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(54) **WATER FLOW TRIGGERING OF CHLORINATION TREATMENT**

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(52) **U.S. Cl.**
CPC ***C02F 1/76*** (2013.01); *C02F 1/008* (2013.01); *C02F 2201/005* (2013.01); *C02F 2209/03* (2013.01)

(58) **Field of Classification Search**
CPC C02F 1/76
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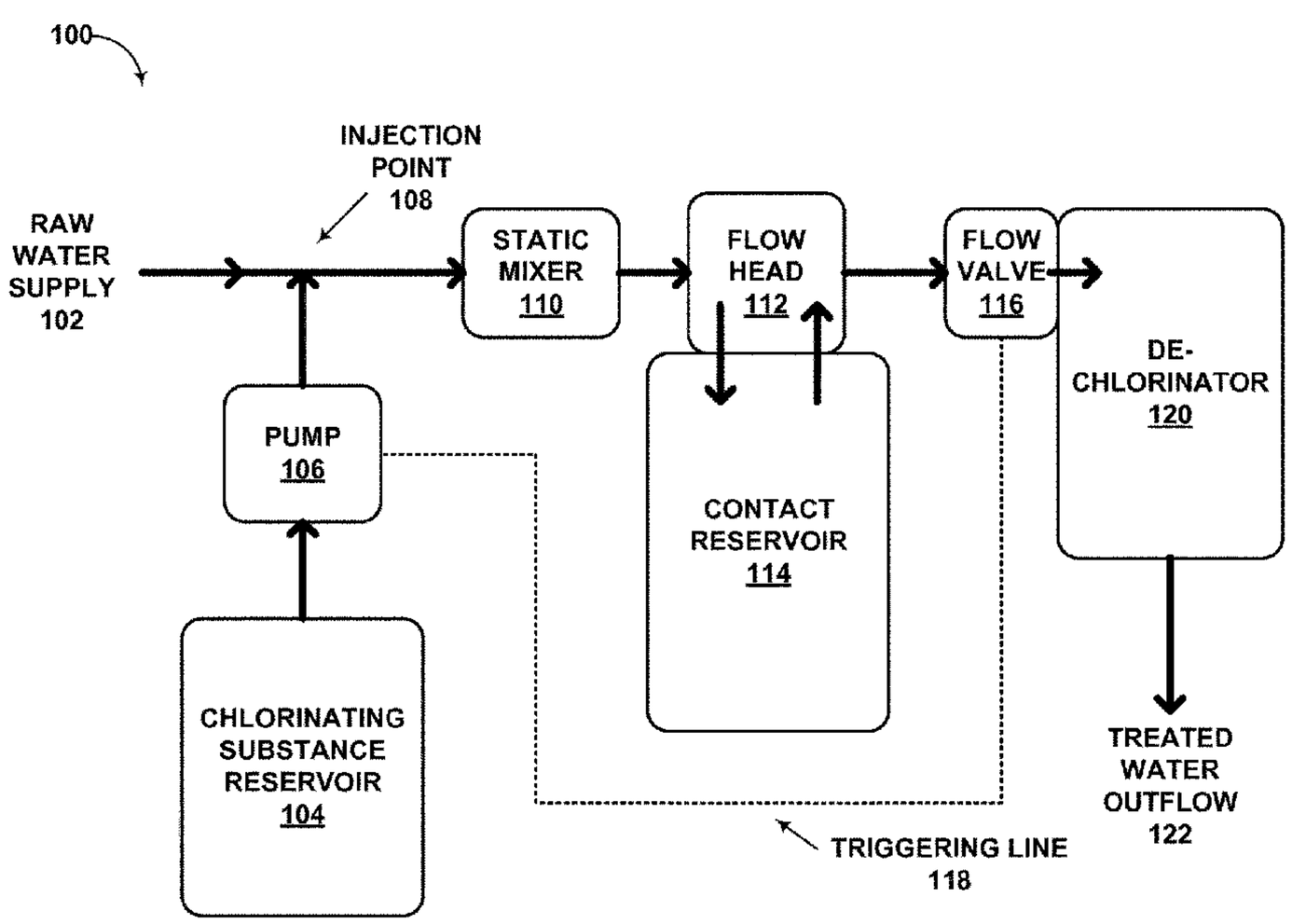
(74) *Attorney, Agent, or Firm* — McDonnell Boehnen Hulbert & Berghoff LLP

(57) **ABSTRACT**

As an example embodiment, a system may detect water flow in a well water system and may responsively trigger a pump to inject a chlorinating substance into untreated water from the well. Further, the system may include a contact reservoir that allows the water and the chlorinating substance to combine. In this way, the chlorinating substance is drawn only when needed, but is given the opportunity to achieve time in solution with the untreated water. As a result, bacteria in untreated water may be dispatched, while other organic substances in the untreated water are given the opportunity to settle to the bottom of the contact reservoir. A static mixer may be used to mix the chlorinating substance and the untreated water prior to entering the contact reservoir and/or while in the contact reservoir.

17 Claims, 3 Drawing Sheets



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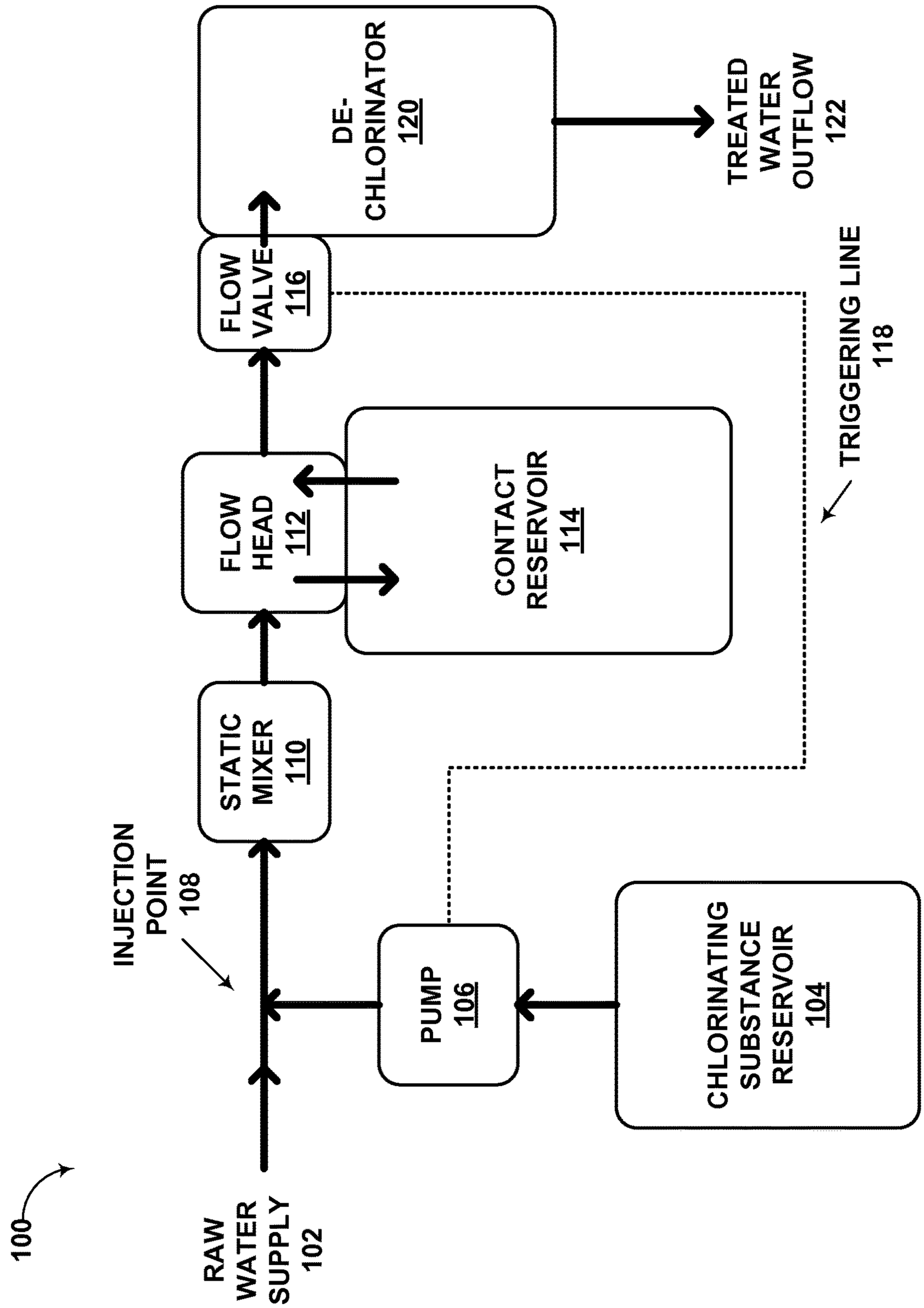
100
RAW WATER SUPPLY 102
INJECTION POINT 108
STATIC MIXER 110
FLOW HEAD 112
CONTACT RESERVOIR 114
FLOW VALVE 116
DE-CHLORINATOR 120
TREATED WATER OUTFLOW 122
TRIGGERING LINE 118
PUMP 106
CHLORINATING SUBSTANCE RESERVOIR 104

FIG. 1

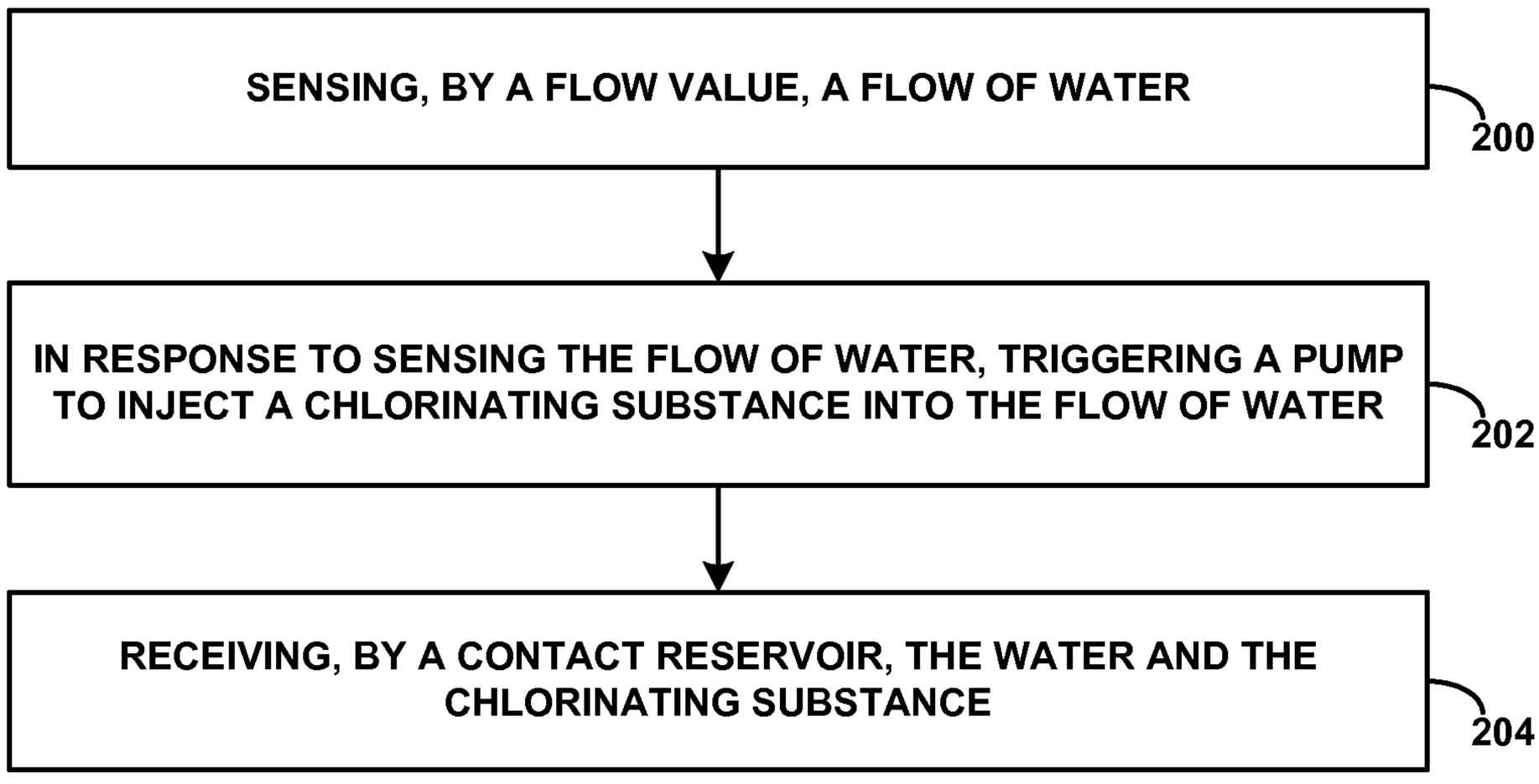
SENSING, BY A FLOW VALUE, A FLOW OF WATER
200
IN RESPONSE TO SENSING THE FLOW OF WATER, TRIGGERING A PUMP TO INJECT A CHLORINATING SUBSTANCE INTO THE FLOW OF WATER
202
RECEIVING, BY A CONTACT RESERVOIR, THE WATER AND THE CHLORINATING SUBSTANCE
204

FIG. 2

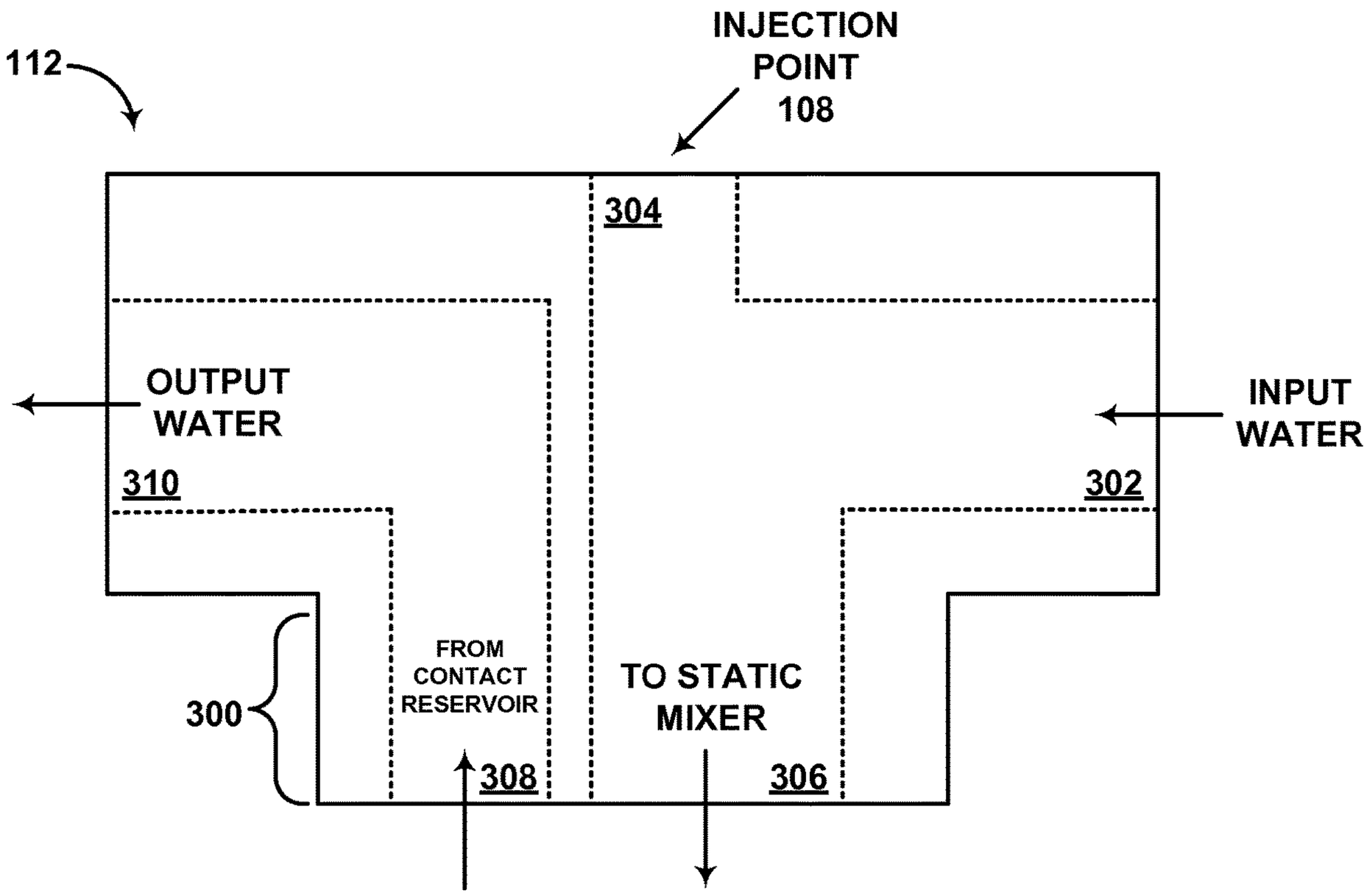
112
INJECTION POINT 108
304
OUTPUT WATER
INPUT WATER
310
302
300
FROM CONTACT RESERVOIR
TO STATIC MIXER
308
306

FIG. 3

WATER FLOW TRIGGERING OF CHLORINATION TREATMENT

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

BACKGROUND

Many residential and smaller commercial water supply systems draw water from a well. The well may be dug or drilled to access groundwater in underground aquifers. Since well water may be used for drinking, contamination is a concern. Thus, it is desirable to be able to eliminate, reduce, and/or neutralize, bacteria and other potentially harmful organic and/or non-organic substances that may exist in raw, untreated well water. However, doing so efficiently can be challenging.

SUMMARY

The embodiments herein disclose a system that may detect water flow in a well water system and responsively trigger a pump to inject a chlorinating substance into untreated water from the well. Further, the system may include a contact reservoir that allows the water and the chlorinating substance to combine. In this way, the chlorinating substance is drawn only when needed, but is given the opportunity to achieve time in solution with the untreated water. As a result, bacteria in untreated water may be dispatched, while other organic substances in the untreated water are given the opportunity to settle to the bottom of the contact reservoir. In some embodiments, a static mixer may be used to mix the chlorinating substance and the untreated water prior to entering the contact reservoir and/or while in the contact reservoir.

The system may further include a de-chlorinator that receives chlorinated water from the contact reservoir, and removes at least some of the chlorinating substance from the water. The de-chlorinator may provide the resulting treated water to a water distribution system in a residence or small business. The treated water may be suitable for drinking, cooking, washing, and/or other household uses. In some cases, the water flow may be detected by a flow valve that is coupled to the de-chlorinator.

Accordingly, in an example embodiment, a pump may be configured to inject a chlorinating substance into water when triggered. A contact reservoir may be configured to receive the water and the chlorinating substance. Further, a flow valve may be configured to sense a flow of the water, and configured to responsively trigger the pump to inject the chlorinating substance into the water.

In another example embodiment, a flow valve may sense a flow of water. In response to sensing the flow of water, a pump may be triggered, perhaps by the flow valve, to inject a chlorinating substance into the flow of water. A contact reservoir may receive the water and the chlorinating substance.

These as well as other aspects, advantages, and alternatives will become apparent to those of ordinary skill in the art by reading the following detailed description with reference where appropriate to the accompanying drawings. Further, it should be understood that the description provided in this summary section and elsewhere in this document is intended to illustrate the claimed subject matter by way of example and not by way of limitation.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** depicts a water treatment system, in accordance with an example embodiment.

FIG. **2** is a flow chart, in accordance with an example embodiment.

FIG. **3** depicts a flow head, in accordance with an example embodiment.

DETAILED DESCRIPTION

FIG. **1** depicts a system **100**, in accordance with an example embodiment. FIG. **1** includes a number of piping units, depicted in broad, solid, lines with arrows indicating the direction of water flow. Thus, generally speaking, water may flow from raw water supply **102** to treated water outflow **122**. The piping units may be pipe, or some other conduit capable of moving liquid from one point to another. For example, the piping units may be copper pipe, polyvinyl chloride (PVC) pipe, hoses, etc.

In FIG. **1**, untreated water is received from raw water supply **102**. Raw water supply **102** may be a well that provides ground water from an aquifer, or some other source of untreated water. For instance, raw water supply **102** may be a reservoir of untreated water, or a unit of piping that provides untreated water to system **100**.

Chlorinating substance reservoir **104** may be a tank, an accumulator, or some other medium that is configured to contain a chlorinating substance. The chlorinating substance may be, for instance, sodium hypochlorite, calcium hypochlorite, hydrogen peroxide, or some other type of bleach or oxidizing agent.

Chlorinating substance reservoir **104** may provide the chlorinating substance to pump **106**. Pump **106** may be any type of pump, such as a peristaltic pump, and may be configured to be either in an activated state or a deactivated state. When in the activated state, pump **106** may move the chlorinating substance from chlorinating substance reservoir **104** to injection point **108**. When in the deactivated state, pump **106** may prevent or impede the movement of the chlorinating substance from chlorinating substance reservoir **104** to injection point **108**. Pump **106** may be triggered to switch from the deactivated state to the activated state by any electrical mechanism, mechanical mechanism, optical mechanism, or via some other type of mechanism. Particularly, pump **106** may be triggered between the states by triggering line **118**.

Injection point **108** may be a junction between the piping unit from raw water supply **102** and the piping unit from pump **106**. Thus, when pump **106** is in the activated state, injection point may receive water from raw water supply **102** and the chlorinating substance from pump **106**. However, when pump **106** is in the deactivated state, injection point **108** might only receive water from raw water supply **102**. Regardless, injection point **108** may provide the received matter to static mixer **110**. (In the following, it is assumed that pump **106** is in the activated state, and thereby providing the chlorinating substance into other parts of system **100**, unless context indicates otherwise.)

Static mixer **110** may receive the water and the chlorinating substance, and mix the two together. To do so, static mixer **110** may create turbulence that combines the water and the chlorinating substance. In some embodiments, the

static mixer may be combined with, mounted on, or otherwise integrated with contact reservoir **114**. Static mixer **110** may provide the combined water and chlorinating substance (hereafter, "the solution") to flow head **112**.

Flow head **112** may receive the solution and provide it into contact reservoir **114**. In turn, contact reservoir **114** may allow for an extent of the solution to blend, thereby dispatching at least some of any bacteria that may be introduced by raw water supply **102**. The chlorinating substance in the solution may further serve to neutralize organic substances from raw water supply **102**. These neutralized organic substances may settle to the bottom and/or sides of contact reservoir **114**, where they may be conveniently removed. In some embodiments, flow head **112** may be referred to as a reverse flow head.

Contact reservoir **114** may be a tank, an accumulator, or some other medium that is configured to contain the solution. Further, contact reservoir **114** may include a spin-down function that acts as or similarly to that of a centrifuge. Thus, this function may serve to efficiently separate the neutralized organic substances from the solution.

In some embodiments not shown in FIG. **1**, static mixer **110** may be located inside of, or otherwise combined with, contact reservoir **114**. In these scenarios, flow head **112** may push untreated water and the chlorinating substance through static mixer **110** into contact reservoir **114**.

Regardless, flow head **112** may also receive the solution from contact reservoir **114**, and provide the received solution to flow valve **116**. In normal operation, the received solution will have had some, most, or all of its bacteria dispatched, and some, most, or all of the other organic substances removed.

Flow valve **116** may receive the solution from flow head **112** and provide the solution to de-chlorinator **120**. Additionally, flow valve **116** may be configured to be able to detect when water is flowing through system **100**. For instance, in normal residential use, raw water supply **102** provides pressurized water throughout system **100**, and to the residence's plumbing system via treated water outflow **122**. Therefore, when all faucets and other devices that draw water through system **100** are turned off, there may be no flow through system **100**. Consequently, in this case, there may also be no flow through flow valve **116**. However, when one of these faucets or other devices (e.g., a sink faucet, a shower faucet, a dishwasher, a washing machine, etc.) is turned on, then water will flow through system **100**, including flow valve **116**.

Flow valve **116** may be configured detect changes in water pressure or to detect water flow in some other way. Regardless, when flow valve **116** detects water flow, flow valve **116** may use triggering line **118** to trigger pump **106** to switch from the deactivated state to the activated state. Similarly, when flow valve **116** detects that the water flow has stopped, flow valve **116** may use triggering line **118** to trigger pump **106** to switch from the activated state to the deactivated state.

Triggering line **118** may include electrical wire, optical fiber, network cable, or some other medium that transports one or more types of signals between flow valve **116** and pump **106**. Alternatively, triggering line **118** may be mechanical, and may serve to mechanically switch pump **106** between states.

De-chlorinator **120** may receive the solution from flow valve **116** and separate the chlorinating substance from the water. For example, de-chlorinator **120** may be a charcoal filter, or some other mechanism. De-chlorinator **120** may provide this treated water to treated water outflow **112**.

Treated water outflow **122** may represent an indoor or outdoor plumbing system. For instance, as noted above, treated water outflow **122** may provide treated water to faucets and other devices in a residence, small business, etc.

It should be understood that system **100** may be rearranged in various ways. For instance, some components may be placed in different locations relative to other components, and/or may be connected in different arrangements. Further, the functionality of some components may be combined with that of other components.

As an example, flow valve **116** may be located between static mixer **110** and flow head **112**, between injection point **108** and static mixer **110**, after de-chlorinator **120**, or closer to raw water supply **102**. Alternatively, flow valve **116** may be coupled to de-chlorinator **120**. In some embodiments, static mixer **110** may be integrated with contact reservoir **114** and/or pump **106** may be integrated with contact reservoir **114**.

Alternatively, and as described further in the context of FIG. **3**, the top of flow head **112** may include or be coupled to injection point **108**, and the bottom of flow head **112** may be coupled to static mixer **110**.

FIG. **2** depicts a method according to an example embodiment. At block **200**, a flow of water may be sensed by a flow valve. At block **202**, in response to sensing the flow of water, the flow valve may trigger a pump to inject a chlorinating substance into the flow of water. At step **204**, a contact reservoir may receive the water and the chlorinating substance.

In some embodiments, the chlorinated flow of water may be received from the contact reservoir, and the chlorinated water may be de-chlorinated. De-chlorinating the chlorinated water may occur in a de-chlorinator, and the flow valve may be coupled to the de-chlorinator. Further, the water may be drawn from an untreated, or raw, water supply, and the de-chlorinator may provide treated water.

Alternatively or additionally, the pump may be configured to draw the chlorinating substance from a chlorinating substance reservoir. In some cases, a static mixer may be configured to combine the water and the injected chlorinating substance prior to, or in conjunction with, the water entering the contact reservoir. The static mixer may be integrated with the contact reservoir, and the pump may also be integrated with the contact reservoir.

The pump may be connected by a first unit of piping to the contact reservoir, and the contact reservoir may be connected by a second unit of piping to the flow valve. A flow head may be coupled to the contact reservoir. The flow head may include an input water port and an output water port. The input water port may be coupled to the first unit of piping, and the output water port may be coupled to the second unit of piping.

This system and process of injecting the solution into a water supply provides significantly safer and cleaner water than many other filter system technologies. Other technologies may focus on the elimination of bacteria from the filter material rather than from the water supply. As a result, other technologies may allow bacteria-riddled water to exist within the plumbing distribution system, where the bacteria have an opportunity to grow. The disclosed system and process kills bacteria in the water supply, while eliminating nuisance odors and oxidizing particles from the water. Then, excess amounts of the chlorinating substance are removed, which provides improved quality water. The process of killing bacteria is accurately achieved using a flow valve. The flow valve provides a precise dosing of the chlorinating substance to water while water is being used.

FIG. **3** depicts a side view of flow head **112** in accordance with an example embodiment. In some arrangements, the bottom section **300** of flow head **112** may be coupled with static mixer **110**. This coupling may be based on a slideable attachment, a screwable attachment, a welded attachment, or some other form of attachment. The top of flow head **112** may serve as injection point **108**, or may be coupled to injection point **108**.

Flow head **112** may receive untreated input water via right-hand port **302**, and a chlorinating substance via top port **304** (which may be integrated with or coupled to injection point **108**). This water and chlorinating substance may be pushed down and out of flow head **112** via right-hand, bottom port **306** into static mixer **110**.

Via the left-hand, bottom port **308**, flow head **112** may receive a solution from contact reservoir **114**. The solution may include a mixture of the water and the chlorinating substance. The solution may have passed through a diffuser in contact reservoir **114**. The solution may be pushed out of flow head **112** via output port **310**.

The above detailed description describes various features and functions of the disclosed systems, devices, and methods with reference to the accompanying figures. In the figures, similar symbols typically identify similar components, unless context indicates otherwise. The illustrative embodiments described in the detailed description, figures, and claims are not meant to be limiting. Other embodiments can be utilized, and other changes can be made, without departing from the scope of the subject matter presented herein. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the figures, can be arranged, substituted, combined, separated, and designed in a wide variety of different configurations, all of which are explicitly contemplated herein.

While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope being indicated by the following claims.

What is claimed is:

1. A system comprising:

a *first* unit of piping configured to connect to a source of untreated water**[**, wherein the untreated water is pressurized**]**;

a pump, in fluid communication with the *first* unit of piping, configured to inject a chlorinating substance into the *first* unit of piping when remotely triggered by a flow valve that is downstream from the pump, the flow valve electronically coupled to the pump by a triggering line, *wherein the pump is connected by a second unit of piping to the first unit of piping*;

a contact reservoir, in downstream fluid communication with the *first* unit of piping and the pump, configured to receive the untreated water and the chlorinating substance, and to combine the untreated water and chlorinating substance to produce chlorinated water therefrom, *wherein the first unit of piping connects to a top portion of the contact reservoir, wherein the pump is in fluid communication with the contact reservoir by way of the second unit of piping, wherein the contact reservoir is connected by a third unit of piping to the flow valve, and wherein the flow valve is in fluid communication with the contact reservoir by way of the third unit of piping;*

a flow head coupled to the contact reservoir, wherein the flow head comprises an input port and an output port, wherein the input port is coupled to the first unit of piping, and wherein the output port is coupled to the third unit of piping; and

the flow valve, in downstream fluid communication with the contact reservoir and electronically coupled to the pump, configured to:

receive a flow of water from the contact reservoir;

sense the flow through the flow valve; and

in response to sensing the flow, generate and transmit to the pump an electronic control signal by way of the triggering line that remotely triggers the pump to inject the chlorinating substance into the untreated water, which causes the flow of water through the flow valve to become chlorinated.

2. The system of claim **1**, further comprising:

a de-chlorinator configured to receive the chlorinated water from the contact reservoir, and configured to de-chlorinate the chlorinated water.

3. The system of claim **2**, wherein the flow valve is coupled to the de-chlorinator, and wherein the de-chlorinator is in fluid communication with the contact reservoir by way of the flow valve.

4. The system of claim **2**, wherein the untreated water is drawn from the source of untreated water when the chlorinated water is flowing, and wherein the de-chlorinator provides treated water.

5. The system of claim **1**, wherein the pump is in fluid communication with a chlorinating substance reservoir and wherein the pump is further configured to draw the chlorinating substance from the chlorinating substance reservoir when remotely triggered.

6. The system of claim **1**, further comprising:

a static mixer integrated with the contact reservoir, configured to combine the untreated water and the injected chlorinating substance.

7. The system of claim **[6]** *1*, wherein the pump is **[**also**]** integrated with the contact reservoir.

[8. The system of claim **1**, wherein the unit of piping is a first unit of piping, wherein the pump is connected by a second unit of piping to the first unit of piping, wherein the pump is in fluid communication with the contact reservoir by way of the second unit of piping, wherein the contact reservoir is connected by a third unit of piping to the flow valve, and wherein the flow valve is in fluid communication with the contact reservoir by way of the third unit of piping.**]**

[9. The system of claim **8**, further comprising:

a flow head coupled to the contact reservoir, wherein the flow head comprises an input port and an output port, wherein the input port is coupled to the first unit of piping, and wherein the output port is coupled to the third unit of piping.**]**

10. A method comprising:

sensing, by a flow valve, a flow of water, through the flow valve, from a contact reservoir, wherein the flow valve is in downstream fluid communication with the contact reservoir;

in response to sensing the flow of the water through the flow valve, generating and transmitting, by the flow valve, an electronic control signal to a pump, the signal remotely triggering the pump to inject, at a *first* unit of piping, a chlorinating substance into a flow of untreated water to the contact reservoir, wherein the flow valve is electronically coupled to the pump, wherein the flow of untreated water to the contact reservoir is by way of the *first* unit of piping in fluid communication with *a top portion of* the contact reservoir and the pump, **[**and**]** wherein the *first* unit of piping is configured to connect

to a [pressurized] source of the untreated water, *wherein the pump is connected by a second unit of piping to the first unit of piping, wherein the first unit of piping connects to a top portion of the contact reservoir, wherein the pump is in fluid communication with the contact reservoir by way of the second unit of piping, wherein the contact reservoir is connected by a third unit of piping to the flow valve, wherein the flow valve is in fluid communication with the contact reservoir by way of the third unit of piping, wherein a flow head is coupled to the contact reservoir, wherein the flow head comprises an input port and an output port, wherein the input port is coupled to the first unit of piping, and wherein the output port is coupled to the third unit of piping*;

receiving, by the contact reservoir, the flow of untreated water and the chlorinating substance; and

combining, by the contact reservoir, the untreated water and chlorinating substance to produce the chlorinated water therefrom, which causes the flow of water through the flow valve to become chlorinated.

11. The method of claim **10**, further comprising:

receiving, by a de-chlorinator, the flow of the chlorinated water from the contact reservoir; and

de-chlorinating, by the de-chlorinator, the chlorinated water.

12. The method of claim **11**, wherein the flow valve is coupled to the de-chlorinator, and wherein the de-chlorinator is in fluid communication with the contact reservoir by way of the flow valve.

13. The method of claim **10**, wherein the pump is in fluid communication with a chlorinating substance reservoir, and wherein the pump is configured to draw the chlorinating substance from the chlorinating substance reservoir when remotely triggered.

14. The method of claim **10**, wherein the contact reservoir includes a static mixer that is configured to combine the untreated water and the injected chlorinating sub stance.

[15. The method of claim **10**, wherein the unit of piping is a first unit of piping, wherein the pump is connected by a second unit of piping to the first unit of piping, wherein the pump is in fluid communication with the contact reservoir by way of the second unit of piping, wherein the contact reservoir is connected by a third unit of piping to the flow valve, and wherein the flow valve is in fluid communication with the contact reservoir by way of the third unit of piping.**]**

[16. The method of claim **15**, wherein a flow head is coupled to the contact reservoir, wherein the flow head comprises an input port and an output port, wherein the input port is coupled to the first unit of piping, and wherein the output port is coupled to the third unit of piping.**]**

17. A system comprising:

a pump connected to a proximate end of a first unit of piping and configured to inject a chlorinating substance into the first unit of piping when remotely triggered by a flow valve that is downstream from the pump, the flow valve electronically coupled to the pump by a triggering line;

a contact reservoir connected *at a top portion* to a distal end of the first unit of piping and configured to receive untreated water and the chlorinating substance by way of the first unit of piping, and to combine the untreated water and chlorinating substance to produce chlorinated water therefrom[, wherein the untreated water is pressurized];

a flow head coupled to the contact reservoir, wherein the flow head comprises an input port and an output port, wherein the input port is coupled to the first unit of piping, and wherein the output port is coupled to a second unit of piping;

a de-chlorinator connected to the contact reservoir by [a] *the* second unit of piping and configured to receive chlorinated water from the contact reservoir by way of the second unit of piping; and

the flow valve connected in-line with the second unit of piping between the contact reservoir and the de-chlorinator, wherein the flow valve is configured to:

receive a flow of water from the contact reservoir;

sense the flow of water out of the contact reservoir and into the de-chlorinator by way of the second unit of piping by sensing [a] *the* flow of the water through the flow valve; and

in response to sensing the flow of water through the flow valve, generate and transmit to the pump an electronic control signal that remotely triggers the pump to inject the chlorinating substance into the first unit of piping, wherein the generated electronic control signal is provided to the pump by way of the triggering line, which causes the flow of water through the flow valve to become chlorinated.

18. The system of claim **17**, wherein the flow valve is configured to sense the flow by detecting a change in pressure of the chlorinated water at the flow valve.

19. The system of claim **1**, wherein the flow valve is configured to sense the flow by detecting a change in pressure of the chlorinated water at the flow valve.

20. The system of claim 1, wherein the flow head also has a second output port coupled to the contact reservoir and in fluid communication with the first unit of piping by way of the input port and the second unit of piping by way of a second input port, and wherein the flow head also has a third input port coupled to the contact reservoir and in fluid communication with the third unit of piping by way of the output port.

21. The method of claim 10, wherein the flow head also has a second output port coupled to the contact reservoir and in fluid communication with the first unit of piping by way of the input port and the second unit of piping by way of a second input port, and wherein the flow head also has a third input port coupled to the contact reservoir and in fluid communication with the third unit of piping by way of the output port.

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