, in which

Figure 1 shows a schematic view of a data communication network in accordance with the invention;

Figure 2 shows an end view of a first embodiment of a capacitive coupling device of a meter of the data communication network;

Figure 3 shows and end view of a second embodiment of the capacitive coupling device;

Figure 4 shows a schematic view a first network configuration of the data communication network;

Figure 5 shows a schematic view a second network configuration of the data communication network;

Figure 6 shows a flow chart illustrating the flow of data between adjacent components in the network;

Figure 7 shows a schematic view of optically coupled components of the network;

Figure 8 shows a schematic view of an alternative configuration of the optically coupled components of the network;

Figure 9 shows a schematic view of inductively coupled adjacent meters in the network;

Figure 10 shows a schematic view of capacitively coupled adjacent meters in the network;

Figure 11 shows a schematic view of acoustically coupled adjacent meters within the network; and

Figure 12 shows a perspective view of an interior of an electricity power meter for use in the network of Figure 8.

DETAILED DESCRIPTION OF THE DRAWINGS

In the Figure 1, reference numeral 5 generally indicates a data communication network, in accordance with the invention.

The utility is electricity and the data communications network 5 has a number of prepayment meter systems 10 of the split meter type, two of which are shown in detail. Each meter system 10 has a user interface 14, which is located at a location 16 of the end-user of the utility, being a commercial dwelling. The user

interface 14 includes a keyboard 18, which is operable by the end-user to enter prepayment tokens (not shown) to recharge a meter of the meter system 10. Further, the user interface 14 has a visible display 20, which permits the end-user to ascertain, at any time, the available balance remaining from the quantity of the utility previously purchased by means of prepayment. The available balance is given in kilowatt hours of electricity or the money value of the kilowatt hours remaining for use. Further, the split electricity meter system 10 includes a utility dispensing device 22, in the form of a meter, for dispensing the utility to the end-user. The meter 22 includes switch gear (shown in Figure 12) for opening and closing a power line to the premises of the end-user. The meter 22 is housed in a meter housing (not shown) situated on a roadside electricity pole (not shown) and is remote from the user interface 14. Each user interface 14 and its associated meter 22 are interconnected by means of a communications channel 28, comprising an electric cable.

Further, each of the meters 22 has a data processing means 30 for processing data and a data storage means (not shown) operatively connected to the data processing means 30. The data processing means 30 is a central processing unit (CPU) integrated circuit chip and is operable under control of a computer program to process data relating to the utility dispensed by its utility meter 22 and to control the storage and transmission of such data. The data storage means is operable to store data relating to the utility dispensed via that meter 22.

Further, the data communication network has a communications control means 32, in the form of a network controller, interconnected to each of the utility meters 22 of the network 5. The network controller 32 is operable to communicate information relating to the use of the utility. The network controller 32 is installed within the housing of the electricity meters 22. The network controller 32 has a data processing means, in the form of a CPU 34, for processing data and a data storage means (not shown) operatively connected to the CPU integrated circuit chip 34. The CPU 34 is operable under control of a computer program to process

data relating to the utility and to control the storage and transmission of such data. Further, the data storage means of the network controller 32 is operable to store data relating to the utility dispensed by the associated utility meters 22 of the network 5, and prepayment transactions for the respective meters.

The meters 22 and the network controller 32 are capacitively wirelessly inter-coupled for data transmission, as indicated schematically by the arrows marked 33 in Figure 1. It will be appreciated that, instead, the meters 22 and the network controller 32 may be inductively, optically or acoustically wirelessly inter-coupled, or inter-coupled in any other manner suitable for short range (proximate) wireless data communication.

Each of the meters 22 and the network controller 32 has a data communication means 36, in the form of a modem, for communicating data to and from the respective meter 22 or network controller 32. It will be appreciated that the data communication means 36 may be any suitable communication device, such as an interface, and need not necessarily be a modem. The modem 36 has data input and data output facilities (not shown) for inputting data to and outputting data from the respective meter 22 or network controller 32. The modem 36 is connected to, and under the control of, the CPU 30,34, of the respective utility meter 22 or network controller 32.

The meters 22 and the network controller 32 are housed within a single housing and are in close proximity to one another, side-by-side, as shown in Figure 1. Then, the data input and data output facilities of each of the meters 22 and the network controller 32 comprise an electrical capacitor device 40, in the form of a pair of capacitor plates 42, each of which is located adjacent a casing wall 44 of its associated meter 22 or network controller 32, and is in operative register with a complementary pair of capacitor plates 42 of an adjacent meter 22 or network controller 32, as the case may be. It will be appreciated that the plates 42 may be of any suitable shape and configuration, such as a pair of aligned rectangular

plates 42.1, as shown in Figure 2, or a circular and an annular plate 42.2, 42.3, arranged concentrically, as shown in Figure 3.

A further modem 37 of the network controller 32 enables communication with a master station (not shown) and may be a GSM, radio or power line carrier modem, or the like. An input/output facility (not shown) of the modem 37 of the network controller 32 terminates in an antenna 38 for remote communication with the master station. Thus, a plurality of network controllers 32 may be connected via a communications network to a single master station. Each network controller 32 is operable periodically to poll each individual meter 22 to which it is interconnected and to download predetermined data from the meter 22. The master station, to which the network controller 32 and similar network controllers are networked, may periodically poll the, or each, network controller 32 and download stored data. The data may be used for a variety of purposes, including remote or automatic meter reading. It will be appreciated that, in addition, this configuration will facilitate the monitoring of tamper detection, power profiling, meter connection status information, credit monitoring, as well as many other functions.

The network controller 32 may be connected to any suitable data network for communication with the master station, including GSM, radio WAN or a power line communications network, or a combination of these.

In Figures 4 and 5, alternative network configurations are illustrated. In Figures 4 to 11, with reference to Figure 1, like reference numerals indicate like components, unless otherwise specified. Figure 4 shows the meters 22 and network controller 32 coupled in parallel so that data is transmitted (broadcast) along the network 5 directly between a respective meter 22 and the network controller 32, without having to be repeated by intervening meter units 22. Alternatively, in Figure 5 the meters 22 and controller 32 of the network 5 are connected in series. In this configuration, data is transmitted from one component

(meter 22 or controller 32) to another and is repeated along the line until it reaches its destination.

Figure 4 shows a block diagram illustrating the process of transmission of data between a sending component and a receiving component of the network 5. The components may be a pair of meters 22 or a meter 22 and the network controller 32. Data for transmission is modulated or encoded via a modulator or bit encoder. The data may be modulated by a higher frequency or a baseband signal may be sent. The signal may be encoded. From the modulator/bit encoder, the data signal is transmitted to a driver/amplifier. The signal will generally need to be buffered or amplified so that a signal of sufficient power can be delivered to the transducer. This function may also be performed by the modulator/bit encoder facility. Having been amplified, the data signal is transmitted to a transducer. As described above, the transducer may take the form of a capacitive, electromagnetic, optical or acoustic device. The data signal is transmitted from the transducer of the transmitting component to a complementary transducer of the receiving component. Various forms of transducer pair are illustrated and described hereunder. The data transmission process is reversed in the receiving component, so that the transducer transmits a data signal to an amplifier, where the received signal may be amplified to a predetermined desired level. From the amplifier, the signal is transmitted to a demodulator/decoder in which the signal is converted to a digital data stream. It will be appreciated that in certain embodiments of the data communication networks, the date signals may not be indicated.

Figures 7 to 11 show various transmitter/receiver transducer couplings between components of the network 5.

In Figure 7 adjacent meters 22 are optically coupled. An LED (light emitting diode) 50 is used for transmission and a PIN diode or photo transistor 52 is used for reception. The preferred frequency for transmission is in the infrared range. In

the parallel or broadcast configuration, each unit will have a single LED 50 and PIN diode/photo transistor 52, whereas in the series configuration, each component would have two LED's 50 and PIN's 52, in order to communicate with both of its neighbouring units. As shown in Figure 8, a light pipe 54 may be used to improve optical coupling.

In Figure 9, a pair of meters 22 of the network 5 is coupled inductively, by means of complementary pairs of coils 56, which are located adjacent the casing 44 of their respective meters 22. It will be appreciated that a signal produced in one of the coils 56 will produce a corresponding induced signal in its neighbouring coil 56, thereby permitting communication.

In Figure 10, adjacent meters 22 are capacitively coupled. The preferred arrangement comprises a pair of conductive plates 42 mounted on each of the opposed sides of the casing wall 44 of the meter housing, such that they are in alignment with, and in close proximity to, corresponding plates 42 of the adjacent meter 22, effectively forming capacitor pairs. A differential signal is transmitted between the units via the electric field established between the capacitive plates 42.

In Figure 11, adjacent meters 22 are acoustically coupled, each unit having a speaker 58 and a microphone 60. Preferably, ultrasonic transducers are employed to transmit and receive data. Each component of the network 5 has a speaker 58 to transmit data and a microphone 60 for receiving data. These are mounted on the wall 44 of the meter housing of the respective unit, and are aligned with the complementary device of the adjacent unit to permit transmission of an acoustic signal between adjacent units.

In Figure 12, a typical electricity power meter 22 is shown, with part of the meter casing 70 removed. The meter 22 has a circuit board 72 containing a CPU, power supply, data storage device, modem and other electric circuits, which will

be apparent to a person skilled in the art. These circuits and the components thereof are not illustrated. Further, the input and output terminals of the modem of the circuit board 72 are connected, respectively, to a light emitting diode (LED) 74, acting as a transmitting transducer, and a PIN diode or photo transistor 76, acting as a receiving transducer. The transducers 74, 76 are in close proximity to a light pipe 54. The light pipe 54 is generally rectangular and extends between apertures (not shown) on opposing sides of the casing 70 of the meter 22, so that ends 78 of the light pipe 54 are flush with respective side walls of the casing 70 of the meter 22. Further, the light pipe 54 has an interface portion 80, for interfacing with the transducers 74, 76. Thus, it will be appreciated that when similar meters are placed in side-by-side configuration with one another and with a similarly configured network controller, the operative ends 78 of their respective light pipes will be in abutment, thereby creating a virtually continuous optical channel for communication, as shown in Figure 8. Further, the meter 22 has a relay (circuit breaker) 82, which is selectively operable, under control of the CPU, to interrupt and reconnect the supply of electricity to the end-user.

By means of the invention, the remote access to metering data relating to dispensing of a utility is provided. The utility is not restricted to electricity, and may be water, gas, a heated heating fluid, or the like. Data downloaded via the network 5 may include utility usage, i.e. automatic meter reading. In addition, by monitoring metered usage and actual usage, tamper detection may be provided. Further, downloaded data may be used to establish power profiles and meter connection status information. Still further, credit monitoring is facilitated. In one aspect of the invention, credit tokens may be loaded directly from a vending station (not shown) into a meter 22, without the necessity of manual intervention by an end-user via his user interface 14. On exhaustion of prepaid credit or on the occurrence of any other predetermined event, the network controller 32 may be operated to activate a meter switch (not shown) of the associated meter 22, cutting off the connection and supply of the utility to the user.

It is advantage of the invention that data communication with utility meters is provided, inexpensively and simply. Data processing and storage functions may be largely removed from individual meters and these functions transferred to a network controller, which is in data communication with the meters via a relatively inexpensive communication mechanism. Thus, the meters may have a relatively primitive processing facility and little, or even no data storage facility, these functions and facilities existing in the network controller.

CLAIMS

1. A meter for the metering of a utility, the meter having data communication means for the wireless close proximity transmission of data relating to use of the utility between the meter and at least one other device in close proximity thereto.

2. The meter as claimed in claim 1, comprising an electricity power meter of an electricity prepayment meter system of the split meter type, the electricity prepayment meter system including a user interface and a power meter for metering electricity consumption be a consumer, the power meter being remote from the user interface and connected thereto via a communications channel.

3. The meter as claimed in claim 1 or claim 2, which has a data processing means for processing data and a data storage means operatively connected to the data processing means and operable to store data relating to the use of the utility in respect of that meter.

4. The meter as claimed in claim 3, in which the data processing means is a central processing unit (CPU), operable under control of a computer program to process data relating to use of the utility in respect of that meter and to control the storage of such data.

5. The meter as claimed in claim 4, in which the data communication means is connected to, and under the control of, the data processing means of the meter.

6. The meter as claimed in claim 5, in which the data communication means is a modem.

7. The meter as claimed in any one of the preceding claims, in which the data communication means includes data input and data output means for inputting data to and outputting data from the meter.

8. The meter as claimed in claim 7, in which the data input and data output means of the meter comprise an electrical capacitance device operable to couple capacitively with a corresponding capacitive device of the, or one of the, other devices to permit the meter and the said other device to be capacitively coupled for data communication therebetween.

9. The meter as claimed in claim 8, in which the electrical capacitance device comprises a pair of capacitor plates operably connected to the data communication means and arranged adjacent a wall of a housing of the meter, thereby to enable the capacitor plates to register operatively with corresponding capacitor plates of the said other device.

10. The meter as claimed in claim 7, in which the data input and data output means of the meter comprise an electrical inductive device operable to couple inductively with a corresponding inductive device of the, or one of the, other devices to permit the meter and the said other device to be inductively coupled for data communication therebetween.

11. The meter as claimed in claim 10, in which the electrical inductive device comprises a coil operably connected to the data communication means and arranged adjacent a wall of a housing of the meter, thereby to enable the coil to register operatively with a corresponding coil of the said other device.

12. The meter as claimed in claim 7, in which the data input and data output means of the meter comprise an optical device operable to couple

optically with a corresponding optical device of the, or one of the, other devices to permit the meter and the said other device to be optically coupled for data communication therebetween.

13. The meter as claimed in claim 7, in which the optical device comprises light sensing and light emitting means optically connected to a light guide, the light guide terminating at an aperture in a wall of a housing of the meter, thereby to enable the light guide to register operatively with a corresponding light guide of the said other device.

14. The meter as claimed in claim 7, in which the data input and data output means of the meter comprise a sonic device operable to couple sonically with a corresponding sonic device of the, or one of the, other devices to permit the meter and the said other device to be sonically coupled for data communication therebetween.

15. The meter as claimed in claim 14, in which the sonic device comprises sound sensing and sound emitting means operably connected to the data communication means and arranged adjacent a wall of a housing of the meter, thereby to enable the sound sending and sound emitting means to register operatively, respectively, with corresponding sound emitting and sound sensing means of the said other device.

16. The meter as claimed in any one of the preceding claims, in which the, or one of the, at least one other devices with which the meter is operable to communicate is another similar utility meter.

17. The meter as claimed in any one of the preceding claims, in which the, or one of the, at least one other devices with which the meter is operable to communicate is a communications control means.

18. The meter as claimed in an one of claims 1 to 15, which is operable to communicate with a plurality of other devices, at least one of which is a communications control means, the remainder of which being similar meters.

19. The meter as claimed in claim 17 or claim 18, in which the communications control means is a network controller.

20. A communications control means having data communication means for the wireless close proximity transmission of data relating to use of a utility between the communications control means and at least one utility meter in close proximity thereto.

21. The communications control means as claimed in claim 20, which comprises a network controller.

22. The communications control means as claimed in claim 21, in which the network controller has a data processing means for processing data and a data storage means operatively connected to the data processing means.

23. The communications control means as claimed in claim 22, in which the data processing means comprises a central processing unit (CPU) and is operable under control of a computer program to process data relating to the utility as metered by the at least one utility meter and to control the storage and transmission of such data.

24. The communications control means as claimed in claim 23, which includes a communications device to enable communication between the network controller and a master station.

25. The communications control means as claimed in claim 24, in which the communications device comprises one of a GSM, radio or power line carrier modem.

26. The communications control means as claimed in claim 25, in which the network controller is operable periodically to poll the, or each, individual meter to which it is interconnected and to download predetermined data from the meter.

27. The communications control means as claimed in claim 24, which is operable for two-way wireless close proximity transmission with the at least one utility meter in close proximity thereto.

28. The communications control means as claimed in claim 27, which is operable to receive from the master station a signal containing a pre-payment token for use of the utility and transmitting the said token to the, or a preselected one of the, at least one utility meters for loading into the said meter to enable use of the utility.

29. The communications control means as claimed in any one of claims 22 to 28, in which the data communication means is connected to, and under the control of, the data processing means of the meter.

30. The communications control means as claimed in claim 29, in which the data communication means is a modem.

31. The communications control means as claimed in claim 30, in which the data communication means includes data input and data output means for inputting data to and outputting data from the communications control means.

32. The communications control means as claimed in claim 31, in which the data input and data output means comprise an electrical capacitance device operable to couple capacitively with a corresponding capacitive device of the, or one of the, at least one utility meters to permit the communications control means and the said meter to be capacitively coupled for data communication therebetween.

33. The communications control means as claimed in claim 32, in which the electrical capacitance device comprises a pair of capacitor plates operably connected to the data communication means and arranged adjacent a wall of a housing of the communications control means, thereby to enable the capacitor plates to register operatively with corresponding capacitor plates of the said at least one meter.

34. The communications control means as claimed in claim 31, in which the data input and data output means comprise an electrical inductive device operable to couple inductively with a corresponding inductive device of the, or one of the, at least one meters to permit the communications control means and the said at least one meter to be inductively coupled for data communication therebetween.

35. The communications control means as claimed in claim 34, in which the electrical inductive device comprises a coil operably connected to the data communication means and arranged adjacent a wall of a housing of the communications control means, thereby to enable the coil to register operatively with a corresponding coil of the said at least one meter.

36. The communications control means as claimed in claim 31, in which the data input and data output means comprise an optical device operable to couple optically with a corresponding optical device of the, or one of the, at least one meter to permit the communications control means and the at

least one meter to be optically coupled for data communication therebetween.

37. The communications control means as claimed in claim 36, in which the optical device comprises light sensing and light emitting means optically connected to a light guide, the light guide terminating at an aperture in a wall of a housing of the communications control means, thereby to enable the light guide to register operatively with a corresponding light guide of the said at least one meter.

38. The communications control means as claimed in claim 31, in which the data input and data output means comprise a sonic device operable to couple sonically with a corresponding sonic device of the, or one of the, at least one meters to permit the communications control means and the said at least one meter to be sonically coupled for data communication therebetween.

39. The communications control means as claimed in claim 38, in which the sonic device comprises sound sensing and sound emitting means operably connected to the data communication means and arranged adjacent a wall of a housing of the communications control means to enable the sound sending and sound emitting means to register operatively, respectively, with corresponding sound emitting and sound sensing means of the said at least one meter.

40. A data communication network including a plurality of meters for the metering of a utility as claimed in any one of claims 1 to 7, the meters being wirelessly interconnected for the close proximity transmission therebetween of data relating to the use of the utility metered by the respective meters.

41. The data communication network as claimed in claim 40, which includes a communications control means, as claimed in any one of claims 20 to 31, wirelessly interconnected to the utility meters of the network for the close proximity transmission therebetween of data relating to the use of the utility metered by the respective meters.

42. The data communication network as claimed in claim 41, in which the communications control means and the meters are capacitively inter-coupled for wireless close proximity data transmission therebetween.

43. The data communication network as claimed in claim 41, in which the communications control means and the meters are inductively inter-coupled for wireless close proximity data transmission therebetween.

44. The data communication network as claimed in claim 41, in which the communications control means and the meters are optically inter-coupled for wireless close proximity data transmission therebetween.

45. The data communication network as claimed in claim 41, in which the communications control means and the meters are sonically inter-coupled for wireless close proximity data transmission therebetween.

46. A method for transmitting data to and from a meter for the metering of a utility, the method including

wirelessly interconnecting the meter to at least one other device in close proximity therewith to form a data communication network; and

transmitting data to and from the said meter via the network.

47. The method as claimed in claim 46, in which the, or each, other device is a utility meter similar to the meter, and each of the meters is as claimed in any one of claims 1 to 19.

48. The method as claimed in claim 46, in which the, or one of the, at least one other devices with which the meter is operable to communicate is a communications control means.

49. The method as claimed in claim 48, in which the meter is operable to communicate with a plurality of other devices, at least one of which is a communications control means, the remainder of which being similar meters, and the method includes

wirelessly interconnecting the meter to plurality of other devices in close proximity therewith to form a data communication network; and

transmitting data to and from the said meter via the network.

50. The method as claimed in claim 49, in which the meter and the plurality of other devices are connected in series.

51. The method as claimed in claim 49, in which the meter and the plurality of other devices are connected in parallel.

52. The method as claimed in any one of claims 49 to 51, in which the meter and the plurality of other devices are capacitively inter-coupled for wireless close proximity data transmission therebetween.

53. The method as claimed in any one of claims 49 to 51, in which the meter and the plurality of other devices are inductively inter-coupled for wireless close proximity data transmission therebetween.

54. The method as claimed in any one of claims 49 to 51, in which the meter and the plurality of other devices are optically inter-coupled for wireless close proximity data transmission therebetween.

55. The method as claimed in any one of claims 49 to 51, in which the meter and the plurality of other devices are sonically inter-coupled for wireless close proximity data transmission therebetween.

56. The method as claimed in any one of claims 49 to 55, which includes the steps of, for each meter, storing data relating to the use of the utility in respect of that meter.

57. The method as claimed in claim 56, in which one of the plurality of other devices comprises a communications control means and the method includes the steps of periodically polling each individual meter by means of the communications control means and downloading predetermined data from the respective meters to the communications control means.

58. The method as claimed in claim 57, which includes transmitting the downloaded data to a master station.

59. The method as claimed in claim 58, which includes receiving at the communications control means a signal containing a pre-payment token for use of the utility and transmitting the said token to a preselected one of the utility meters for loading into the said meter to enable use of the utility.

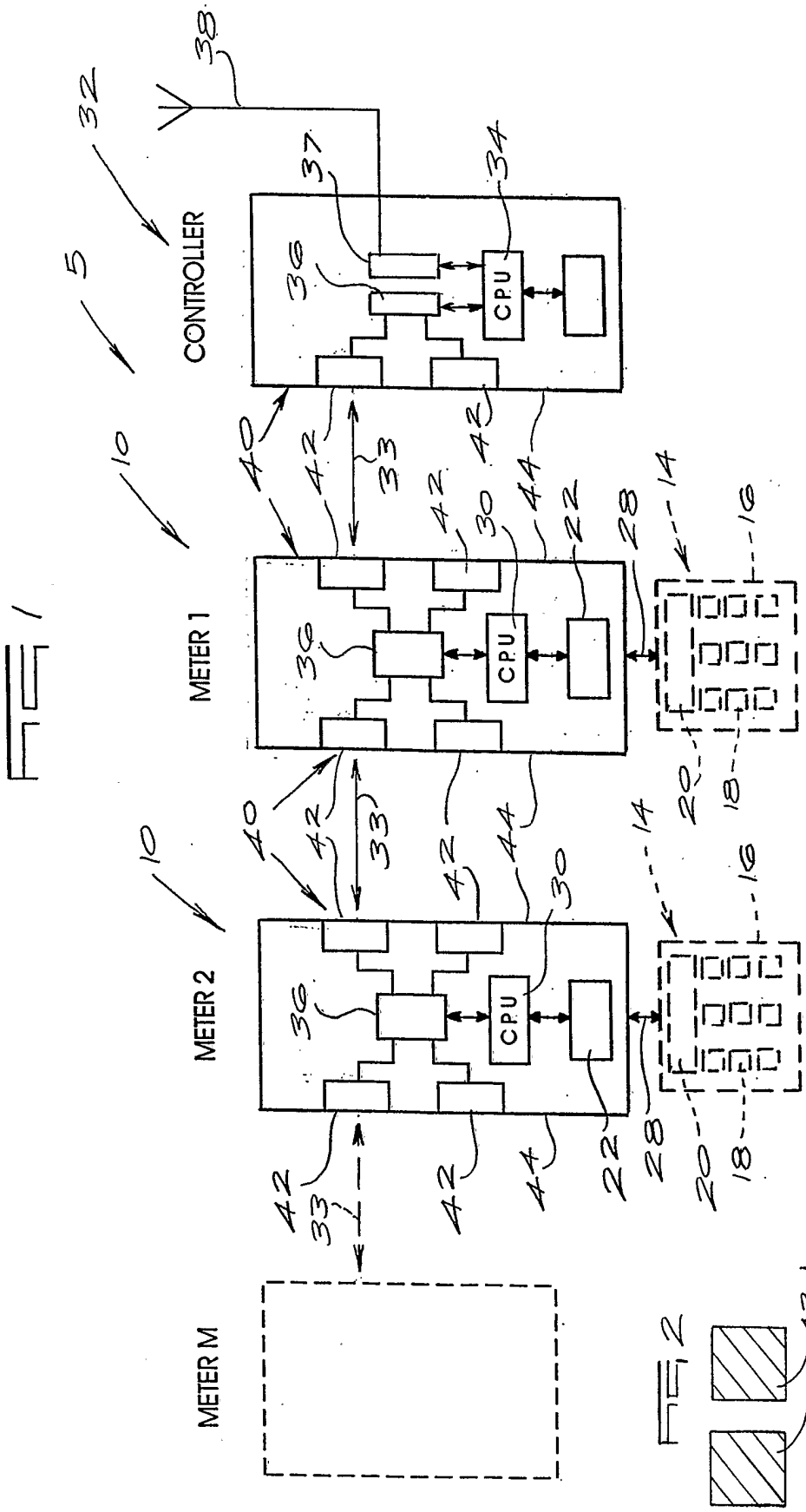


FIG 1

FIG 2

FIG 3

FIG 4

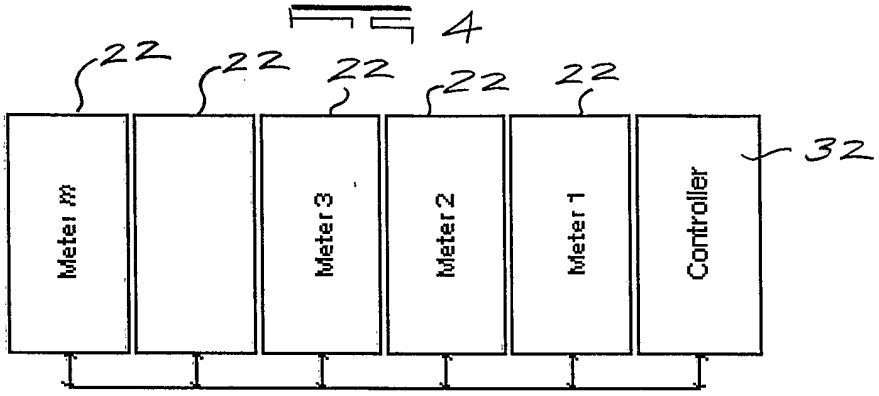
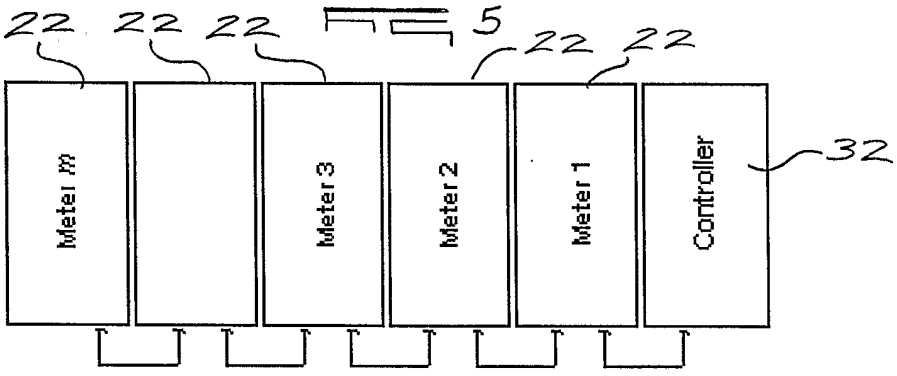

22
22
22
22
22
Meter m
Meter 3
Meter 2
Meter 1
Controller
32

FIG 5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Meter 1
Controller
32

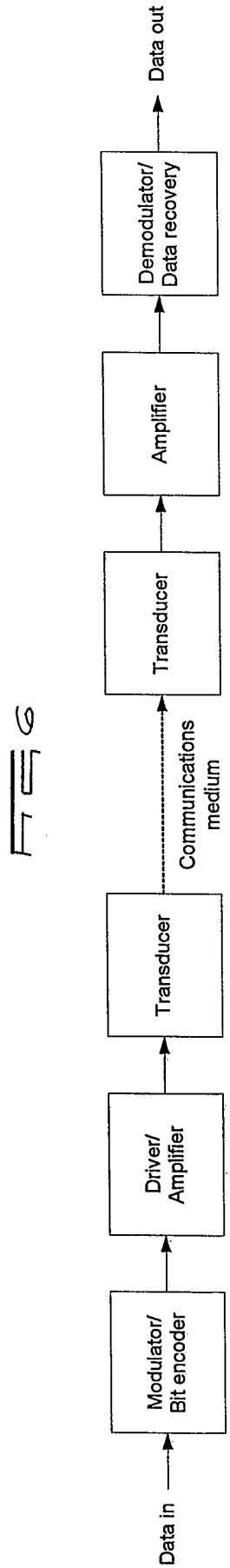

Data in
Modulator/
Bit encoder
Driver/
Amplifier
Transducer
Communications
medium
Transducer
Amplifier
Demodulator/
Data recovery
Data out

FIG 6

FIG 7

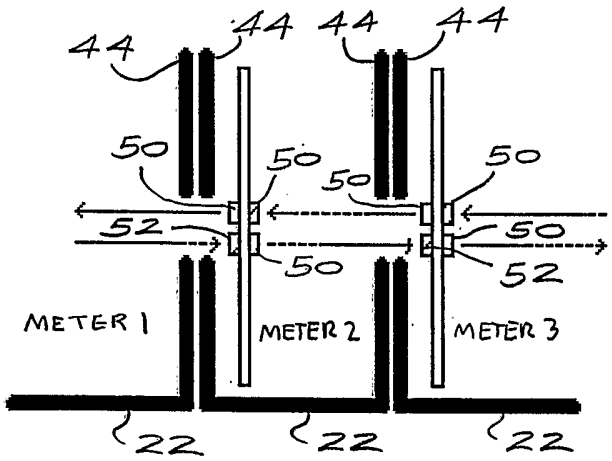


FIG 8

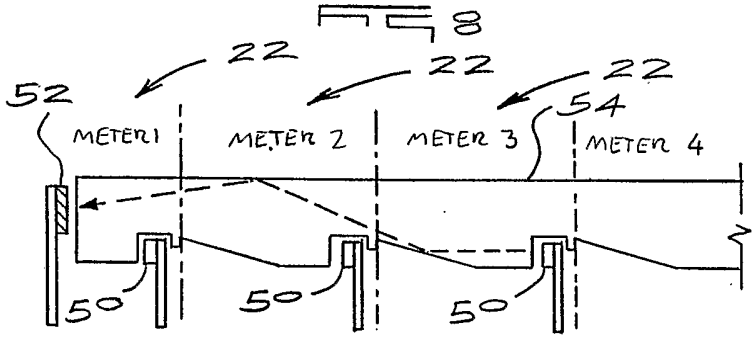


FIG 9

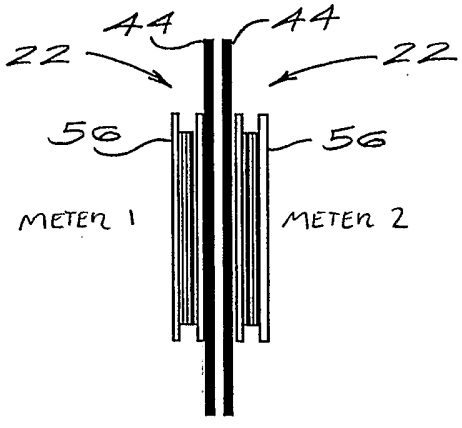


FIG 10

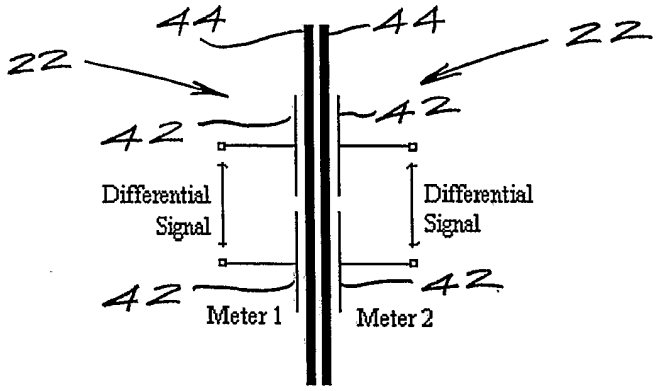
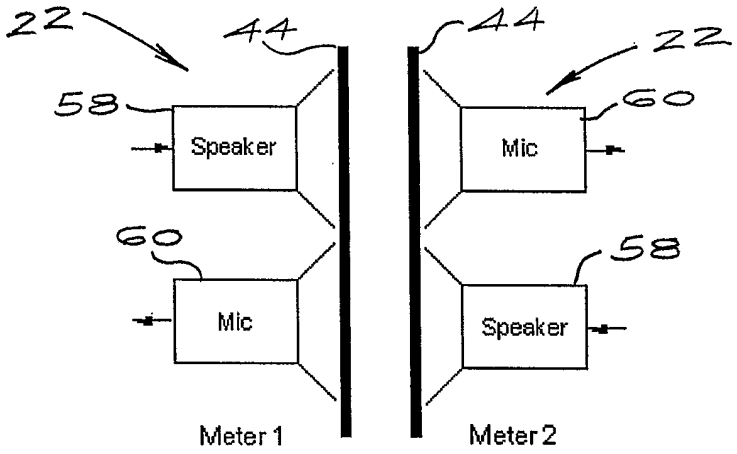

44
44
22
22
42
42
Differential Signal
Differential Signal
42
42
Meter 1
Meter 2

FIG 11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44
44
22
58
Speaker
Mic
60
60
Mic
58
Speaker
Meter 1
Meter 2

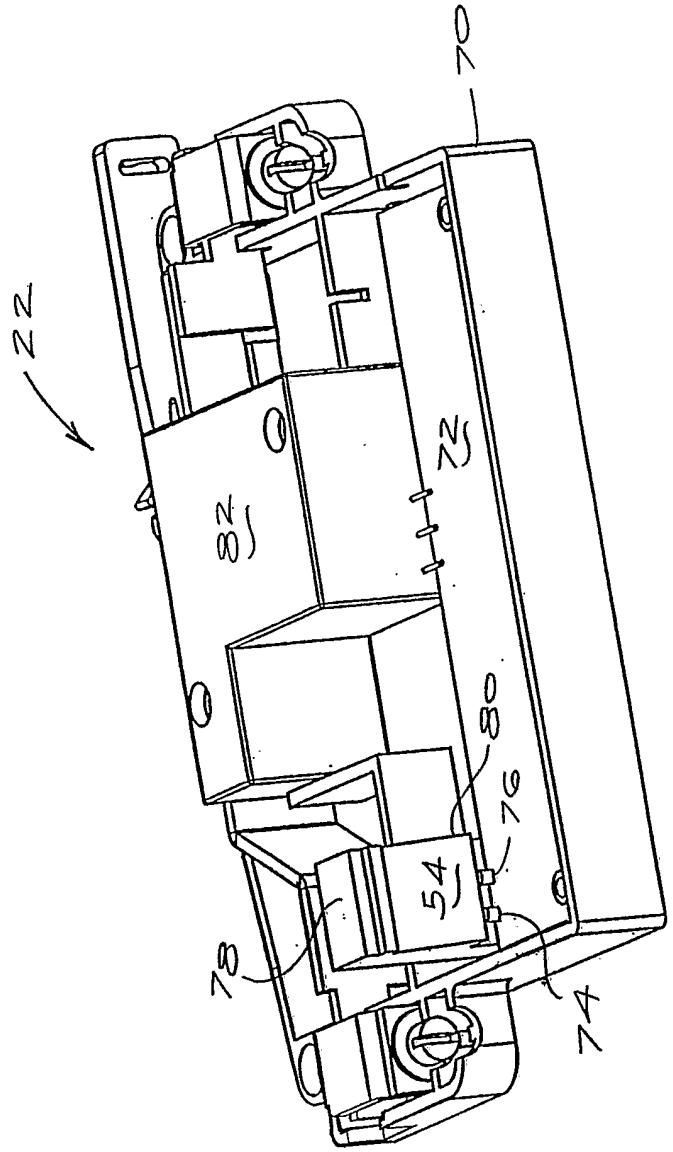

FIG 12

INTERNATIONAL SEARCH REPORT

PCT/IB 03/02718

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G08C17/00 G01R21/00 G07F7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G08C G01R G07F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 874 903 A (BRAGG ARNOLD W ET AL) 23 February 1999 (1999-02-23) column 3, line 16 -column 6, line 17	1-59
X	US 5 986 574 A (COLTON LAURENCE J) 16 November 1999 (1999-11-16) column 2, line 23 -column 3, line 45	1-59
X	WO 00 57382 A (CONECTISYS CORP) 28 September 2000 (2000-09-28) page 6, line 1 -page 8, last line	1-59
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A	page 2, left-hand column, line 45 -right-hand column, line 75; figure	59

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 December 2003	16/12/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Janyszek, J-M

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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