

What is claimed is:

1. A method of determining an electrical conductivity of a flow of water passing through a water meter, wherein the method comprises:

determining a value of at least part of a complex admittance of a capacitor assembly, wherein the flow of water forms at least part of a medium between a first electrode and a second electrode of the capacitor assembly;

calculating the electrical conductivity of the flow of water using inputs comprising the value of at least part of the complex admittance of the capacitor assembly, wherein calculating the electrical conductivity of the flow of water comprises:

mapping at least part of the complex admittance to a model of the capacitor assembly, wherein the model comprises a circuit with a constant phase element (CPE) connected to a first resistor R_b and a first capacitor C_b , wherein the first resistor R_b and the first capacitor C_b are configured in parallel, and wherein the model has an initial calibration comprising an inductor having value LC , a second capacitor having value CC , a second resistor having value RC , and a geometrical factor; and

solving for a value of the first resistor R_b ;

wherein the inputs used to calculate the electrical conductivity of the flow of water additionally comprise the value of the first resistor R_b ;

measuring a flowrate of the flow of water passing through the water meter; and

reporting information based at least in part on the electrical conductivity of the flow of water and the flowrate of the flow of water to a data-collecting device.

2. The method of claim 1, wherein determining the value of at least part of the complex admittance of the capacitor assembly comprises:

applying an input signal to the capacitor assembly at a plurality of frequencies; and
measuring a current flow through the capacitor assembly at each of the plurality of frequencies.

3. A method to determine a value of water conductivity, comprising:

conducting a flow of water through a conduit and a capacitor assembly of a water meter, wherein a first electrode and a second electrode of the capacitor assembly are separated by a medium of the capacitor assembly, wherein the medium comprises at least part of the flow of water and at least part of the conduit used to conduct the flow of water;

defining a model of the capacitor assembly, wherein the model comprises a circuit with a constant phase element (CPE) connected to a resistor R_b and a capacitor, wherein the resistor R_b and the capacitor are configured in parallel, and wherein the model has an initial calibration;

applying inputs to the capacitor assembly over a range of frequencies, thereby using a plurality of inputs;

measuring respective currents passing through the capacitor assembly at each input frequency, to obtain a plurality of measured outputs;

deriving at least part of a complex admittance of the capacitor assembly based at least in part on the plurality of inputs and the plurality of measured outputs;

identifying at least one parameter of the model based on at least part of the complex admittance, wherein the at least one parameter comprises a value of the resistor R_b ;

determining the value of water conductivity using the value of the resistor R_b and at least one value of the initial calibration of the model of the capacitor assembly; and
reporting the value of water conductivity to a data-collecting device.

4. The method of claim 3, wherein the initial calibration of the model comprises:
the value of the resistor R_b divided by a reference conductivity based at least in part on an inductor having value LC , a second capacitor having value CC , a second resistor having value RC , and a geometrical factor.

5. The method of claim 3, wherein the initial calibration of the model is based on actions comprising:

passing water having a known conductivity through the water meter;
applying a range of input frequencies to the first electrode and the second electrode of the capacitor assembly; and
using values obtained from measurements associated with the range of input frequencies, and using the known conductivity, to identify the at least one value of the initial calibration.

6. A water meter, comprising:
a conduit to conduct a flow of water;

an upstream transducer, attached to an upstream location in the conduit, to send a downstream-directed acoustic signal and to receive an upstream-directed acoustic signal;

a downstream transducer, attached to a downstream location in the conduit, to send the upstream-directed acoustic signal and to receive the downstream-directed acoustic signal; and

a processor to compare a first time-of-flight of the downstream-directed acoustic signal to a second time-of-flight of the upstream-directed acoustic signal and to determine a flowrate of the flow of water, wherein the processor additionally performs actions comprising:

determining a value of at least part of a complex admittance of a capacitor assembly, wherein the flow of water forms at least part of a medium between a first electrode and a second electrode of the capacitor assembly;

calculating an electrical conductivity of the flow of water using inputs comprising the value of at least part of the complex admittance of the capacitor assembly, wherein calculating the electrical conductivity of the flow of water comprises:

mapping at least part of the complex admittance to a model of the capacitor assembly, wherein the model comprises a circuit with a constant phase element (CPE) connected to a first resistor R_b and a first capacitor C_b , wherein the first resistor R_b and the first capacitor C_b are configured in parallel, and wherein the model has an initial calibration comprising an

inductor having value LC , a second capacitor having value CC , a second resistor having value RC , and a geometrical factor; and

solving for a value of the first resistor R_b ;

wherein the inputs used to calculate the electrical conductivity of the flow of water additionally comprise the value of the first resistor R_b ;

measuring a flowrate of the flow of water passing through the water meter;

and

reporting information based at least in part on the electrical conductivity of the flow of water and the flowrate of the flow of water to a data-collecting device.

7. The water meter of claim 6, additionally comprising:

a model to determine the electrical conductivity of the flow of water, wherein an initial calibration of the model is based on actions comprising:

passing water having a known conductivity through the water meter;

applying a range of input frequencies to the first electrode and the second electrode of the capacitor assembly; and

using values obtained from measurements associated with the range of input frequencies, and using the known conductivity, to identify at least one value of the initial calibration.

8. The water meter of claim 6, wherein:

the upstream transducer comprises the first electrode of the capacitor assembly;

and

the downstream transducer comprises the second electrode of the capacitor assembly.

9. The water meter of claim 6, wherein:

the first electrode and the second electrode of the capacitor assembly are positioned in-line within the conduit, wherein the first electrode is upstream from the second electrode.

10. The water meter of claim 6, wherein:

the first electrode and the second electrode of the capacitor assembly are positioned in a face-to-face relationship on opposed sides the conduit.

11. The water meter of claim 6, additionally comprising:

a lookup table to map the complex admittance of the capacitor assembly to the electrical conductivity of the flow of water.

12. The water meter of claim 6, additionally comprising:

a lookup table, defined in a memory device in communication with the processor, to map the complex admittance of the capacitor assembly to the electrical conductivity of the flow of water based at least in part on a geometric factor that is based at least in part on a distance between the first electrode and the second electrode and a material from which the conduit is made.

13. A water meter, comprising:

a conduit to conduct a flow of water;

an upstream transducer, attached to an upstream location in the conduit, to send a downstream-directed acoustic signal and to receive an upstream-directed acoustic signal;

a downstream transducer, attached to a downstream location in the conduit, to send the upstream-directed acoustic signal and to receive the downstream-directed acoustic signal;

a processor to compare a first time-of-flight of the downstream-directed acoustic signal to a second time-of-flight of the upstream-directed acoustic signal and to determine a flowrate of the flow of water, wherein calculating an electrical conductivity of the flow of water comprises:

mapping at least part of a complex admittance of a capacitor assembly to the electrical conductivity of the flow of water using a lookup table, wherein the lookup table is based at least in part on a geometric factor that is based at least in

part on a distance between a first electrode and a second electrode and a material from which a conduit, through which the flow of water is conducted, is made;

measuring a flowrate of the flow of water passing through the water meter;

and

reporting information based at least in part on the electrical conductivity of the flow of water and the flowrate of the flow of water to a data-collecting device.

14. The water meter of claim 13, additionally comprising:

a model to determine the electrical conductivity of the flow of water, wherein an initial calibration of the model is based on actions comprising:

passing water having a known conductivity through the water meter;

applying a range of input frequencies to the first electrode and the second electrode of the capacitor assembly; and

using values obtained from measurements associated with the range of input frequencies, and using the known conductivity, to identify at least one value of the initial calibration.

15. The water meter of claim 13, wherein:

the upstream transducer comprises the first electrode of the capacitor assembly;

and

the downstream transducer comprises the second electrode of the capacitor assembly.

16. The water meter of claim 13, wherein:

the first electrode and the second electrode of the capacitor assembly are positioned in-line within the conduit, wherein the first electrode is upstream from the second electrode.

17. The water meter of claim 13, wherein the capacitor assembly comprises:

the first electrode and the second electrode of the capacitor assembly are positioned in a face-to-face relationship on opposed sides of the conduit.

18. A method, comprising:

determining an electrical conductivity of a flow of water passing through a water meter, wherein the determining comprises:

determining a value of at least part of a complex admittance of a capacitor assembly, wherein the flow of water forms at least part of a medium between a first electrode and a second electrode of the capacitor assembly; and

calculating the electrical conductivity of the flow of water using inputs comprising the value of at least part of the complex admittance of the capacitor assembly, wherein calculating the electrical conductivity of the flow of water comprises:

mapping at least part of the complex admittance of the capacitor assembly to the electrical conductivity of the flow of water using a lookup table, wherein the lookup table is based at least in part on a geometric factor that is based at least in part on a distance between the first and second

electrodes and a material from which a conduit, through which the flow of water is conducted, is made;

measuring a flowrate of the flow of water passing through the water meter; and

reporting information based at least in part on the electrical conductivity of the flow of water and the flowrate of the flow of water to a data-collecting device.

19. The method of claim 18, wherein determining the value of at least part of the complex admittance of the capacitor assembly comprises:

applying an input signal to the capacitor assembly at a plurality of frequencies; and

measuring a current flow through the capacitor assembly at each of the plurality of frequencies.