United States Patent Application Publication 20250262578
Kind Code A1
Publication Date August 21, 2025
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WATER FILTER ASSEMBLY AND METHOD FOR FLOW RECOVERY

Abstract

A water filtration assembly, a method for self-cleaning at a fluid filter assembly, and a refrigeration appliance are provided. The water filtration assembly includes a filtration housing forming a first volume configured to receive unfiltered water, and a second volume configured to receive filtered water. A filter medium separates the first volume from the second volume. An electrolytic cell includes a first electrode formed at the filter medium and a second electrode extended into the first volume. The electrolytic cell is configured to reverse polarity to reverse an ionic current through the electrolytic cell to restore permeability at the filter medium. A power supply or delivery system is operably coupled to the electrolytic cell and is configured to selectively apply a potential difference between the first electrode and the second electrode and selectively reverse a polarity of the applied potential.

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Family ID: **1000007730591**

Appl. No.: **18/442729**

Filed: **February 15, 2024**

Publication Classification

Int. Cl.: **B01D35/06** (20060101); **B01D35/143** (20060101); **B01D35/16** (20060101); **B01D37/04** (20060101); **B01D39/20** (20060101); **C02F1/00** (20230101); **F25D23/12** (20060101)

U.S. Cl.:

CPC **B01D35/06** (20130101); **B01D35/143** (20130101); **B01D35/16** (20130101); **B01D37/043** (20130101); **B01D39/2055** (20130101); **C02F1/003** (20130101); **F25D23/126**

(20130101); B01D2201/08 (20130101); C02F2307/12 (20130101); F25D2323/121 (20130101)

Background/Summary

FIELD OF THE INVENTION

[0001] The present subject matter relates generally to refrigerator appliances, and more particularly to a system and method for cleaning a filter for a water filtration assembly of a refrigerator appliance.

BACKGROUND OF THE INVENTION

[0002] Water filtration assemblies, such as for refrigerator appliances, standalone kitchen vessels, or mainline water filtration, can filter water entering the water filtration assembly, such as to improve taste, appearance, or remove undesired particulates. Certain refrigerator appliances may include water filter assemblies for filtering water. Water filter assemblies can filter water entering the refrigerator appliances to provide filtered water to various refrigerator appliance components, such as an ice maker and/or a water dispenser.

[0003] Over a period of usage, flowrate of water or other fluid through filter assemblies may generally decrease, such as due to build-up of filtered particulates at a filter medium. Decreases in flowrate can slow water filtration, such as to render the water filter unusable, too slow, or insufficient volume for a user. At such time, the water filter, or the water filtration assembly, may generally be replaced.

[0004] However, removal, disposal, and replacement of water filters can be wasteful, or can present issues to the user with finding, removing, and replacing the water filter.

[0005] Additionally, water filter assemblies for appliances may include one or more features that require power, such as various lights, sensors, valves, actuators, filtration means, hardware, etc. Conventionally, the water is routed in and out of the filter assembly through a filter manifold, which is generally a permanent component of the refrigerator appliance. As such, the power is typically transferred or supplied to the internal electronic components of the water filter assemblies via integration of electrical connections into the manifold. However, power through the manifold can increase the risk of water exposure to the electronic components of the filter assembly. In addition, routing the power through the manifold can also increase the complexity of the design of the manifold, which may inhibit integration of systems and methods for operating a water filtration assembly that use or modulate voltage or current at the water filtration assembly.

[0006] A water filtration assembly addressing one or more of the aforementioned issues would be beneficial and advantageous. Additionally, an appliance including a water filtration assembly addressing one or more of the aforementioned issues would be beneficial and advantageous.

BRIEF DESCRIPTION OF THE INVENTION

[0007] Aspects and advantages of the invention will be set forth in part in the following description, or may be obvious from the description, or may be learned through practice of the invention.

[0008] An aspect of the present disclosure is directed to a method for self-cleaning at a fluid filter assembly. The method includes disposing unfiltered fluid into a first volume enclosed in a housing. The unfiltered fluid is in fluid communication at a first side of a filter medium including a first electrode. A second volume is formed at a second side of the filter medium at which filtered fluid is disposable. The method includes applying a potential difference between the first electrode at the filter medium and a second electrode positioned at the first volume. The method includes reversing, for a period of time, a polarity of the applied potential. Reversing the polarity reverses an ionic current at an electrolytic cell including the first electrode and the second electrode.

[0009] Another aspect of the present disclosure is directed to a water filtration assembly including a filtration housing forming a first end distal from a second end. The first end includes one or more of a fluid inlet port or a fluid outlet port fixed to the filtration housing. The filtration housing forms a first volume configured to receive unfiltered water. The filtration housing forms a second volume configured to receive filtered water. A first electrode including a filter medium is positioned at the filtration housing and separates the first volume from the second volume. A second electrode extends into the first volume. A power delivery system is operably coupled to an electrolytic cell including the first electrode and the second electrode. The power delivery system is configured to selectively apply a potential difference between the first electrode and the second electrode. The power delivery system is configured to selectively reverse a polarity of the applied potential.
[0010] Still another aspect of the present disclosure is directed to a refrigeration appliance. The refrigeration appliance includes a cabinet defining a chilled chamber and a water filtration assembly. The water filtration assembly includes a filtration housing forming a first end distal from a second end. The first end includes one or more of a fluid inlet port or a fluid outlet port fixed to the filtration housing. The filtration housing forms a first volume configured to receive unfiltered water. The filtration housing forms a second volume configured to receive filtered water. A filter medium is positioned at the filtration housing and separates the first volume from the second volume. An electrolytic cell includes a first electrode and a second electrode. The filter medium forms the first electrode, and the second electrode extends into the first volume. The electrolytic cell is configured to reverse polarity to reverse an ionic current through the electrolytic cell to restore permeability at the filter medium. A power supply system is operably coupled to the electrolytic cell. The power supply system is configured to selectively apply a potential difference between the first electrode and the second electrode. The power supply system is configured to selectively reverse a polarity of the applied potential.
[0011] These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0012] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures.
[0013] FIG. **1** provides an elevation view of a refrigerator appliance according to exemplary embodiments of the present disclosure.
[0014] FIG. **2** provides a perspective view of the exemplary refrigerator appliance of FIG. **1**.
[0015] FIG. **3** provides an elevation view of the exemplary refrigerator appliance of FIG. **1** wherein the doors are shown in an open position.
[0016] FIG. **4** provides a simplified side elevation view of an embodiment of a water filtration assembly within a refrigerator appliance according to exemplary embodiments of the present disclosure.
[0017] FIG. **5** provides a perspective view of a water filtration assembly, including an illustration of a second electrical contact sub-assembly separated from the rest of the water filtration assembly for clarity.
[0018] FIG. **6** provides an exploded perspective view of the exemplary water filtration assembly of FIG. **5**.

[0019] FIG. **7**A provides a side perspective view of the water filter of the exemplary water filtration assembly of FIG. **5**.

[0020] FIG. **7**B provides a cross-sectional perspective view of the water filter of the exemplary water filtration assembly of FIG. **5**.

[0021] FIG. **7**C provides an exploded perspective view of the water filter of the exemplary water filtration assembly of FIG. **5**.

[0022] FIG. **8** provides a cross-sectional perspective view of the housing cap of the exemplary water filtration assembly of FIG. **5**.

[0023] FIG. **9** provides a cross-sectional perspective view of a portion of the filter label of the exemplary water filtration assembly of FIG. **5**.

[0024] FIG. **10** provides a perspective view of a portion of the housing cap of the exemplary water filtration assembly of FIG. **5**.

[0025] FIG. **11** provides a simplified side perspective view of an embodiment of a water filtration assembly within a refrigerator appliance according to exemplary embodiments of the present disclosure.

[0026] FIG. **12** provides an exploded perspective view of the water filter of the exemplary water filtration assembly of FIG. **11**.

[0027] FIG. **13**A provides a side perspective view of a water filter of an exemplary water filtration assembly in accordance with aspects of the present disclosure.

[0028] FIG. **13**B provides a cross-sectional perspective view of the water filter of the exemplary water filtration assembly of FIG. **13**A.

[0029] FIG. **13**C provides an exploded perspective view of the water filter of the exemplary water filtration assembly of FIG. **13**A.

[0030] FIG. **14**A provides a perspective view of a water filter of an exemplary water filtration assembly, with components removed for clarity, in accordance with an embodiment of the present disclosure.

[0031] FIG. **14**B provides an exploded perspective view of a water filter of an exemplary water filtration assembly, with components removed for clarity, in accordance with an embodiment of the present disclosure.

[0032] FIG. **15** provides a schematic side view of a water filter of an exemplary water filtration assembly in accordance with an embodiment of the present disclosure.

[0033] FIG. **16** provides a schematic plan view of a water filter of an exemplary water filtration assembly in accordance with an embodiment of the present disclosure.

[0034] FIG. **17** provides a schematic view of a water filter of an exemplary water filtration assembly in accordance with an embodiment of the present disclosure.

[0035] FIG. **18** provides a flowchart outlining steps of a method for operating a water filtration assembly in accordance with aspects of the present disclosure.

[0036] Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the present invention.

DETAILED DESCRIPTION

[0037] Reference now will be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

[0038] As used herein, the terms “first,” “second,” and “third” may be used interchangeably to distinguish one component from another and are not intended to signify location or importance of the individual components. The terms "includes" and "including" are intended to be inclusive in a manner similar to the term "comprising." Similarly, the term "or" is generally intended to be inclusive (i.e., "A or B" is intended to mean "A or B or both"). In addition, here and throughout the specification and claims, range limitations may be combined or interchanged. Such ranges are identified and include all the sub-ranges contained therein unless context or language indicates otherwise. For example, all ranges disclosed herein are inclusive of the endpoints, and the endpoints are independently combinable with each other. The singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise.

[0039] Approximating language, as used herein throughout the specification and claims, may be applied to modify any quantitative representation that could permissibly vary without resulting in a change in the basic function to which it is related. Accordingly, a value modified by a term or terms, such as "generally," "about," "approximately," and "substantially," are not to be limited to the precise value specified. In at least some instances, the approximating language may correspond to the precision of an instrument for measuring the value, or the precision of the methods or machines for constructing or manufacturing the components or systems. For example, the approximating language may refer to being within a 10 percent margin (i.e., including values within ten percent greater or less than the stated value). In this regard, for example, when used in the context of an angle or direction, such terms include within ten degrees greater or less than the stated angle or direction (e.g., "generally vertical" includes forming an angle of up to ten degrees in any direction, such as, clockwise or counterclockwise, with the vertical direction V).

[0040] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." In addition, references to "an embodiment" or "one embodiment" does not necessarily refer to the same embodiment, although it may. Any implementation described herein as "exemplary" or "an embodiment" is not necessarily to be construed as preferred or advantageous over other implementations. Moreover, each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

[0041] Embodiments of a water filter, filtration system, and methods are generally provided herein. It should be appreciated that embodiments provided herein may form fluid filter assemblies and methods for water and water-based solutions generally, or other appropriate solutions.

[0042] Generally, the present disclosure is directed to a filtration system and method for maintaining or improving flow characteristic, such as, flowrate, pressure drop, or other characteristic corresponding to flow across a filtration medium to a filtered fluid. Embodiments depicted and described herein include an electrochemical configuration to remove ions, particles, debris, or other particulates from water and filter medium by application of a potential difference between a first electrode, such as an activated carbon medium, and a second electrode, such as a conductive electrode (e.g., metal, conductive polymer, ceramic, carbon, etc.). The filtration system includes a electrolytic cell configured as a cathode and an anode electrode. A power supply system or power delivery system may be configured to supply or deliver controlled voltage or current output at the electrolytic cell. A measuring system may be configured to measure or determine a flow characteristic, such as, flowrate, pressure drop, time-in-service, volume-in-service, or other parameter or characteristic corresponding to a quality or quantity of flow across the filtration medium. A control system may be configured to selectively apply voltage or current at the electrolytic cell based on a period of time or a flow characteristic threshold. The control system may be configured to receive or transmit signals corresponding to flow characteristic, determine quantity or quality of flow across the filtration medium.

[0043] Embodiments of the method for maintaining or improving flow characteristic at the filtration system include applying a potential difference between the first and second electrodes. Applying the potential difference may perform an oxidation-reduction (redox) reaction to form coagulated particles of dissolved particulates from the fluid. The coagulated particles may be captured and precipitated on the filter medium, such as a carbon or carbon-based material. As precipitated particles accumulate on the filter medium, the flow characteristic corresponding to a quantity or quality of flow across the filter medium may decrease (e.g., a flowrate of fluid across the filter medium may decrease). The control system reverses a polarity of the applied potential, such as via the power supply or power delivery system. The change in polarity reverses a flow of ionic current in the electrolytic cell, such as to form a gap between a surface of the filter medium and a sediment layer. Forming the gap may restore permeability of the filter medium, such as to improve the flow characteristic or maintain the flow characteristic at a desired level, such as to facilitate flowing clean water through the filter medium without obstruction by the precipitated particles. In some embodiments, the control system reverses the polarity of the applied potential based on a period of time (e.g., a predetermined frequency of polarity reversal), or when a determined flow characteristic exceeds a predetermined threshold.
[0044] Embodiments of the filtration system may be configured as a standalone fluid filter assembly, such as a water filter assembly including a reservoir to receive filtered water, or as an appliance configured to receive the filtration system, such as a refrigeration appliance.
[0045] Embodiments provided herein may desirably increase life and usability of a water filter, improve flowrate or pressure drop across the filter medium, or improve an accuracy of determination of a need for filter replacement. Assemblies and methods provided herein may reduce waste, reduce or remove a need for filter replacement, or reduce a need for a user to replace a filter.
[0046] Referring now to the drawings, FIG. **1** illustrates a front view of an embodiment of a refrigerator appliance **10** according to an embodiment of the present disclosure. FIG. **2** illustrates a perspective view of the refrigerator appliance **10** of FIG. **1**. FIG. **3** illustrates a front view of the refrigerator appliance **10** of FIG. **1** with refrigerator doors **28** in an open position. Referring particularly to FIG. **1** the refrigerator appliance **10** extends between a top **11** and a bottom **12** along a vertical direction V. The refrigerator appliance **10** also extends between a first side **15** and a second side **16** along a lateral direction L. As shown in FIG. **2**, a transverse direction T may additionally be defined perpendicular to the vertical and lateral directions V, L. The refrigerator appliance **10** extends along the transverse direction T between a front portion **18** and a back portion **19**.
[0047] The refrigerator appliance **10** may include a cabinet or housing **20** (FIG. **2**) defining an upper fresh food chamber **22** (FIG. **3**) and a lower freezer storage chamber **24** arranged below the upper fresh food chamber **22** along the vertical direction V. An auxiliary food storage chamber may be positioned between the upper fresh food chamber **22** and the lower freezer storage chamber **24**, e.g., along the vertical direction V. Because the lower freezer storage chamber **24** is positioned below the upper fresh food chamber **22**, the refrigerator appliance **10** may be generally referred to as a bottom mount refrigerator. In the embodiment, the housing **20** may also define a mechanical compartment (not shown) for receipt of a sealed cooling system (not shown). Using the teachings disclosed herein, one of ordinary skill in the art will understand that the present technology can be used with other types of refrigerators (e.g., side-by-side) or a freezer appliance as well. Consequently, the description set forth herein is for illustrative purposes only and is not intended to limit the technology in any aspect.
[0048] Referring now particularly to FIG. **3**, the refrigerator doors **28** may each be rotatably hinged to an edge of the housing **20** for accessing the upper fresh food chamber **22**. It should be noted that while two refrigerator doors **28** in a “French door” configuration are illustrated, any suitable arrangement of doors utilizing one, two or more doors is within the scope and spirit of the present

disclosure. A freezer door **30** may be arranged below the refrigerator doors **28** for accessing the lower freezer storage chamber **24**. In the embodiment, the freezer door **30** is coupled to a freezer drawer (not shown) slidably mounted within the lower freezer storage chamber **24**. An auxiliary door **27** may be coupled to an auxiliary drawer which may be slidably mounted within the auxiliary chamber.

[0049] Referring back to FIG. **1** operation of the refrigerator appliance **10** can be regulated by a controller **34** that is operatively coupled to a user interface panel **36**. The user interface panel **36** may provide selections for user manipulation of the operation of the refrigerator appliance **10** to modify environmental conditions therein, such as temperature selections, etc. In some embodiments, the user interface panel **36** is proximate a dispenser assembly **32**. In response to user manipulation of the user interface panel **36**, the controller **34** may operate various components of the refrigerator appliance **10**. Operation of the refrigerator appliance **10** may be regulated by the controller **34**, e.g., the controller **34** may regulate operation of various components of the refrigerator appliance **10** in response to programming and/or user manipulation of the user interface panel **36**.

[0050] The controller **34** may include a memory and one or more microprocessors, CPUs, or the like, such as general or special purpose microprocessors operable to execute programming instructions or micro-control code associated with operation of the refrigerator appliance **10**. The memory may represent random access memory such as DRAM, or read only memory such as ROM or FLASH. In one embodiment, the processor executes programming instructions stored in memory. The memory may be a separate component from the processor or may be included onboard within the processor. It should be noted that controller(s) **34** as disclosed herein are capable of and may be operable to perform any methods and associated method steps as disclosed herein, such as one or more steps of method **1000** (FIG. **18**).

[0051] The controller **34** may be positioned in a variety of locations throughout the refrigerator appliance **10**. In the illustrated embodiment, the controller **34** is located within the refrigerator doors **28**. In such an embodiment, input/output ("I/O") signals may be routed between the controller and various operational components of the refrigerator appliance **10**. In one embodiment, the user interface panel **36** represents a general purpose I/O ("GPIO") device or functional block. In one embodiment, the user interface panel **36** includes input components, such as one or more of a variety of electrical, mechanical or electro-mechanical input devices including rotary dials, push buttons, and touch pads. The user interface panel **36** may include a display component, such as a digital or analog display device designed to provide operational feedback to a user. For example, the user interface panel **36** may include a touchscreen providing both input and display functionality. The user interface panel **36** may be in communication with the controller via one or more signal lines or shared communication busses.

[0052] Using the teachings disclosed herein, one of skill in the art will understand that the present disclosure can be used with other types of refrigerators such as a refrigerator/freezer combination, side-by-side, bottom mount, compact, and any other style or model of refrigerator appliance. Accordingly, other configurations of the refrigerator appliance **10** could be provided, it being understood that the configurations shown in the accompanying figures and the description set forth herein are by way of example for illustrative purposes only.

[0053] Embodiments of the filtration assembly **102** may be configured as a standalone fluid filter assembly, as components of a mainline filtration system, or as a portion of an appliance configured to receive the filtration system, such as the refrigeration appliance **10** depicted and described herein.

[0054] Referring now to FIG. **4**, a simplified side view of an embodiment of an appliance wall **104** of an appliance **10** (such as an interior wall, an exterior wall, a side wall, etc.) having the water filtration assembly **102** secured thereto is illustrated. As shown, the water filtration assembly **102** has a filtration housing **112**. As would be understood, a volume or mass of filtration media (e.g., water filtration cartridge or filter medium **138**, such as depicted in FIGS. **7**B and **7**C) may be disposed within the filtration housing **112**. Optionally, the filtration housing **112** may have a cylindrical configuration. In further embodiments, the filtration housing **112** may have any other suitable configuration other than a cylindrical configuration. Moreover, as shown, the water filtration assembly **102** may also include a liquid receiving space **132** within the filtration housing **112** and an electronics compartment **134** having one or more electronic components **135** (e.g., various lights, sensors, valves, actuators, filtration means, etc., as would be understood) housed, at least in part, therein. In such embodiments, the electronics compartment **134** is fluidly isolated from the liquid receiving space **132**, and thus fluidly isolated from the flow of water received within the liquid receiving space **132**.

[0055] In further embodiments, as shown, the water filtration assembly **102** may include a manifold **106** that can be mounted to the appliance wall **104** of the appliance **10**. Accordingly, as shown, the manifold **106** may generally contain a filter latching/mating interface and water connections therein.

[0056] Generally, and as would be understood, the appliance **10** includes a water source (not shown) that provides water to and from the water filtration assembly **102** (e.g., through the manifold **106** via a water inlet **108** and a water outlet **110**, such as depicted in FIG. **4**). Thus, in certain embodiments, the water filtration assembly **102** is in fluid communication with the water inlet **108** and the water outlet **110**. It is noted that although FIG. **4** illustrates a simplified view whereby the water inlet **108** and water outlet **110** are spaced apart (e.g., at the same end of filtration housing **112**), alternative embodiments may provide a coaxial inlet-outlet configuration, or other suitable configuration for a separate inlet and outlet for a filtration assembly, as would be understood.

[0057] The filtration housing **112** includes a first end **116** opposite a second end **118**. In optional embodiments, the first end **116** includes one or more features for securing the water filtration assembly **102** to the manifold **106** via the filter latching/mating interface, with the manifold **106** being secured to the appliance wall **104** of the appliance **10**. For instance, the filter latching/mating interface may include the first end **116** of the filtration housing **112** having one or more interlocking features **120** and corresponding interlocking features **122** of the manifold **106**. In some such embodiments, the interlocking features **120** of the first end **116** of the filtration housing **112** are configured to engage with the corresponding interlocking features **122** of the manifold **106** for securing the filtration housing **112** to the appliance **10**. In further embodiments, the first end **116** of the filtration housing **112** may be secured to the manifold **106** using any other suitable means.

[0058] Referring still to FIG. **4**, the water filtration assembly **102** further includes an electrical connection **126** electrically coupling the water filtration assembly **102** to a power source or a controller (e.g., controller **34**, FIG. **1**). Generally, the power source may be any suitable source of electricity. More specifically, as shown, the electrical connection **126** may include at least one first electrical contact **128** positioned on the filtration housing **112** and at least one second electrical contact **130** fixed to the cabinet **20** (e.g., positioned on the appliance wall **104** of the appliance **10**). When installed or mounted to the appliance **10** (FIG. **4**), the first electrical contact(s) **128** is configured to align with the second electrical contact(s) **130**, details of which are further explained herein below with respect to FIGS. **5** through **11**.

[0059] Generally, the electrical connection **126** may include one or more electrical harnesses **136**, **124**. For instance, a first electrical harness **136** includes various electrical paths (e.g., connected in series or parallel) and is configured to electrically couple the first electrical contact **128** to an electronics compartment **134** (FIG. **4**) having one or more electronic components **135** (FIG. **4**) housed within the filtration housing **112**. Moreover, as shown, a second electrical harness **124** is configured to electrically couple the second electrical contact **130** to the power source or any other communication device, such as a controller **34** (FIG. **1**).

[0060] Generally, the electrical connection **126** is separate and spaced apart from the manifold **106** and the flow of water received therein, e.g., separate and spaced apart from the water inlet port(s) **108** and the water outlet port(s) **110**. As such, in an embodiment, when the first electrical contact(s) **128** contacts the second electrical contact(s) **130**, power is provided to the water filtration assembly **102** from the power source, for example, via the electrical connection **126**. Additionally, or alternatively, one or more other signals for communication, security, or sensing may also be provided to the water filtration assembly **102** when the first electrical contact(s) **128** contacts the second electrical contact(s) **130**.

[0061] Generally, the housing label **140** is separate and spaced apart from the fluid inlet port **108** and the fluid outlet port **110**. For instance, the housing label **140** may include an adhesive layer or coating (e.g., applied to an interior surface of the housing label **140**, such as to contact an external surface of the filtration housing **112**) that adheres or sticks to an external surface **115** of filtration housing **112**. Additionally, or alternatively, a separate exterior label or coating (e.g., fitted polymer, such as a shrink wrap or vacuum-sealed layer) may be provided to hold housing label **140** to the filtration housing **112**. Optionally, the housing label **140** may extend about at least a portion of filtration housing **112**. As would be understood, housing label **140** may include printed text, labeling, or figures indicative or descriptive of the water filtration assembly **102**. Nonetheless, as would also be understood, the present disclosure is not limited to any particular printed text, labeling, or figures.

[0062] Referring to FIG. **9**, in some embodiments, an electrical connector **142** (e.g., electrical passthrough facilitating an electrical voltage or current to flow therethrough) is provided on, with, beneath, or through the housing label **140**. Generally, the electrical connector **142** defines an intermediate electrical path **154** (e.g., singular path or, alternatively, plurality of electrically parallel paths) that extends outside (e.g., partially or, alternatively, fully outside) of at least a portion of the filtration housing **112**. When assembled (e.g., such that filtration housing **112** is mounted within appliance in fluid connection with a water source), intermediate path may conduct power or communication signals between the water filtration assembly **102** and the separate appliance **10** (FIG. **4**).

[0063] The electrical connector **142** may extend from a first connector end **144** to a second connector end **146**. Generally, between the first connector end **144** and the second connector end **146** one or more circuit conductors (e.g., wires, conductive traces, pins, etc.) through which a current may be conducted between first connector end **144** and second connector end **146**. In some embodiments, electrical connector **142** is joined to the housing label **140**, such as between first connector end **144** and second connector end **146** (e.g., by an adhesive, attachment panel, embedding material, or other suitable conductor attachment structure, as would be understood). Optionally, both first connector end **144** and second connector end **146** (e.g., the entirety of electrical connector **142** between first connector end **144** and second connector end **146**) may be disposed outside of the liquid receiving space **132**, electronics compartment **134** (FIG. **4**), or general interior of filtration housing **112**.

[0064] In certain embodiments, first connector end **144** is defined as or at first electrical contact **128**. Thus, the intermediate electrical path **154** may extend from the first electrical contact **128** to conduct power or communication signals between the water filtration assembly **102** and the separate appliance **10** (FIG. **4**). In embodiments wherein multiple discrete contacts **128** are provided, a similar number of branches of intermediate electrical path **124** may be provided (e.g., in parallel to each other). In additional or alternative embodiments, second connector end **146** is defined as or at one or more housing contact pads **148**. The contacts pads **148** may correspond (e.g., in number and placement) to the (e.g., parallel) electrical branches of path **154** or, alternatively, be distinct (e.g., in number and placement) from the (e.g., parallel) electrical branches of path **154** while still being in electrical communication with the same (e.g., directly or, alternatively, indirectly, such as through an electrical chip **170**). Additionally, or alternatively, the contact pad(s) **148** may be disposed on or fixed to the external surface **115** of filtration housing

112. Optionally, the housing contact pads **148** may be disposed beneath or on an internal surface of housing label **140**. When assembled the intermediate electrical path **154** may extend to the housing contact pad(s) **148** to conduct power or communication signals between the water filtration assembly **102** and the separate appliance **10** (FIG. **4**).

[0065] Turning to FIGS. **5** through **10**, the first electrical contact(s) **128** may include axially spaced pads. In particular, first electrical contact(s) **128** may be formed or be shaped as one more conductive rings. For instance, first electrical contact **128** may extend around at least a portion of filtration housing **112**. Optionally, a plurality of first electrical contacts **128** may be provided as conductive rings. In particular, as shown, the water filtration assembly **102** may include a plurality of first electrical contacts **128** extending around at least a portion of the filtration housing **112**. Optionally, a plurality of second electrical contacts **130** may be arranged on the appliance wall **104** of the appliance **10** (FIG. **4**). Additionally, or alternatively, each of the plurality of first electrical contacts **128** may generally have a ring-shaped configuration extending around an entire circumference of filtration housing **112**. Accordingly, the ring-shaped first electrical contact(s) **128** allow for the filtration housing **112** to be installed in any orientation such that, regardless of the orientation, the first electrical contact(s) **128** align with the second electrical contact(s) **130**. In such embodiments, the ring-shaped first electrical contacts **128** may be arranged adjacent to each other and may be axially spaced apart from each other (e.g., equally spaced or separated by differing distances along the axis of the filtration housing **112**). In the illustrated embodiment, four first electrical contacts **128** are provided, however, it should be understood that more than four or less than four first electrical contacts **128** may be employed in the water filtration assembly **102** of the present disclosure.

[0066] Moreover, as shown, each of the plurality of second electrical contacts **130** is arranged on the appliance wall **104** of the appliance **10** (FIG. **4**) to align with and contact one of the plurality of first electrical contacts **128** when the water filtration assembly **102** is mounted within the appliance **10**. In some embodiments, the second electrical contacts **130** include or are provided spring-loaded contact pins, such as pogo pins (e.g., as shown), biased outward or downward toward first electrical contacts **128**, such as at contact surface **129**. The second electrical contact **130** includes contact surface **129** configured to touch the first electrical contact **128**. Thus, as shown in the illustrated embodiment, four second electrical contacts **130** are provided, however, it should be understood that more than four or less than four second electrical contacts **130** may be employed in the water filtration assembly **102** of the present disclosure, with the number of second electrical contacts **130** corresponding to the number of first electrical contacts **128**.

[0067] Turning briefly to FIGS. **11** and **12**, although certain embodiments may include one or more conducive rings at the first electrical contacts **128**, alternative embodiments may include a rigid card plug **150** (e.g., provided at or as part of the first electrical contact **128**). Such a rigid card plug **150** may include, for instance, an edge connector having a printed circuit board including conductive traces or pathways leading to the edge of the board that are intended to plug into a matching contact socket **152**. As shown, the rigid card plug **150** may extend outward from the housing label **140** (e.g., to the intermediate electrical path below the housing label **140**).

[0068] The contact socket **152** may be fixed or mounted on the separate appliance **10** (FIG. **4**), such as a female card socket to receive the rigid card plug **150**. Moreover, the contact socket **152** may be in electrical communication with the power source or controller **34** (e.g., to direct power or communication signals between the appliance **10** (FIG. **4**) and the water filtration assembly **102**).

[0069] Returning generally to FIGS. **5** through **12**, within the filtration housing **112**, an internal electrical path **156** may be disposed in electrical communication with the intermediate electrical path **154**. The internal electrical path **156** may connect the intermediate electrical path **154** to the one or more electronics components **135** (FIG. **4**) provided within the filtration housing **112** (e.g., within the electronics compartment **134**—FIG. **4**). For instance, as noted above, one or more housing contact pads **148** may be provided (e.g., fixed on an external surface of) the filtration housing **112** to connect to the internal electrical path **156**. In turn, the housing contact pads **148** may be in electrical communication between the internal electrical path **156** and the intermediate electrical path **154**.

[0070] In some embodiments, the internal electrical path **156** may be connected to the intermediate electrical path **154** or housing contact pads **148** through one or more intermediary connectors. For instance, a housing cap **158** may be selectively disposed on the filtration housing **112** (e.g., to close the first housing end **116** or second housing end **118**). Fixed to the housing cap **158** may be one or more cap contact pads **160** in electrical communication with the internal electrical path **156**. When assembled, the cap contact pads **160** may thus be in electrical communication between the internal electrical path **156** and the intermediate electrical path **154**.

[0071] In certain embodiments, the cap contact pads **160** circumferentially align with and conductively contact the housing contact pads **148**. For instance, the cap contact pads **160** may be embedded from an exterior surface of the housing cap **158** at a circumferential rim **162** thereof while one or more mated conductor bodies **164** extend inward through the circumferential rim **162** to the interior of the filtration housing **112**. In some such embodiments, the cap contact pads **160** are overmolded within the housing cap **158**. The housing label **140** may cover at least a portion of the circumferential rim **162** such that the housing contact pads **148** sit over or radially outward from the cap contact pads **160** (e.g., at the same circumferential location about the filtration housing **112**). In turn, an intermediate electrical connection may be formed between the contact pads **148**, **160** to permit electrical communication between the two paths **154**, **156**.

[0072] As noted above, the conductor bodies **164** may extend from the cap contact pads **160**. In optional embodiments, each conductor body **164** includes a conductive trunk **166** that extends from the cap contact pad **160** and a plurality of conductive branches **168** held within the filtration housing **112**. Thus, a discrete conductor body **164** or conductive trunk **166** may extend from each discrete cap contact pad **160**. As shown, each of the conductive branches **168** may be circumferentially spaced apart from each other within filtration housing **112**. Optionally, the discrete branches **168** of one conductive trunk **166** may be circumferentially interposed between the discrete branches **168** of another conductive trunk **166** such that two or more branches **168** of one conductive trunk **166** are circumferentially interrupted or separated by the branch **168** of another conductive trunk **166**. Additionally, or alternatively, a radial collar within filtration housing **112** may radially separate the conductive branches **168** of two or more conductive trunks **166** (e.g., such that the radial collar surface acts as a radially barrier between the two sets of branches **168**). Thus, one set of conductive branches **168** may be arranged radially inward of another set of conductive branches **168**.

[0073] Turning now especially to FIGS. **9** and **12**, a validating electrical circuit or electrical chip **170** may be disposed along the intermediate electrical path (e.g., on the housing label **140**). Specifically, between the first connector end **144** and the second connector end **146**, the electrical chip **170** may be positioned to interrupt electrical communication or the conductive lines in general. Included on the electrical chip **170** may be one or more electrical components, circuits, or processors (e.g., configured to selectively restrict/permit power or communication signals through the electrical chip **170**, as would be understood in light of the present disclosure). In some embodiments, the electrical chip **170** is configured to evaluate one or more electrical signals from the first electrical contact **128** and selectively permit power transfer through the electrical chip **170** to the filtration housing **112** based on the evaluation. For instance, the electrical chip **170** may include a Field-Effect Transistor (FET) circuit configured to selectively permit or restrict electrons through the electrical chip **170**. Additionally, or alternatively, the electrical chip **170** may include a chip processor or controller configured to receive an authentication communication signal from the controller **34** and match the authentication communication signal to a stored condition. In response to matching the authentication communication signal, the chip processor or controller may permit power or communication signals through the electrical chip **170** (e.g., to the internal electrical path

156). Alternately, if the chip processor or controller of chip **170** fails to match the authentication communication signal, the chip processor or controller may be configured to restrict or prevent power or communication signals through the electrical chip **170** (e.g., to the internal electrical path **156**).

[0074] Referring to FIGS. **7**A-**7**B, and FIGS. **13**A-**13**C, and FIGS. **14**A-**14**B, and FIGS. **15-16**, embodiments of the filtration system **102** include an electrochemical configuration to remove ions, particles, debris, or other particulates from unfiltered water, such as depicted schematically as unfiltered water **139**, and the filter medium **138**. In various embodiments, the filter medium **138** includes a carbon or carbon-based material, such as formed as a surface, wall, block, or other structure, such as an activated carbon medium. The filtration system **102** is configured to apply a potential difference between the filter medium **138**, forming a first electrode, and a second electrode **180** at the unfiltered water **139**. The second electrode **180** extends into a separate volume from the filter medium **138**, such as a volume at which unfiltered water **139** is positioned within the filtration housing **112**. The second electrode **180** forms a rod, a plate, or other desired geometry forming a surface or wall extending into the volume. An electrolytic cell **101** is configured as a cathode electrode and an anode electrode formed from the filter medium **138** as the first electrode and the surface forming the second electrode.

[0075] In some embodiments, a first volume is formed at the filtration housing **112**. The first volume forms a plenum at which unfiltered water may be received, such as a volume adjacent to a first side of the filter medium **138**. A second volume forms a plenum at which water filtered through the filter medium **138** is provided, such as a volume adjacent to a second side of the filter medium **138**.

[0076] In various embodiments, a power supply, power delivery, or driving system **400** is configured to supply or deliver a controlled voltage or current output at the electrolytic cell, such as depicted in FIG. **17**. In some embodiments, the power supply or power delivery system **400** forms an electronic driving system. For instance, the power supply is electrically coupled to the electrodes at the electrolytic cell **101**, such as depicted via connections **181**, **182** to the respective first electrode formed at filter medium **138** and the second electrode **180**. In some embodiments, connections **181**, **182** may form electrical wires. In still some embodiments, connections **181**, **182** may include all or part of electrical connector **142**, electrical contacts **128**, **130**, contact pad **160**, conductor body **164**, or other portions, such as depicted and described in regard to FIGS. **8-10**.

[0077] In some embodiments, the power supply **400** is configured to selectively apply voltage or current at the electrolytic cell based on a period of time. The period of time may include one or more frequencies of application and inverse polarity of applying voltage or current at the electrolytic cell to reverse a flow of ionic current in the electrolytic cell. Reversing the flow of ionic current may form a gap between a surface of the filter medium **138** and a sediment layer formed from filtration of water through the filter medium **138** (e.g., formed from unfiltered water **139** passing through the filter medium **138** to a volume at which filtered water is positioned, such as depicted at filtered water **141**. Forming the gap may remove obstructions at the filter medium **138** that may restore permeability of the filter medium **138**, such as to improve the flow characteristic or maintain the flow characteristic at a desired level. Restoring permeability of the filter medium **138** may facilitate increased life and usability of the filter medium and improve flowrate or pressure drop across the filter medium.

[0078] Referring now to FIG. **17**, in some embodiments, the controller **34** is operably coupled to the power supply or power delivery system **400** and a measuring system **410**. In various embodiments, such as described herein, the power supply or power delivery system **400** is configured to selectively apply voltage or current to the electrolytic cell. The measuring system **410** may be configured to measure or determine a flow characteristic, such as flowrate and/or pressure drop across the filter medium **138**, time-in-service or volume-in-service of the filter medium **138**, or other parameter or characteristic corresponding to a quality or quantity of flow across the filter medium **138**. The controller **34** may be configured to control voltage or current at the electrolytic cell based on a flow characteristic threshold. The controller **34** may be configured to receive or transmit signals from the measuring system **410**, such as signals corresponding to flow characteristic. The controller **34** may further be configured to determine quantity or quality of flow across the filter medium **138**.

[0079] In various embodiments, the electrolytic cell is electrically coupled to the power supply or power delivery system **400** via conductive branches **168**, such as depicted and described in regard to FIGS. **8-10**. Power supply or power delivery system **400** may selectively communicate voltage or current through electrical contacts **128**, **130**. Conductor body **165** may operably couple to electrodes to communicate voltage or current from the power supply or power delivery system **400**. For instance, respective conductive branches **168** may operably contact respective electrodes such as described herein. In still various embodiments, electrical chip(s) **170** may be positioned to interrupt or change electrical communication at the electrodes, such as to selectively reverse polarity based on a frequency or period of time, or based on a flow characteristic, such as described herein.

[0080] Referring now to FIG. **18**, a flowchart outlining steps of a method for self-cleaning at a fluid filter assembly is provided (hereinafter, “method **1000**”). Embodiments of the method **1000** may additionally, or alternatively, form a method for maintaining or improving a flow characteristic at a fluid filter assembly, such as flow rate or pressure drop. Still various embodiments of the method **1000** may additionally, or alternatively, form a method for determining filter replacement at a filtration assembly. Embodiments of the method **1000** may be provided by embodiments of a filtration assembly such as described herein. It should be appreciated that embodiments provided herein may be performed at a standalone filtration assembly, such as a kitchen water filter assembly or a mainline (e.g., residential housing) water system, or at an appliance (e.g., a refrigeration or freezer appliance, a washing machine appliance, etc.).

[0081] Embodiments of the method **1000** include at **1010** disposing unfiltered fluid into a first volume (e.g., volume at which unfiltered water **139** is disposed) enclosed in a housing (e.g., filtration housing **112**). The unfiltered fluid is in fluid communication at a first side of a filter medium (e.g., filter medium **138**). A second volume (e.g., volume at which filtered water **141** is disposed) is formed at a second side of the filter medium at which filtered fluid is disposable.

[0082] Method **1000** includes at **1020** applying (e.g., via a power supply or driving system, such as power supply or power delivery system **400**) a potential difference between a first electrode (e.g., electrode **188**) positioned at the filter medium and a second electrode (e.g., electrode **180**) positioned at the first volume.

[0083] Method **1000** includes at **1030** reversing (e.g., via a power supply or driving system, such as power supply or power delivery system **400**), for a period of time, a polarity of the applied potential. Reversing the polarity reverses an ionic current at an electrolytic cell (e.g., electrolytic cell **101**) including the first electrode and the second electrode.

[0084] In some embodiments, applying the potential difference includes controlling a voltage through an electrolytic cell including the second electrode and the filter medium as the first electrode. In various embodiments, controlling the voltage may include applying a first voltage, and reversing the polarity of the applied potential may include applying a second voltage having a reverse polarity relative to the first voltage. In various embodiments, the first and second voltage may be the same, similar, or different in magnitude.

[0085] In still some embodiments, applying the potential difference includes controlling a current at an electrolytic cell including the second electrode and the filter medium as the first electrode. In various embodiments, applying the current may include applying a first current. Reversing the polarity of the applied potential may include selectively applying a second current different from the first current.

[0086] In an exemplary embodiment, the voltage or current may be adjusted to increase or improve an ionic current to form a gap between a surface of the filter medium and a sediment layer that may be formed at the filter medium from filtering water. As such, forming the gap may restore permeability of the filter medium, such as to improve the flow characteristic or maintain the flow characteristic at a desired level.

[0087] In still various embodiments, the period of time over which the polarity is reversed may include a frequency over which the polarity is reversed and returned to an initial polarity. For instance, the period of time may be a predetermined period of time from which the polarity is reversed (e.g., a period of time from initial usage of the water filter assembly, or a period of time from a previous polarity reversal). In various instances, the period of time may be a predetermined period over which the polarity is reversed.

[0088] In still yet various embodiments, polarity reversal may be triggered when a determined flow characteristic (e.g., flow rate or pressure drop across between the volumes at which respective volumes of water **139**, **141** are disposed exceeds a predetermined threshold). For instance, when the flow rate, or a parameter indicative thereof, decreases below the predetermined threshold, the controller **34** may command the power supply or power delivery system **400** (e.g., via a first signal) to apply the potential difference to perform a redox reaction to form coagulated particles of dissolved particulates from the water, and command the power supply or power delivery system **400** (e.g., via a second signal) to reverse the polarity to reverse the ionic current at the electrolytic cell and form a gap of the coagulated particles at the filter medium, such as to improve permeability that may improve flow characteristic above the predetermined threshold (e.g., improve or restore flow rate or pressure drop).

[0089] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they include structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

Claims

1. A method for self-cleaning at a fluid filter assembly, the method comprising: disposing unfiltered fluid into a first volume enclosed in a housing, wherein the unfiltered fluid is in fluid communication at a first side of a filter medium comprising a first electrode, and wherein a second volume is formed at a second side of the filter medium at which filtered fluid is disposable; applying a potential difference between the first electrode at the filter medium and a second electrode positioned at the first volume; and reversing, for a period of time, a polarity of the applied potential, wherein reversing the polarity reverses an ionic current at an electrolytic cell comprising the first electrode and the second electrode.

2. The method of claim 1, wherein applying the potential difference comprises controlling a voltage at an electrolytic cell comprising the first electrode and the second electrode.

3. The method of claim 1, wherein applying the potential difference comprises controlling a current through an electrolytic cell including the first electrode and the second electrode.

4. The method of claim 1, wherein the filter medium comprises a carbon material.

5. The method of claim 1, wherein the second electrode extends into the first volume, the second electrode comprising a conductive material.

6. A water filtration assembly comprising: a filtration housing forming a first end distal from a second end, wherein the first end includes one or more of a fluid inlet port or a fluid outlet port fixed to the filtration housing, wherein the filtration housing forms a first volume configured to

receive unfiltered water, and wherein the filtration housing forms a second volume configured to receive filtered water, wherein a first electrode comprising a filter medium is positioned at the filtration housing and separates the first volume from the second volume; a second electrode extending into the first volume; a power delivery system operably coupled to an electrolytic cell comprising the first electrode and the second electrode, the power delivery system configured to selectively apply a potential difference between the first electrode and the second electrode, and wherein the power delivery system is configured to selectively reverse a polarity of the applied potential.
7. The water filtration assembly of claim 6, wherein the power delivery system is configured to reverse the polarity based on potential difference between the first and second electrodes.
8. The water filtration assembly of claim 6, wherein the power delivery system is configured to reverse the polarity based on current through the electrolytic cell.
9. The water filtration assembly of claim 6, wherein the filter medium comprises a carbon material.
10. The water filtration assembly of claim 6, wherein the second electrode extends into the first volume, the second electrode comprising a conductive material.
11. The water filtration assembly of claim 6, comprising: a controller operably coupled to the power delivery system, the controller configured to command at the power delivery system: applying the potential difference between the first electrode and the second electrode; and reversing, for a period of time, the polarity of the applied potential, wherein reversing the polarity reverses an ionic current at the electrolytic cell comprising the first electrode and the second electrode.
12. The water filtration assembly of claim 11, wherein the controller is configured to determine a flow characteristic across the filter medium and reverse the polarity of the applied potential based on the determined flow characteristic.
13. The water filtration assembly of claim 11, comprising: a measuring system configured to determine a flow characteristic, wherein the controller is configured to reverse the polarity of the applied potential difference for the period of time when a flow characteristic threshold is exceeded.
14. A refrigeration appliance, comprising: a cabinet defining a chilled chamber; a water filtration assembly comprising; a filtration housing forming a first end distal from a second end, wherein the first end includes one or more of a fluid inlet port or a fluid outlet port fixed to the filtration housing, wherein the filtration housing forms a first volume configured to receive unfiltered water, and wherein the filtration housing forms a second volume configured to receive filtered water, wherein a filter medium is positioned at the filtration housing and separates the first volume from the second volume; an electrolytic cell comprising a first electrode and a second electrode, the filter medium forming the first electrode, the second electrode extending into the first volume, wherein the electrolytic cell is configured to reverse polarity to reverse an ionic current through the electrolytic cell to restore permeability at the filter medium; and a power supply system operably coupled to the electrolytic cell, the power supply system configured to selectively apply a potential difference between the first electrode and the second electrode, wherein the power supply system is configured to selectively reverse a polarity of the applied potential.
15. The refrigeration appliance of claim 14, wherein the filter medium comprises a carbon material.
16. The refrigeration appliance of claim 14, comprising: a controller operably coupled to the power supply system, the controller configured to command at the power supply system: applying the potential difference between the first electrode and the second electrode; and reversing, for a period of time, the polarity of the applied potential, wherein reversing the polarity reverses the ionic current at the electrolytic cell.
17. The refrigeration appliance of claim 16, wherein applying the potential difference comprises controlling a voltage at the electrolytic cell.
18. The refrigeration appliance of claim 17, wherein the controller is configured to reverse the polarity based on potential difference between the first and second electrodes.

19. The refrigeration appliance of claim 17, wherein the power supply system is configured to reverse the polarity based on current through the electrolytic cell.

20. The refrigeration appliance of claim 14, comprising: a measuring system configured to determine a flow characteristic, wherein the controller is configured to reverse the polarity of the applied potential difference for the period of time when a flow characteristic threshold is exceeded.