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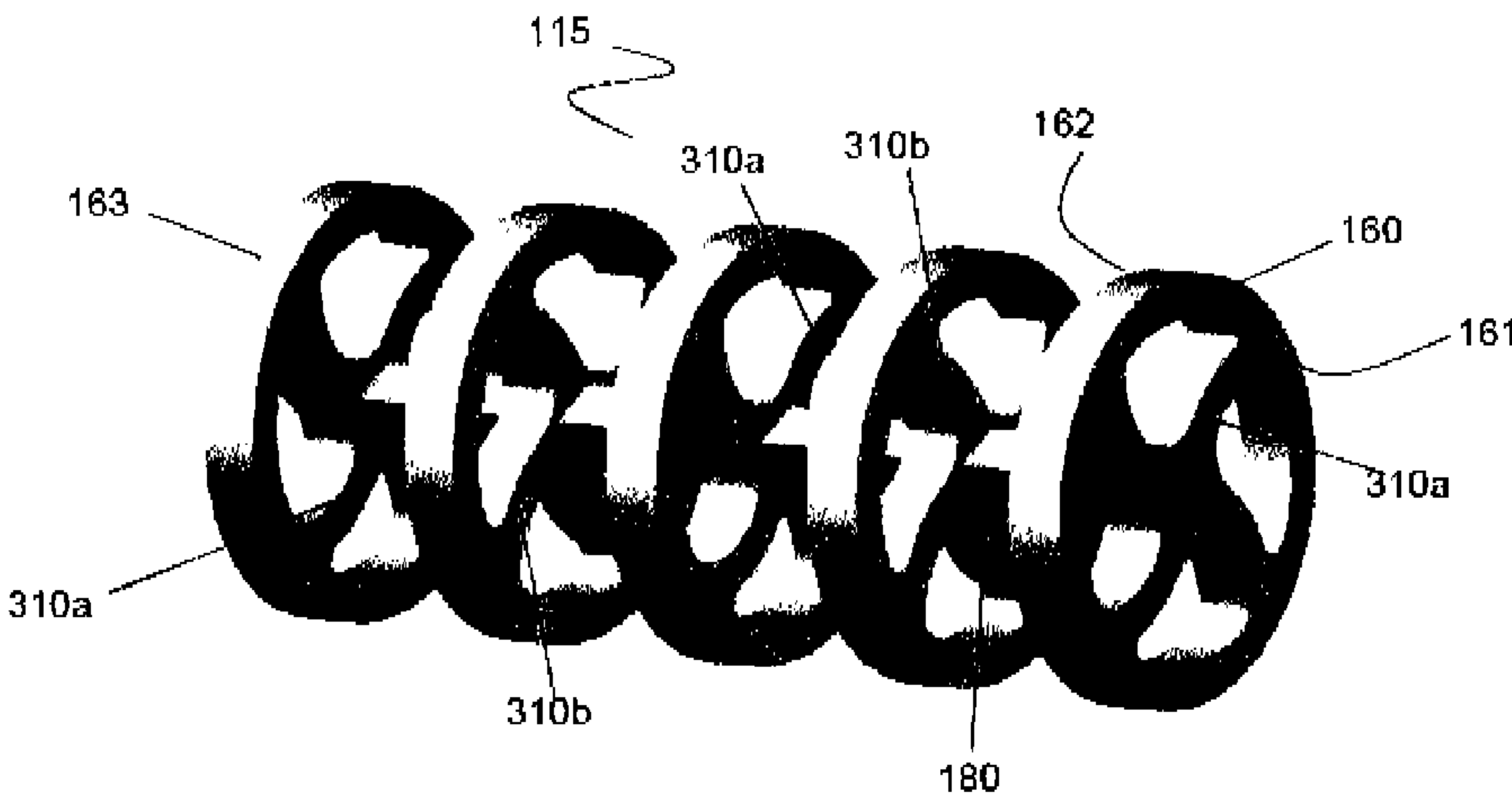
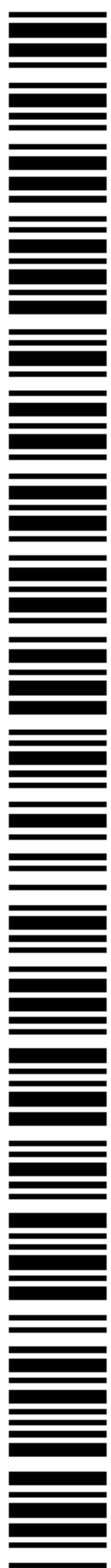


FIG. 2

(57) Abstract: A reversing flow apparatus comprising a chamber having a series of two or more sequential rings mounted on a shaft extending axially through the chamber, the rings being separated by a space, each ring comprising a circumference and one or more S-shaped members extending from a point in the circumference to another point in the circumference and across a center of the ring, the two or more sequential rings being mounted along the shaft in a twist arrangement such that at least one ring in the apparatus has its S-shaped member in a forward-facing position and at least one ring in the apparatus has its S-shaped member in a reverse-facing position.



TITLE OF THE INVENTION

REVERSING FLOW APPARATUS

FIELD OF THE INVENTION

The present disclosure relates to a reversing flow apparatus device for mixing
5 two or more solutions or mixing one or more solutions with one or more solutes and to systems and methods of producing mixed liquid solutions. The present disclosure relates also to processing emulsions with the reversing flow apparatus of the present disclosure.

BACKGROUND OF THE INVENTION

10 In the marketplace today the static mixers do not cut and redirect the flow of liquid solutions from laminar to turbulent flow. The liquid remains partially laminar therefore they are inefficient on creating a true new homogeneous mix. They also have dead spots within them that have little to no flow allow debris to collect.

Oil emulsions are broken using solvents, ultrasound and/or heat distillation
15 extraction. It would be advantageous to have a device requires no heat, ultrasound or solvents to break inter and intra molecular bonds and separate water from an oil emulsion.

SUMMARY OF THE INVENTION

Within the present disclosure, an apparatus for obtaining a mixture of liquids or
20 for obtaining a mixture of liquid(s) and solid(s) or a mixture of liquid(s) and gas(es), and systems and methods enabling the generation of said mixtures.

In one embodiment, the present disclosure provides for a reversing flow apparatus comprising a chamber having a series of two or more sequential rings

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mounted on a shaft extending axially through the chamber, the rings being separated by a space, each ring comprising a circumference and one or more S-shaped members extending from a point in the circumference to another point in the circumference and across a center of the ring, the two or more sequential rings being
5 mounted along the shaft in a twist arrangement such that at least one ring in the apparatus has its S-shaped member in a forward-facing position and at least one ring in the apparatus has its S-shaped member in a reverse-facing position.

In embodiments of the reversing flow apparatus of the present disclosure, the spiral apparatus includes a housing having an inflow portion for receiving one or more
10 untreated liquids, a treatment portion containing the chamber for treating the one or more untreated liquid, and an outflow portion for releasing the treated one or more liquids.

In embodiments of the reversing flow apparatus of the present disclosure, the one or more rings are made of a metal or a combination of metals.

15 In embodiments of the reversing flow apparatus of the present disclosure, the rings are made of stainless-steel containing molybdenum (Mo).

In embodiments of the reversing flow apparatus of the present disclosure, the rings are made of a metal alloy comprising about 0.5 wt. % or more molybdenum, about 1.0 wt. % or more molybdenum, about 1.5 wt. % or more molybdenum or from
20 about 3.0 wt. % to about 4.0 wt. % molybdenum.

In embodiments of the reversing flow apparatus of the present disclosure, the space is 15 cm or less.

In another embodiment, the present disclosure provides for a system for

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treating liquid solutions or emulsion, the system including a source of the liquid solution or emulsion and a reversing flow apparatus according an embodiment of the present disclosure, the inflow portion of the reversing flow apparatus being operatively connected to the source.

5 In embodiments, the system further comprises at least one of a filtration device, a UV sterilizer and a Z potential crystal generator, wherein the reversing flow apparatus, the source and the at least one of the filtration device, the UV sterilizer and the Z potential crystal generator are in liquid communication with one another.

10 In embodiments, the system further comprises a filtration device, a UV sterilizer and a Z potential crystal generator, wherein the reversing flow apparatus, the source, the filtration device, the UV sterilizer and the Z potential crystal generator are in liquid communication with one another.

 In embodiments, the system comprises multiple reversing flow apparatuses according to embodiments of the present disclosure.

15 In another embodiment, the present disclosure relates to a method producing a mixed solution of liquids or of one or more liquids with one or more solids, the method comprising passing the liquids to be mixed or the one or more liquids and the one or more solids to be mixed through the reversing flow apparatus according to an embodiment of the present disclosure, thereby producing the mixed solution.

20 In embodiments of the method of producing a mixed solution, the one or more liquids includes a gas.

 In embodiments of the method of producing a mixed solution, the one or more liquids are optionally passed, before or after the apparatus, through at least one

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filtration system.

In embodiments of the method of producing a mixed solution, the gas include nitrogen, oxygen, carbon dioxide, ozone, ethanol, methanol, hydrogen or combinations thereof.

5 In another embodiment, the present disclosure relates to a method of converting laminar flow to turbulent flow, the method comprising passing a liquid with laminar flow through the reversing flow apparatus according to an embodiment of the present disclosure.

In another embodiment, the present disclosure provides for a liquid or emulsion
10 processed with an apparatus of the present disclosure.

In another embodiment, the present disclosure relates to a method of breaking an oil-in-water emulsion, the method comprising passing the oil-in-water emulsion through a reversing flow apparatus of the present disclosure to obtain a processed material whereby a separate aqueous phase and oil phase is produced.

15 In one embodiment of the method of breaking an oil-in-water emulsion, the method further comprises pyrolyzing the oil-in-water emulsion to obtain a derivative, and wherein the method comprises passing the derivative through the reversing flow apparatus instead of the oil-in-water emulsion.

In another embodiment of the method of breaking the oil-in-water emulsion, the
20 oil-in-water emulsion is oily wastewater, a petroleum feedstock or a part of a secondary oil recovery system.

In another embodiment, the present disclosure relates to a method of lowering the viscosity of liquid solution or emulsion containing oil, the method comprising

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passing the liquid solution or emulsion containing oil through a reversing flow apparatus of the present disclosure to obtain a processed material having lower viscosity than the liquid solution or emulsion containing oil, thereby lowering the viscosity of the liquid solution or emulsion containing oil.

5 In another embodiment, the present disclosure relates to a method of lowering the boiling point of an original liquid source having kerogens, long-chain hydrocarbons or a mixture thereof, the method comprising passing the original liquid source through a reversing flow apparatus of the present disclosure to obtain a treated material, wherein the boiling point of the original liquid source is higher than the boiling point of
10 the treated liquid.

 In another embodiment, the present disclosure relates to a method of cracking a liquid comprising passing the liquid through a reversing flow apparatus of the present disclosure to obtain a cracked liquid.

 In embodiments of the method of cracking a liquid, the cracked liquid contains
15 contain more hydrocarbons having shorter carbon chain species relative to the liquid.

 In embodiments of the method of cracking a liquid, the method is devoid of solvents.

 In embodiments of the method of cracking a liquid, the liquid is an emulsion, a petroleum feedstock or a part of a secondary oil recovery system.

20 In another embodiment, the present disclosure relates to a method of treating Crohn's Disease, a neuropathy or reducing inflammation of knee joints in a subject, comprising administering to the subject a liquid processed through a reversing flow apparatus of the present disclosure.

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In another embodiment, the present disclosure relates to a use of liquid processed through a reversing flow apparatus of the present disclosure for the treatment of Crohn's Disease, a neuropathy or for reducing inflammation of joints.

5 **BRIEF DESCRIPTION OF THE DRAWINGS**

The following figures illustrate various aspects and preferred and alternative embodiments of the disclosure.

FIG. 1. Perspective view of an outside of a reverse flow apparatus according to one embodiment of the present disclosure.

10 **FIG. 2.** Perspective view of an inside of the treatment portion of a reverse flow apparatus according to one embodiment of the present disclosure.

FIG. 3. Perspective view of a ring element and a shaft of a reverse flow apparatus according to one embodiment of the present disclosure.

FIG. 4. Front view of a ring element of a reverse flow apparatus according to one
15 embodiment of the present disclosure.

FIG. 5A. Illustration of a set-up of 7 rings within a reverse flow apparatus according to one embodiment.

FIG. 5B. An embodiment of a set-up of 7 rings within the same reverse flow apparatus illustrated in FIG. 5A.

20 **FIG. 6.** Side view of a reverse flow apparatus according to one embodiment of the present disclosure.

FIG. 7. Graph illustrating a system containing a reverse flow apparatus in accordance to one embodiment of the present disclosure.

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FIG. 8. Photograph of centrifuge tubes containing emulsions processed with the reverse flow apparatus of the present disclosure. The emulsions were taken from different levels of a waste tank. The sample in the first tube from the left was taken from a cone at the bottom of a waste tank, while the fourth tube from the left is taken
5 from the top of the waste tank.

DESCRIPTION OF THE INVENTION

Definitions

Unless defined otherwise, all technical and scientific terms used herein have
10 the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. Also, unless indicated otherwise, except within the claims, the use of "or" includes "and" and vice versa. Non-limiting terms are not to be construed as limiting unless expressly stated or the context clearly indicates otherwise (for example "containing", "including", "having" and "comprising" typically indicate
15 "including without limitation"). Examples of limiting terms include "consisting of" and "consisting essentially of". Singular forms including in the claims such as "a", "an" and "the" include the plural reference unless expressly stated otherwise.

The term "fluid" includes liquids and/or gases.

The term "liquid" is used to include liquid solutions and/or emulsions (oil-in-
20 water, or water-in-oil emulsions) and/or liquids containing a single component.

The term "waste oil" used herein includes a fossil fuel waste oil, a waste edible oil, and a mixture thereof and to solution and emulsions containing waste oil.

The terms "treat," "treating," and "treatment" when used in relation to treating a

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disease, refer to a method of alleviating or abating the disease and/or its attendant symptoms.

In order to aid in the understanding and preparation of the within disclosure, the following illustrative, non-limiting, examples are provided.

5 *a. Overview*

The inventive static, reversing flow apparatus, system and method of the present disclosure effectively converts the flow of a liquid from laminar to a turbulent flow. The inventive apparatus, system and method of the present disclosure effectively produces mixtures of liquids, or liquids with solids or liquids with gases, and
10 without requiring the use of catalysts toxic or harmful additives or chemicals. In some embodiments, the term "mixture" is used to refer to the output of the apparatus of the present disclosure. The system and process may be implemented in a stationary, installed unit, or in a portable unit. The inventive system may also be retrofitted in existing liquid solution distribution systems, such as water distribution systems.
15 Although several specific embodiments are described, it will be apparent that the disclosure is not limited to the embodiments illustrated, and that additional embodiments may also be used. The liquid mixtures produced by the methods of the present disclosure are highly effective in a variety of application as it will be described herein below. The apparatus, systems and methods of the present disclosure do not
20 require external air or gas to produce the mixtures.

b. Reversing Flow Apparatus

With reference to the embodiments illustrated in FIGs. 1 to 6, the apparatus or device 100 of the present disclosure includes a housing or body 110 of the apparatus

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100 having an inflow portion 140 for receiving one or more liquids (the untreated liquids) with or without one or more solids or gases, an out-flow portion 150 for releasing the mixture (the treated liquid or liquids), and a treatment portion 115 between the inflow 140 and outflow 150 for treating the one or more liquids with or without one or more solids or for treating emulsions, such as oil-in-water or water-in-oil emulsions. For example, tap water can contain chloride and fluoride, wastes can contain water and oils, and so forth. The apparatus or device 100 of the present disclosure may also be referred to as a static apparatus because it has no moving parts.

10 In embodiments, the housing 110 takes a substantially tubular form. The inlet 140 and outflow 150 portions may include a threaded boss 120 and 130 at each end. The housing 110 and bosses 120 and 130 are preferably made of a substantially inert material. In embodiments examples of such inert material include polymers such as polyvinyl chloride (pvc).

15 The treatment portion 115 of the apparatus includes a series of ring elements 160 sequentially disposed along a longitudinal axis of the housing 110 and are interposed between the inflow and the outflow portions of the spiral apparatus 100 as shown in FIGs. 2, 5A-5B and 6. The number of rings in the spiral apparatus 100 will depend on the length of the housing 110. In embodiments, between 2 and 30 spaced apart rings 160 may be used. More than 30 spaced apart rings 160 may also be used
20 in longer housings. Each ring element 160 may take the form of a disc. In embodiments, the ring elements 160 are supported upon or mounted on a central rod or shaft 180. The ring element 160 may include opposite sides or walls 161, 162, and

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a peripheral or side wall along the circumference 163 of the ring element 160. One side 161 of the ring element 160 faces the Inflow portion and the opposite side 162 faces the outflow portion of the apparatus. The peripheral wall 163 extends between opposite shear walls 161, 162. The ring-like elements 160 may be held in spaced
5 relation to each other. The elements 160 may be separated from one another by a space 170. In embodiments, the space 170 that separates elements 160 may vary depending on the length and/or diameter of the housing 110. The bigger the diameter and/or longer the length, the longer the space 170 may be. For example, for a housing 110 having a diameter of 8 inches (about 20.32 cm) or less, the space 170 may be,
10 for example, between about 0.1 inches (about 0.25 cm) to about 12 inches (about 30.5 cm). In embodiments, the space is about 30 cm or less. In embodiments, the space is 15 cm or under 15 cm. A 60-inch (about 152.4 cm) diameter housing 110 may include spaces 170 that are over 8 inches (about 20.32 cm). FIGs. 5A-5B illustrate different set ups of the rings 160 within the same apparatus. 100.

15 In embodiments, each element 160 includes or receives at least one curved member 310, which can take an S-shape or serpentine-shape. The S-shaped member 310 extends from one point in the circumference 163 of element 160 to another point in the circumference 163, while crossing the center 169 of the ring element 160, thereby creating apertures 311 between S-shaped members 310 of one ring 160. In
20 embodiments, each S-shaped member 310 includes edges 167. In embodiments, the edges 167, which in embodiments have a scallop design, are sharp. Each element 160 can include at least one S-shaped member 310. In embodiments, the element 160 includes 2 co-planar S-shaped member 310. In embodiments, element 160 may

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also include more than 2 (i.e. 3, 4, 5 and so forth) S-shaped members. Preferably the disc-like elements including the S-shaped member 310 are made laser cut.

Each element 160 has a width "a". In embodiments, the width "a" of each disc-like element 160, is about one half or less of the distance "b" between two consecutive
5 ring elements 160. In embodiments, the center 169 of each element 160 includes an aperture 168 to receive the shaft 180. The ring element illustrated in Fig. 3 does not show an aperture to receive the shaft 180, however, this illustration is just an example, and an aperture should be present to receive the shaft.

The axially successive rings 160 are arranged along the rod 180. In one
10 embodiment, the elements 160 are arranged on rod 180 in a twister or spiral arrangement, such that at least one ring 160 has its S-shaped member 310 in a forward-facing position (310a) and at least one ring has its S-shaped member in a reverse-facing position (310b) (i.e. at least one ring element is inverted or flipped relative to another ring element in the apparatus). FIG. 2 illustrates an alternating
15 pattern in which a ring having the S-shaped member 310 in a forward-facing position (310a) is followed by ring having a ring with the S-shaped member in a reverse-facing position (310b). Having the members 310 arranged in a spiral arrangement serves to rotate the flow of the incoming liquid and to increase shear force by reversing the flow of the liquids, solutions or emulsions being treated, hence the apparatus 100 of the
20 present disclosure may be referred to as a reversing flow apparatus. However, it should be understood that the present disclosure also covers a situation in which two or more rings with the same direction of the S-shaped member 310 are next to one another as long as at least one ring in the housing 110 has the reverse direction S-

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shaped member 310.

In embodiments, each ring 160 is disposed substantially perpendicular to the flow of the untreated liquid or fluid within the housing 110, such as the elements 160 substantially reduces any direct liquid or fluid flow through the housing 110 and as a result the liquid or fluid flow passes through the apertures 311 in each of the rings 160. Due to the twist arrangement of the S-shaped members 310, the liquid/fluid flow between the rings 160 is turbulent and by virtue of the differing cross-sectional areas of the apertures 311 in each ring 160, the width of the rings 160, and the space 170 between the rings 160 the liquid/fluid is caused to accelerate and decelerate on its passage through the housing 110 to ensure a turbulent flow over the surfaces of the discs 160.

In embodiments, the rings 160 are manufactured from a single metal. Preferably the ring elements 160 are made of a corrosion resistant metal. Preferably, the ring elements are made from a nonmagnetic stainless steel 300 series, such as 316L, 317L or 904L or any stainless steel that contains molybdenum (Mo). Preferably the elements 160 are laser cut, machined cut or cut with a nonionic process such as water jet cutting in order to help maximize the properties of the metallurgy.

In embodiments, the elements 160 are made of a corrosion resistant metal or alloy containing from about 0.5 wt. % to about 4 wt. % molybdenum or more. In certain embodiments, it is envisioned that the elements may contain up to 5 wt. % molybdenum or up to 10 wt. % molybdenum. The elements 160 may be made from a stainless steel 300 series alloy such as 316L or 317L and also 904L. According to certain aspects of the present teaching, the 300 series alloy includes a minimum

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amount of molybdenum. In certain embodiments, the minimum amount of molybdenum is about 0.5 wt. % of the total weight of the alloy. In further embodiments, the minimum amount of molybdenum is greater than 3 wt. %, or about 4 wt. % of the total weight of the alloy. In further embodiments, the minimum amount of molybdenum is greater than 4 wt. % of the total weight of the alloy. In certain embodiments, the elements 160 are made from stainless steel 317L or 904L.

At least one of surface of the elements 160 may be machined or polished to remove forging scale from the casting process. In certain embodiments, the surfaces may be machined or polished to remove forging scale and in other embodiments, the surfaces are machined or polished to remove forging scale from the casting process. For example, in certain cases, the thickness of the elements is reduced from 5/8 inch to 1/4 inch (about 1.6 cm to about 0.6 cm) by machining and/or polishing thereby exposing the bare metal of the disc-like metal.

Molybdenum-Activated Liquid Producing System

Molybdenum is an essential trace mineral found in foods such as milk, cheese, cereal grains, legumes, nuts, leafy vegetables, and organ meats.

Molybdenum is most used for molybdenum deficiency. It is also used for cancer of the esophagus, other types of cancer, Wilson disease, and other conditions, but there is no good scientific evidence to support these uses.

The molybdenum-activated treated liquid of the present disclosure may condition surfaces by removing oils, enzymes, phenols, and other impurities within the liquid. The molybdenum-activated liquid improves the solvency of the liquid and produces a new type of lubricant which serves to deter biofilm attachment to surfaces.

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The combination of the effects above creates a sanitized surface/system.

c. System

The system of the present disclosure may be constructed in a variety of different embodiments and may be employed in connection with creating mixtures of liquids or
5 of liquid(s) and solid(s) and of processing liquids.

In embodiments, the inventive system includes at least one apparatus 100 of the present disclosure. The system may include one, two, three or more apparatuses 100 of the present disclosure. If more than one apparatus 100 are included, the apparatuses 100 may be disposed in series one next to another, or they may alternate
10 between other components of the system. In another embodiment, the system includes a source of liquid and a treatment module including an apparatus 100 of the present disclosure.

Polar and non-polar liquid, hydrophilic and lipophilic liquids, including solutions and emulsions, may be used as source liquid or fluid for the inventive system and
15 treated to create a mixture or to create a processed liquid/emulsion or liquid solution or emulsion. As such, the source may include oils, alcohols, water, solvents, fuels, surfactants, gels, carbohydrates, oil wastes, petroleum, a part of a secondary oil recovery, water wastes and so forth, or combinations of any one of oils, alcohols, water, solvents, fuels, surfactants, gels, carbohydrates, oil wastes, water wastes.

20 With reference to FIG. 7, the system 600, in embodiments, includes an optional source liquid pre-treatment system (not shown), an apparatus 100 of the present disclosure, optionally at least one filtration device 660, and an optional UV sterilizer 650. The apparatus 100, the filter 660 and the UV sterilizer 650 are in liquid

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communication with one another and are connected by way of a conduit system. The conduit system may include, for example, pipes, hoses, tubes, channels, and the like.

The source liquid or source fluid, such as water or tap water, solutions, emulsions, oils, alcohols, liquid wastes and so forth, is supplied from any suitable source (for example a faucet, a tank or container) and the liquid/fluid may be stored in a reservoir, or may be supplied continuously or intermittently from any source. The composition of source liquid may be tested and, if necessary, additional minerals and other constituents may be added. The source liquid may also be treated, prior or subsequent to holding in reservoir, in pre-treatment system to substantially remove unwanted contaminants that may interfere with the treatment process, such as debris, oil-containing constituents, and the like.

Source liquid may be added continuously or intermittently to the liquid reservoir. The liquid may flow through the apparatus 100 with enough force and pressure to initiate the mixing process. When necessary, a pump may be used to generate said force and pressure. In this embodiment, the liquid may be actively pumped towards apparatus 100 of the system 600 of the present disclosure. The liquid may also be released using a passive system, such as located in a plume to treat the water before a water turbine or propeller.

In another embodiment, the treated source liquid is next passed through at least one filtration device 660. In a preferred embodiment, filtration device 660 reduces or substantially eliminates bacteria, viruses, cysts, and the like. Any filtration devices known in the art may be used. Filtration device 660 may include, but not limited to, particle filters, charcoal filters, reverse osmosis filters, active carbon filters, ceramic

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carbon filters, distiller filters, ionized filters, ion exchange filters, ultraviolet filters, back
flush filters, magnetic filters, energetic filters, vortex filters, chemical oxidation filters,
chemical additive filters, Pi water filters, resin filters, membrane disc filters,
microfiltration membrane filters, cellulose nitrate membrane filters, screen filters, sieve
5 filters, or microporous filters, and combinations thereof. The treated and filtered liquid
may be stored or distributed for use and consumption.

Before reaching the at least one filtration device 660, the treated liquid can
optionally be passed through a zeta potential crystal generator (not shown). High zeta
potential crystal generators are known in the art and generally useful for prevention or
10 reduction of scaling. One known high zeta potential crystal generator is the Zeta Rod™
system. The Zeta Rod™ system increases zeta potential of crystals by electronically
dispersing bacteria and mineral colloids in liquid systems, eliminating the threat of
biofouling and scale and significantly reducing use of chemical additives. Colloids in
liquid systems become components of the capacitor and receive a strong boost to their
15 natural surface charge, altering double-layer conditions that govern particle
interactions. Mineral scale formation is prevented as the Zeta Rod™ system stabilizes
the dispersion of colloidal materials and suspended solids, preventing nucleation and
attachment of scale to wetted surfaces. Bacteria remain dispersed in the bulk fluid
rather than attaching to surfaces and cannot absorb nutrition or replicate to form slime
20 and create foul odors. Existing biofilm hydrates excessively, loses bonding strength
and disperses. Also, biological fouling, biocorrosion, and scale formation are arrested
by the Zeta Rod™ system.

Another known high zeta potential crystal generator is the Sterling Water Anti-

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Scale Appliance manufactured by Sterling Water Systems, LLC, a subsidiary of Porta
Via Water Company. As water passes through the Sterling Water Anti-Scale
Appliance, an electrical current is discharged into the water, which decreases the
water's surface tension and inhibits the formation of scale and hard water spots from
5 appearing. The inhibition of scale formation is due to the increase of zeta potential of
the treated water, which keeps mineral particles from encountering one another.

The treated liquid or treated fluid may be distributed to consumers or stored in
a storage container, such as a reservoir. In this embodiment, before distribution of the
stored treated liquid, the stored treated liquid may be passed through a second
10 apparatus of the present disclosure. The once or twice or trice and so forth treated
liquid is then distributed for use and consumption. It should be understood that the
system may include one, two or more than 2 apparatuses (i.e. 3, 4, 5, 6, 7, 8, 9, 10
and so forth number of apparatuses), as such the trice or more times treated liquid
may be then be distributed for consumption.

15 *c. Method of Producing a Turbulent Solution*

In one embodiment, the present disclosure relates to a method of mixing liquids
or one or more liquids with one or more solids to form a mixture. The method, in one
embodiment, may include passing one or more source liquids and/or one or more
solids through an apparatus of the present disclosure thereby producing a mixed
20 liquid.

In one step of the method, a source liquid may be passed through the apparatus
100. The source liquid may be passed at a suitable pressure such as about 3.2 bar.
The pressure may be about 4 bar and the maximum pressure may be approximately

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20 bar. The minimum pressure for the device of this disclosure to be effective is about 1 bar.

The critical material for the elements may be manufactured from a single metal, preferably corrosion resistant metal – for example stainless steel 300 series (for example 316L, 317L and so forth), or stainless steel 904L preferably stainless steels containing Mo.

There may be at least two elements in an apparatus of the present disclosure. In one embodiment, there may be a minimum of 2 elements in a small apparatus.

The applications include the homogenous mix of all polar and non-polar solutions. From water and listed chemicals for disinfection to gasoline, diesel fuel, bunker sea oil and also all lubrication and combustions oils.

The present disclosure relates also to a method of producing a liquid having a turbulent flow or of converting laminar flow to turbulent flow. The method includes passing a liquid, which may have a laminar flow through an apparatus of the present disclosure thereby producing a liquid with turbulent flow.

The present disclosure relates also to liquids created with an apparatus of the present disclosure and to liquids having turbulent flows produced with an apparatus of the present disclosure.

f. Applications

The inventive apparatus of the present disclosure and systems of the present disclosure are used to eliminate bacteria and microorganisms and to enhance the overall quality of liquid in several liquid systems. These liquid systems, described in more details below, may include, but are not limited to, water heaters, water coolers,

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potable water systems, food processing settings, molecule purification, household water filtration systems, sanitation settings, water softeners, ion exchangers, and medical, dental, and industrial water supply lines, Steam Assisted Gravity Drainage (SAGD), waste management and the like.

5 Water Heating Systems

In embodiments, the static apparatus of the present disclosure is integrated with various water heating systems. It has been unexpectedly discovered that water treated by a water heating system provided with the static apparatus of the present disclosure can eliminate bacteria and microorganisms in water, thereby improving the
10 heat transfer efficiency of water heating systems. The liquid heating systems benefiting from the inventive system may include, but are not limited to, continuous water heaters, gas-fueled hot water tank type heaters, electric hot water tank type heaters, re-circulating hot water systems for hot water tanks, continuous water heaters, district heating systems, in-floor heating systems, heat exchangers that
15 utilities hot water and/or steam, or in combination with heat transfer liquids, such as hot oils natural or synthetic.

Water Cooling Systems

In embodiments, the static apparatus of the present disclosure is integrated with various water-cooling systems. It has been unexpectedly discovered that water
20 treated by a water-cooling system provided with a static apparatus of the present disclosure, improves cooling transfer efficiency. The water cooling systems may include, but are not limited to, continuous water coolers, refrigerators, gas and electrically fired evaporators, cooling pads, wet film evaporators, evaporative cooling

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systems, ground source cooling systems, lake or river water cooling systems, heat exchange cooling systems for lakes, grounds, rivers, or ocean waters, district cooling systems, re-circulating cooling systems, in-floor cooling systems, cooling towers all types makes and models, vacuum applications for industrial cooling on boilers, sugar
5 plant cooking pans, paper mills, petroleum refining plants, mining plants, power plants including: coal, gas, oil, biomass, and nuclear.

The static apparatus of the present disclosure changes the physical properties of the liquid, lowers zeta potential, and lowers the viscosity of the water.

Potable Water Systems

10 In embodiments, the static apparatus of the present disclosure is integrated with various potable water systems. It has been discovered that water treated in system incorporating the static apparatus of the present disclosure, can enhance quality of water, as well as improving the taste of water. The potable water systems may include, but are not limited to, wells, springs, ponds, lakes, rivers, and the like.
15 The static apparatus of the present disclosure changes the physical properties of the liquid, lowers zeta potential, and lowers the viscosity of the water.

The static apparatus of the present disclosure eliminates bacteria and microorganisms in water, thereby preventing the formation of biofilm in various piping systems, as well as improving the taste of water.

20 Food Processing Industry

It has been unexpectedly discovered that water treated by the static apparatus of the present disclosure can act as a disinfectant with the addition a minimal amount of chlorine (under 5 ppm) for storage of fresh produce. Since the treated water has

- 21 -

been discovered to eliminate biofilm formation, food sanitation and production costs are lower and shelf life is lower. Further, since lower water surface tension increases solvency of the treated water, water treated in a system incorporating the static apparatus of the present disclosure, greatly increases the yield of oils from teas and
5 coffees.

Sanitation Applications

Static apparatuses of the present disclosure can be integrated with sanitation systems such as swimming pools, power washers, car washes, household washing machines, commercial laundry facilities, household and commercial dishwashing
10 facilities, and the like.

Water Treatment Applications

In embodiments, the static apparatus of the present disclosure can be integrated with water treatment applications such as water softeners, ion exchangers, all membrane and filter systems that utilize chlorine, chlorine dioxide, hydrogen
15 peroxide, ozone, and the like.

Medical Industry

The static apparatus of the present disclosure can be integrated with medical systems and the systems are useful in increasing the turbulence of body fluids in humans and animals, and are useful also in applications related generally to skin
20 treatments through bathing, spas, and daily usage, improved calcium uptake, improved teeth and conditions, as well as medical, dental, and industrial water lines.

Processed water on one pass through an apparatus of the present disclosure without filtration has exhibited the following results when used by human subjects:

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Reduction in Crohn's Disease Symptoms by more than 50%, reduction in inflammation of knee joints and muscle joints by more than 50%. Surprisingly a reduction of more than 50% in severe neuropathy and improvement in psoriasis has been seen within 14 days of a subject drinking the water processed with an apparatus of the present disclosure. This indicates that there is a change in the crystallization of the water with minerals and long term it also reduces the deposition of arterial plaque. Softer moisture skin and a reduction of eczema and psoriasis has been witnessed 100% of the time by all who have showered and bathed in the water.

Furthermore, there is a documented trail that scarring of tissue is reduced and healing of skin is accelerated.

Household Water Filtration Systems

The static apparatus of the present disclosure can be used in the common household and be integrated with any filtration device known in the art as described above.

Devices Incorporating the static apparatus of the present disclosure, Systems and Methods of the Present Disclosure

Methods, generators and systems of the present disclosure can be used in conjunction with or retrofitted in existing devices and liquid distribution systems, such as water heating systems including, but are not limited to, continuous water heaters, gas-fueled hot water tank type heaters, electric hot water tank type heaters, re-circulating hot water systems for hot water tanks, continuous water heaters, district heating systems, in-floor heating systems, heat exchangers that utilities hot water and/or steam, or in combination with heat transfer liquids, such as hot oils natural or

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synthetic; water cooling systems including, but are not limited to, continuous water coolers, refrigerators, gas and electrically fired evaporators, cooling pads, wet film evaporators, evaporative cooling systems, ground source cooling systems, lake or river water cooling systems, heat exchange cooling systems for lakes, grounds, rivers, or ocean waters, district cooling systems, re-circulating cooling systems, in-floor cooling systems, cooling towers all types makes and models, vacuum applications for industrial cooling on boilers, sugar plant cooking pans, paper mills, petroleum refining plants, mining plants, power plants including: coal, gas, oil, biomass, and nuclear; potable water systems including, but are not limited to, wells, springs, ponds, lakes, rivers, and the like; food processing applications such as coffee and tea; sanitation systems including, but are not limited to, swimming pools, power washers, car washes, household washing machines, commercial laundry facilities, household dishwashers and commercial dishwashing facilities, and the like; water softeners; ion exchangers; all membrane and filter systems that utilize chlorine, chlorine dioxide, hydrogen peroxide, ozone, and the like; skin treatment systems through bathing, spas, and daily usage, improved calcium uptake, improved teeth and conditions; medical, dental, and industrial water lines; and any household water filtration systems.

Farms:

Animals, including dairy animals and poultry, that drink water treated with the static apparatus of the present disclosure may produce feces with less ammonia (ammonia was converted to organic nitrogen). Manure was changed stabilized and not producing methane or hydrogen sulfide.

Water based paint:

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Paint manufactured with the static apparatus of the present disclosure display: faster drying times and had less volatile organic compounds, paint consumption due to better adhesion was reduced by 40 percent, paint demonstrated mold resistance, paint was brighter and dried smoother

5 Beverage plants:

Liquids treated with systems containing the static apparatus of the present disclosure of may replace the need for CIP (clean in place) for over 1 year in a beverage facility bottle cooling tunnels, spraying treated water on conveyors also removed biofilm in a matter of days.

10 Poultry processing plants:

Using processed water with systems having the static apparatus of the present disclosure in scalders allowed for the reduction of temperature by 3 to 5 degrees Fahrenheit. Birds came out noticeable cleaner.

Using water processed in accordance with the present disclosure in poultry
15 chiller allowed birds to reach a 3-degree colder temperature with the same amount of refrigeration.

Chemicals

Chemicals processed through an apparatus of the present disclosure are more effective in measurable oxidation-reduction potential (ORP), Persistence, and in
20 measurable coagulation and disinfection.

Removal of heavy metals from protein powders:

Water processed with the apparatus of the present disclosure separates on contact heavy metals from proteins such as iron, lead, manganese, arsenic and

- 25 -

others. The reaction is substantially instantaneous and can be used in either a clarifier or a centrifugal separator.

The resulting dried protein material when added to treated water methodology can be used for all dried beverage materials including, teas, coffees, fruit concentrates, medicines, pharmaceuticals, starches, sugars, chocolate mixes, all flavour mixes and all food products including ground meats.

As such, another embodiment of the present disclosure is a method of removing/separating heavy metals from a protein powder, the method comprising contacting the protein powder with a liquid like water processed with a system of the present disclosure, thereby removing/separating the heavy metals from the protein powder.

The method of removing/separating heavy metals from powder protein may also include presoaking ungrounded protein-containing material in a suitable liquid treated with a system containing an apparatus of the present disclosure, like water, drying the presoaked material, grinding the protein-containing material, for example grinding the material to between a 70 and 100 mesh size, and re-washing the grounded protein-containing material in the treated liquid thereby separating the heavy metals from the grounded, protein-containing material. The method may also include spray drying the wet protein-containing material, regrinding the dried protein-containing material and re-washing the dried protein-containing material to separate finer heavy metals, spray drying the protein-containing material or using an alternative drying method. The protein obtained through the method hereby described will be substantially free of heavy metals. The heavy metals thereby separated may then be

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sold or used in other applications.

Ultra- disinfection:

The treated water of the present disclosure may prevent the formation and/or dissolve biofilm with or without the addition of chemicals.

5 Air disinfection and filtration:

Men's urinal can be flushed or washed with water processed with an apparatus of the present disclosure. Ammonia of urine in restrooms may be converted on contact with the processed water in men's urinals to organic nitrogen therefore eliminating the ammonia vapors.

10 In a building in which the running water is treated with an apparatus of the present disclosure, dust may be reduced including biofilm on all surfaces such as glass, wood, tile, metals. Static Electricity is noticeably greatly reduced indoors in dusty and clean environments. Pet hair is observed by all to not be able to float in the air easily and dust always coagulated on all air filters in a uniform pattern.

15 Alcohol manufacture:

Fermentation time of wines may be reduced by more than 50% with the use of water treated with the static apparatus of the present disclosure.

Less energy may be needed for production of ethanol and/or methanol. Production of ethanol may need up to about 17 percent less energy.

20 When treated water of the present disclosure is used in the dilution of alcohol it changes the chemical characteristics of the alcohol producing a finer smoother taste.

The treated liquid solution producing system of the present disclosure may be used to manufacture alcoholic beverages, including sake, vodka, scotch, rum, rye, gin,

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brandy, cognac, tequila, mezcal, wine, beers and so forth.

Ice making:

A Vogt™ commercial ice maker made harder ice in a shorter time period. The machine made about 17 percent more ice.

5 Water heating:

The water heats and dries with less energy at evaporates from surfaces up to about 30 percent faster.

Power plant applications:

10 In steam or thermal power plants improved efficiencies may be expected due to Improved heat transfer, biofouling prevention of membranes and greater lubricity of the water treated with the apparatus of the present disclosure.

Condensing of steam turbines using cooling water can be closed looped using cooling towers and also will be greatly increased for efficiency.

Marine transportation:

15 Treated liquids of the present disclosure may reduce friction on a ship's hull with our water.

Cleaning devices:

The static apparatus of the present disclosure may be used in: power washers, car washes, laundry, carpet cleaning, steam cleaning, hot water cleaning.

20 Other applications include: injection of hydrogen gas into vegetable oils to reduce catalysis and to improve oil quality, use in bioreactors for methane production, elimination of ferric chloride in waste water due to aerobic condition of the waste water and a neutral pH of the waste water (currently this has been demonstrated in manure

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pits and is being validated in a food manufacturing facility. It has also been validated in the cooling tunnels with re-use water).

The mixtures of the present disclosure may be used in the following goods:

1) In water and water-related goods, including: bottled water, carbonated water,
5 cologne water, drinking water, effervescent water, flat water, flavoured water, glacial water, iceberg water, mineral water, sparkling water, toilet water, vitamin enhanced water, water beds, water for spas, baths, whirlpools and swimming pools, water for the use in livestock and pet feeding, water for use in irrigation of vegetables, plants, trees, crops, water for use in the manufacture of solvents, water for use in the manufacture
10 of paints, water for use in the purification of proteins, and water for use in the manufacture of detergents.

2) In dairy products including milk, milk products, evaporated milk, protein-enriched milk, cocoa beverages with milk, milk beverages containing fruits, cheese, sour cream, powdered milk, butter, cream, cheese spreads, soy-based cheese
15 substitute, dairy cream, whipping cream, ice-cream, ice cream makers, soy-based ice-cream substitute.

3) In alcohol beverages, including alcoholic cocktails, alcoholic coffee-based beverages, alcoholic coolers, alcoholic fruit drinks, alcoholic lemonade, alcoholic malt-based coolers, beers, alcoholic tea-based beverages, sake, vodka, scotch, rum, rye,
20 gin, brandy, cognac, tequila, mezcal, wine.

4) In ice related products including ice, ice cube makers, ice packs, industrial ice.

5) In meats, including beef, pork, fish, poultry, frozen meat, smoked meat,

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canned meat.

6) In dental industry, including treated toothpaste, mouthwash, dental floss, dental gel, dental rinses, and denture cleaning preparations.

7) In the pharmaceutical/cosmetic industry, including eye washes, water for use
5 in manufacturing cosmetics, water for use in manufacturing pharmaceuticals and medicinal products.

8) Steam, including steam generators, water for use in manufacturing steam, steam for use in extraction of oils from oil deposits, steam for use in Steam-assisted gravity drainage services.

10 9) Cleaning, including all-purpose cleaning preparations, carpet cleaning preparations, water for steam sanitation and steam cleaning, water for sanitation, water-based paints.

10) Oils, including anti-rust oil, auxiliary fluids for use with abrasives for the oil well industry, baby oil, bath oil, vegetable, mineral and animal oils, catalysts for use in
15 oil processing, chemical additives for oil well drilling fluid, cooking oil, drilling fluids for oil and gas wells, drilling mud for oil well drilling, edible oil, fuel oil, heating oil, high pressure water jetting system for the gas and oil industry, industrial oil, insulating oil for transformers, motor oil, motor oil additives, oil for use in the manufacture of candles, oil for use in the manufacture of cosmetics, oil for use in the manufacture of
20 paints, rubbing oil for wood, petroleum jelly, diesel fuel, aviation fuel, fuel additives, and fuel for domestic heating.

11) Proteins, protein for use as a food additive, protein for use as a food filler, nutritional supplements, water-processed animal and plant protein.

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The mixtures of the present disclosure may preserve flavoring and essences for food. The encapsulation of flavors, fragrances and the like may serve to enhance or alter appearance of food and beverages. Used as a preservative, restore natural nutritional values through the addition of vitamins, minerals and proteins.

5 The mixtures of the present disclosure may be used to clean and eliminate pollutants found in edible birds' nests, for example removal of feathers, fungi, nitrates, nitrites and so forth. The mixtures of the present disclosure may make birds' nests more for manual removal of such contaminants while maintaining the original appearances of the nest and retain its nutrition and essences.

10 The apparatuses of the present disclosure may also be used in process, including waste water treatment, water and sewer management, water treatment, food sanitation, carpet cleaning, cleaning of buildings, diaper cleaning, dry cleaning, fur cleaning, jewelry cleaning, leather cleaning, rug cleaning, window cleaning, pool cleaning, automobile (car, trucks, buses, bikes, motorbikes and so forth) washes, train
15 washes, ship washes, airplane washes, oil and gas well treatment, oil refining, fuel treatment, and steam-assisted gravity drainage.

The static spiral apparatus of the present disclosure provides an elegant novel solution to the problems mentioned in the Background by severely shearing the water and through the inversion of the sequential mixing discs creates a tremendous
20 turbulence preventing dead zones and debris from collecting within the mixing device itself.

13) Waste Management

In embodiments, the apparatus of the present disclosure is used to facilitate the

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separation of waste oils from sludge, and to collect waste oil and lubricant materials for recycling. A variety of oil-in-water emulsions can be treated with the apparatus of the present disclosure to recover oil. Hydrocarbons and/or edible oils can be processed with the apparatus of the present disclosure. Oils in the emulsion and oil
5 contaminated materials, include industrial lubricants, contaminated oils and waters, automotive / motor oils, lubricating oils and hydraulic oils. In embodiments, the recovered oils meet government and environmental regulated discharge approval.

A pump may be used to deliver oil-in-water emulsion obtained from a waste tank to an apparatus of the present disclosure in singular or in series of two, three,
10 four, five, six, seven, eight, nine, ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen to thirty and they can be also in parallel. The processed oil becomes separated from the water and can be recycled or returned back to a waste tank. In aspects the processed oil is a water-in-oil emulsion.

The purpose of this configuration is to allow for processing without re-circulation
15 in a continuous stream to keep the fluid in suspension until it reaches an end destination or be placed in the tank again where it will self-separate according to specific gravity: silt on the bottom, heavy oils, water, light oils on the very top.

No other device may be necessary or can perform the function of the separation which is due to the intense shear of the fluid by the Spiral Static Mixer.

20 Prior to pumping the oil-in-water emulsion, the emulsion may be heated to aid in the processing.

In embodiments, chemicals may be used to assist in the separation if necessary, depending on the oil water emulsion.

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All oil contains some water, so this is for all oil streams including refined oils, fuels, alcohols, ethanol, diesel and Bunker C type fuels.

The process can also be used to desulfurization of oils and fuels.

14) Viscosity Reduction, Breaking Oil-in-Water Emulsions and Oil Cracking

5 There are many ways one can reduce the viscosity of oils, including heavy oils such as bitumen in oil sands and oil contaminated solutions. This may be necessary for enabling transportation of bitumen from the well to a refinery or the recycling of the oil in the oil contaminated solutions.

10 The apparatus of the present disclosure is used, in embodiments, to reduce the viscosity of oil containing liquid materials, such as oil-in-water emulsions, by breaking intermolecular bonding between the oil in the liquid material and the other components in the liquid material. By breaking the bonds between the oil and other substances in the material, the liquid material becomes less viscous. In addition, due to cracking that may be experienced by the oils in the material, smaller hydrocarbon chains have
15 a lower viscosity.

 In embodiments, the present disclosure relates to methods of breaking an oil-in-water emulsion. The method may be applied to any oil-in-water emulsions of any general type. An example of oil-in-water emulsions include oil-containing wastewater. The oil-in-water emulsion may also be part of a secondary oil recovery system. For
20 example, oily wastewater from a plant can be broken using the method of the present disclosure to remove the oil in the oily waste from the water. In order to break the emulsion and remove the oil from the water, the emulsion stored in a tank is delivered to an apparatus of this disclosure, for example with the use of a pump, such as a

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positive displacement pump. If the emulsion is too dense, then prior to delivery to the apparatus, a less dense emulsion derivative may be obtained. To obtain the oil-in-water emulsion derivative, the original oil-in-water emulsion may first be pyrolyzed (in an oxygen deprived environment). The fumes that emanate are quenched with water
5 resulting in an emulsification fluid. The emulsification fluid, also referred to as the emulsion derivative, is then delivered by a pump, such as a positive displacement pump, to an apparatus of the present disclosure. The emulsion or the emulsion derivative, as the case may be, is then passed through, or treated with, an apparatus of the present disclosure to obtain a processed material, whereby a separate aqueous
10 phase and an oil containing phase is produced (see FIG. 8). All or substantially all of the oil in the processed material separates from the water and the oil can be removed from the water, permitting the clean water to be discarded and the oil to be recycled or discarded in an environmentally friendly manner for oil materials. The processed material includes a separate and distinct oil phase and an aqueous phase. The oil
15 phase in the processed material is comprised of pure oil (i.e. about 100% oil) or is substantially comprised of pure oil in the form of a water-in-oil emulsion.

As such, in one embodiment, the present disclosure is a method of breaking an oil-in-water emulsion comprising passing the oil-in-water emulsion, or a derivative of the oil-in-water emulsion, through an apparatus of the present disclosure to obtain a
20 processed material whereby a separate and distinct aqueous phase and oil phase is produced. In embodiments, the method may further include the step of separating the oil phase of the processed material from the water phase.

Cracking, or refining, is the overall reduction of lengths of hydrocarbon chains,

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a process that breaks or cracks the heavier, higher boiling-point petroleum fractions into more valuable products such as gasoline, fuel oil, and gas oils. In embodiments, the apparatus of the present disclosure is used to crack hydrocarbons contained in a source. Processed oil solutions or emulsions contain more hydrocarbons having shorter carbon chain species relative to untreated control oil solutions or emulsions before the process started, as well as losses of hydrocarbons having longer carbon chains relative to the control sample. The boiling point of the original, untreated liquid source is higher than the boiling point of the treated liquid thereby demonstrating the cracking of the untreated liquid source.

Most static mixer designs are meant for mixing two or more fluids either through division or homogenization. The device of this disclosure is designed primarily as a molecular shearing device. Its design gives it enough shearing strength to break both inter (weak molecular bonds) and intra (strong molecular bonds). The apparatus of the present disclosure has clearly demonstrated the ability to break both inter and intra molecular bonds with a water oil emulsion. Independent of the emulsion constituents there is always both an inter and intra molecular bond separation. This separation results in the fluid consistently separating into its separate components by either specific gravity or into a filterable suspension. Furthermore, fluids can be processed to a desired separation by Specific Gravity Fluid Tank Separation or Gas Chromatography Analysis given enough processing time and pressure. For instance, a C-40 Oil can be reduced to smaller chains by the length of time and fluid pressure force of processing. This results in a change in viscosity and chemical composition of the mixture. This is far beyond what a traditional static mixer was ever imagined to be

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able to achieve.

The apparatus of the present disclosure changes the existing paradigm of breaking oil emulsions either using solvents and/or heat distillation extraction. This device requires no heat, ultrasound or solvents to break inter and intra molecular
5 bonds and separate water from an oil emulsion. The apparatus of the present disclosure is an ultra-low energy method of separating oil from water so that the carbon footprint in traditional petroleum industry can be dramatically reduced. It can be referred to as Low Energy Refining. In separating emulsions temperatures have ranged from 15 Degrees Celsius to 21 Degrees Celsius which were the ambient
10 conditions. Less energy is needed to pump the oil water emulsion. In our tests we demonstrated greater than a 50% reduction in pumping energy due to the decreased viscosity of the fluid.

Also, in the treatment of water that is contaminated with Hydrocarbons or Fluorocarbons or also more difficult compounds such as Perfluorooctyl
15 Sulfonate (PFOS). Without this distinct water oil emulsion separation, it is extremely difficult to filter out or mechanically separate these complex chemicals.

EXAMPLES

20 The examples are described for the purposes of illustration and are not intended to limit the scope of the disclosure.

Example 1

In experiments to date the new static apparatus was able to dissolve biofilms in

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plumbing systems by converting the flow from laminar to a turbulent flow. The water remains turbulent even after filtration (even after 9 filters) and flows faster in water system testing to date. In filtration there is a complete elimination of biofouling and a total utilization of the filter media because the gases in the system have been
5 converted into smaller gas structures that promote flow, speed of flow and increase pressure.

Example 2

Bottled water and bottled water processed through the apparatus of the present disclosure were boiled in a Breville® electric pot. After boiling the water was
10 discarded. Mineral deposit can be seen at the bottom of the pot for unprocessed bottled water. No mineral deposits are seen at the bottom of the pot for processed bottled water.

The apparatus of the present disclosure prevents the formation of crystals by lowering the Z potential, thereby eliminating crystallization.

Example 3

The petroleum refining industries generate considerable amounts of sludge and tank bottoms as waste. Crude oil storage tanks are an essential part of all major operations in the petroleum industry. Petroleum refinery receives crude oil containing emulsified water and solids. As the crude oil storage tanks are repeatedly filled and
20 emptied, the water and solids settle towards the bottom as sludge. For tanks that have been in service for several years, the sludge accumulation becomes several feet deep, results in a loss of ullage in refinery crude storage tanks. The refinery sludge waste is categorized as hazardous waste.

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Due to the solids content of crude oil, those tanks loose storage capacity over the years, as they slowly fill up with settled solids from the crude. Those tanks therefore require regular cleaning in order to maintain their storage capacity. Tanks are emptied of crude oil and the residual sediment and residues adhering to the tank walls are then
5 removed with high pressure water jets. The resulting product is characterized by containing a considerable amount of water content (in the order of 30-60% by volume), an oil phase with rather high viscosity, typically the presence of an emulsified phase, and high solids content (in the order of 10-40% by volume).

The apparatus of the present disclosure can be used to maximize the waste oil
10 recovery from sludge and tank bottoms and to minimize the volume of the hazardous waste.

Methodology

The bottom tank sludge is pyrolyzed (in an oxygen deprived environment). The fumes that emanate are quenched with water resulting in an emulsification fluid.

15 The emulsification fluid (about 20,000 Gallons) is delivered by a Positive Displacement Pump to a 1.5 inch (about 3.81 cm) inlet and outlet fitting size and 2-inch (about 5.08 cm) diameter of the body apparatus of the present disclosure (25-30 GPM). The processed oil is then returned to emulsification tank.

20 The processing:

Processing involves three things: (1) flow/Pressure, (2) viscosity modification, and (3) separation of the fluids as a result of inter and intra molecular bonding shifts into specific gravity weight fluids as follow:

Top Layer: Light oils and carbon chains

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(2) Second Layer: Water

(3) Third Layer: Heavier Oil

(4) Fourth Layer: Heaviest Oils

(5) Fifth Layer: Inorganics (Ash, Silt and others)

5

5 grams of the sludge failed to burn under a hood. On the other hand, 5 grams of processed oil was burnt under a fume hood for about 2 minutes. After burning, 3.4 grams remained, thereby showing that at least 1.6 grams of the processed oil included volatiles.

10

The photographs of FIG. 8 illustrate oil separation from an aqueous phase. As it can be seen, the apparatus of the present disclosure separates oil from water even from samples taken from the cone at the bottom tank, which is the most viscous sludge of the tank.

15

In addition, the viscosity of the oil was reduced Independent of the carbon length being C40 or C20. The pump flow more than doubled at temperatures of 15 to 21 degrees Celsius.

Example 4

20

A subject that suffers of neuropathy and psoriasis had an apparatus of the present disclosure installed in his house so that all running water in the house is treated by the apparatus. The subject drank and showered with water treated with an apparatus of the present disclosure for two weeks. After two weeks the subject neuropathy and psoriasis improved. The subject now can feel his toes (which were numbed) and have control of his toes. From showering in the water, the psoriasis decreased by more than 60% after two weeks of treatment.

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The above disclosure generally describes the present disclosure. Changes in form and substitution of equivalents are contemplated as circumstances may suggest or render expedient. Although specific terms have been employed herein, such terms
5 are intended in a descriptive sense and not for purposes of limitation. Other variations and modifications of the disclosure are possible. As such modifications or variations are believed to be within the sphere and scope of the disclosure as defined by the claims appended hereto.

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CLAIMS

What is claimed is:

1. A reversing flow apparatus comprising a chamber having a series of two or
5 more sequential rings mounted on a shaft extending axially through the chamber, the
rings being separated by a space, each ring comprising a circumference and one or
more S-shaped members extending from a point in the circumference to another point
in the circumference and across a center of the ring, the two or more sequential rings
being mounted along the shaft in a twist arrangement such that at least one ring in the
10 apparatus has its S-shaped member in a forward-facing position and at least one ring
in the apparatus has its S-shaped member in a reverse-facing position.

2. The reversing flow apparatus of claim 1, wherein the spiral apparatus
includes a housing having an inflow portion for receiving one or more untreated liquids,
a treatment portion containing the chamber for treating the one or more untreated
15 liquid, and an outflow portion for releasing the treated one or more liquids.

3. The reversing flow apparatus according to any of claims 1 and 2, wherein the
one or more rings are made of a metal or a combination of metals.

4. The reversing flow apparatus of claim 3, wherein the rings are made of
stainless-steel containing molybdenum (Mo).

20 5. The reversing flow apparatus according to any one of claims 1-4, wherein
the rings are made of a metal alloy comprising about 0.5 wt. % or more molybdenum,
about 1.0 wt. % or more molybdenum, about 1.5 wt. % or more molybdenum or from
about 3.0 wt. % to about 4.0 wt. % molybdenum.

6. A system for treating liquid solutions or emulsion, the system including a

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source of the liquid solution or emulsion and a reversing flow apparatus according to any of claims 1 to 5, the inflow portion of the reversing flow apparatus being operatively connected to the source.

7. The system of claim 6, wherein the system further comprises at least one of
5 a filtration device, a UV sterilizer and a Z potential crystal generator, wherein the reversing flow apparatus, the source and the at least one of the filtration device, the UV sterilizer and the Z potential crystal generator are in liquid communication with one another.

8. The system of claim 6, wherein the system further comprises a filtration
10 device, a UV sterilizer and a Z potential crystal generator, wherein the reversing flow apparatus, the source, the filtration device, the UV sterilizer and the Z potential crystal generator are in liquid communication with one another.

9. The system according to any one of claims 6-8, wherein the system comprises multiple reversing flow apparatuses according to any one of claims 1 to 5.

15 10. A method producing a mixed solution of liquids or of one or more liquids with one or more solids, the method comprising passing the liquids to be mixed or the one or more liquids and the one or more solids to be mixed through the reversing flow apparatus according to any one of claims 1 to 5, thereby producing the mixed solution.

11. The method of claim 10, wherein the one or more liquids includes a gas.

20 12. The method of claim 10, wherein the one or more liquids are optionally passed, before or after the reversing flow apparatus, through at least one filtration system.

13. The method of 11, wherein the gas include nitrogen, oxygen, carbon

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dioxide, ozone, ethanol, methanol, hydrogen or combinations thereof.

14. A method of converting laminar flow to turbulent flow, the method comprising passing a liquid with laminar flow through the reversing flow apparatus according to any one of claims 1 to 5.

5 15. A liquid or emulsion processed with the reversing flow apparatus according to any one of claims 1 to 5.

16. A method of breaking an oil-in-water emulsion, the method comprising passing the oil-in-water emulsion through the reversing flow apparatus according to any one of claims 1 to 5 to obtain a processed material whereby a separate aqueous
10 phase and oil phase is produced.

17. The method of claim 16, wherein the method further comprises pyrolyzing the oil-in-water emulsion to obtain a derivative, and wherein the method comprises passing the derivative through the reversing flow apparatus according to any one of claims 1 to 5 instead of the oil-in-water emulsion.

15 18. The method of breaking the oil-in-water emulsion of claim 16 or claim 17, wherein the oil-in-water emulsion is oily wastewater, a petroleum feedstock or a part of a secondary oil recovery system.

19. A method of lowering the viscosity of liquid solution or emulsion containing oil, the method comprising passing the liquid solution or emulsion containing oil
20 through the reversing flow apparatus according to any one of claims 1 to 5 to obtain a processed material having lower viscosity than the liquid solution or emulsion containing oil, thereby lowering the viscosity of the liquid solution or emulsion containing oil.

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20. A method of lowering the boiling point of an original liquid source having kerogens, long-chain hydrocarbons or a mixture thereof, the method comprising passing the original liquid source through the reversing flow apparatus according to any one of claims 1 to 5 to obtain a treated material, wherein the boiling point of the
5 original liquid source is higher than the boiling point of the treated liquid.

21. A method of cracking a liquid comprising passing the liquid through the reversing flow apparatus of any one of claims 1 to 5 to obtain a cracked liquid.

22. The method of cracking a liquid of claim 18, wherein the cracked liquid contains contain more hydrocarbons having shorter carbon chain species relative to
10 the liquid.

23. The method of cracking a liquid of claim 21 or claim 22, wherein the method is devoid of solvents.

24. The method of cracking a liquid of any one of claims 21-23, wherein the liquid is an emulsion, a petroleum feedstock or a part of a secondary oil recovery
15 system.

25. A method of treating Crohn's Disease, a neuropathy or reducing inflammation of knee joints in a subject, comprising administering to the subject a liquid processed through the reversing flow apparatus according to any one of claims 1 to 5.

26. A use of liquid processed through the reversing flow apparatus of any one
20 of claims 1 to 5 to treat Crohn's Disease, a neuropathy or reduce inflammation of joints.

1/5

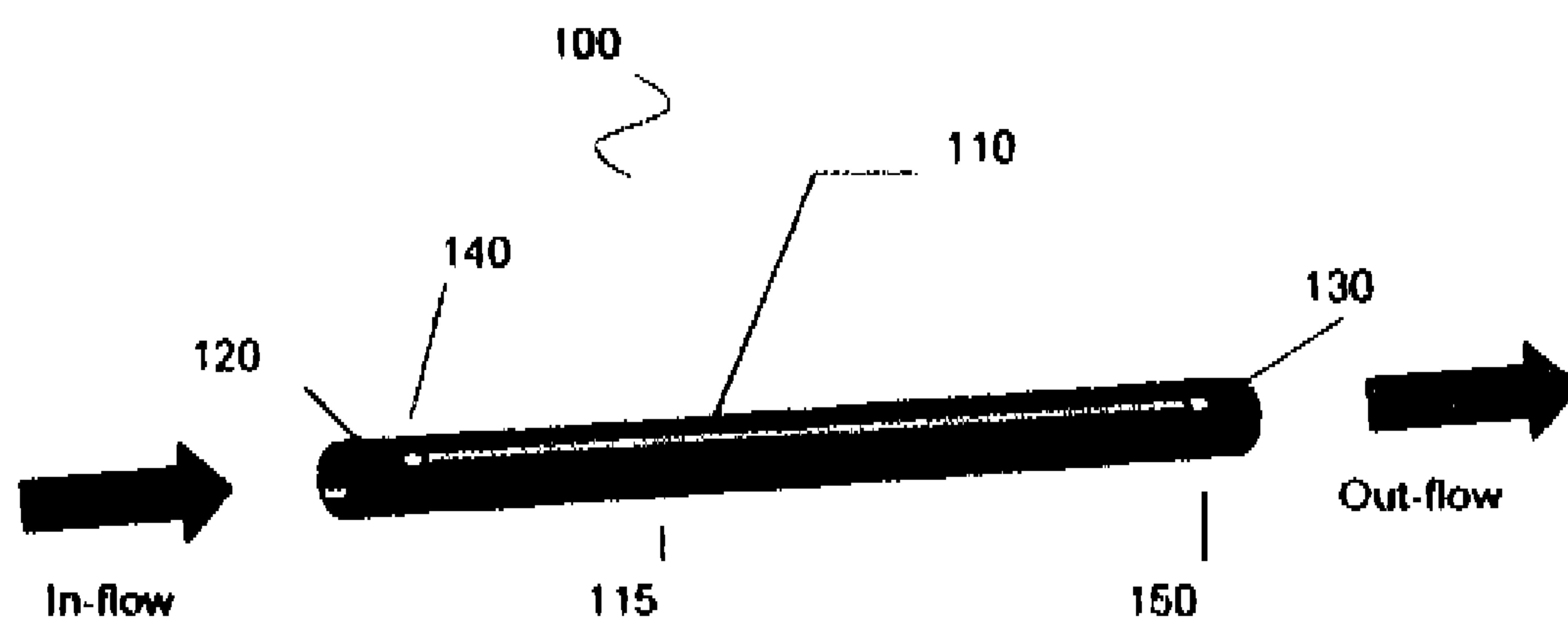


FIG. 1

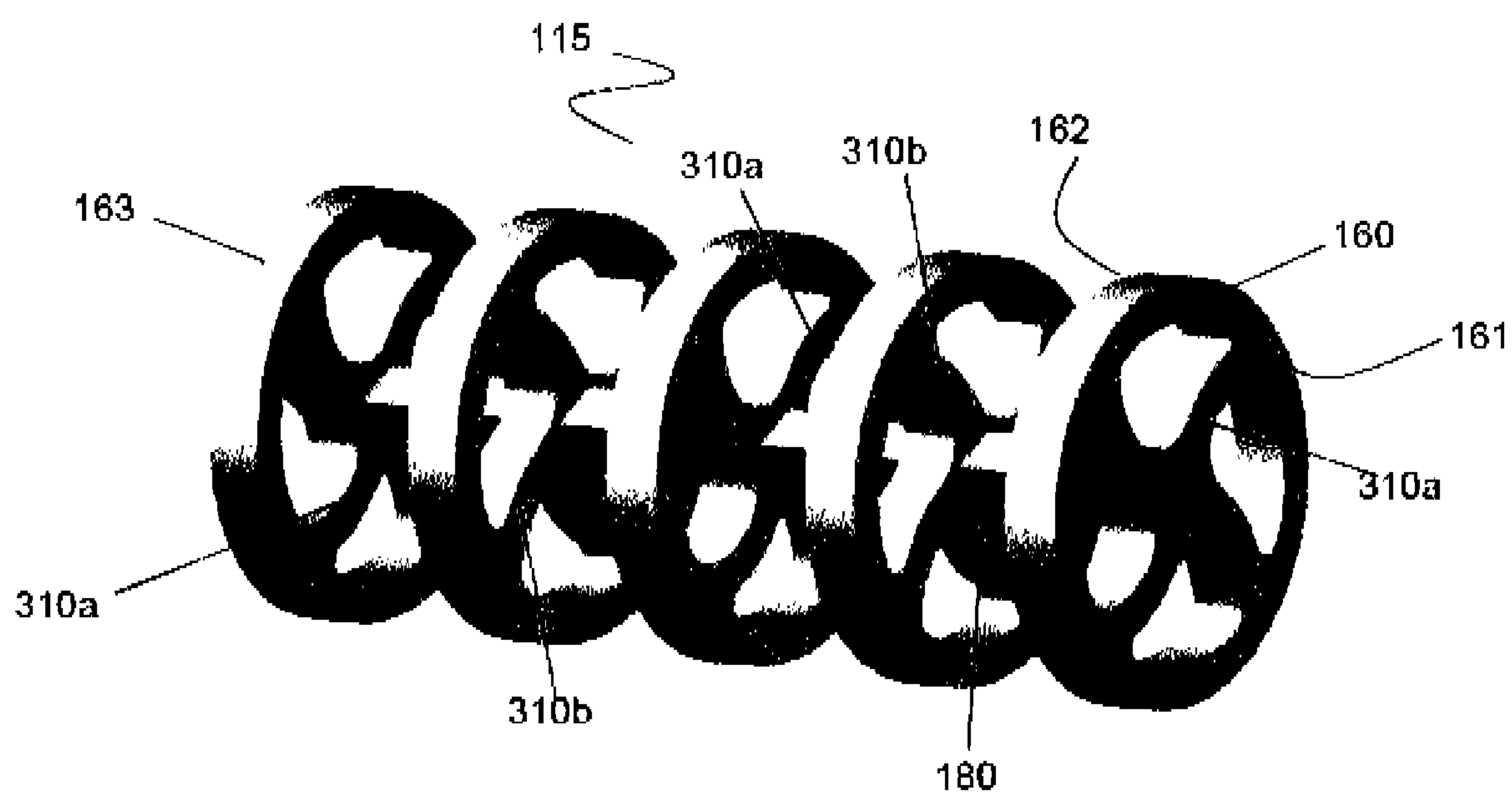


FIG. 2

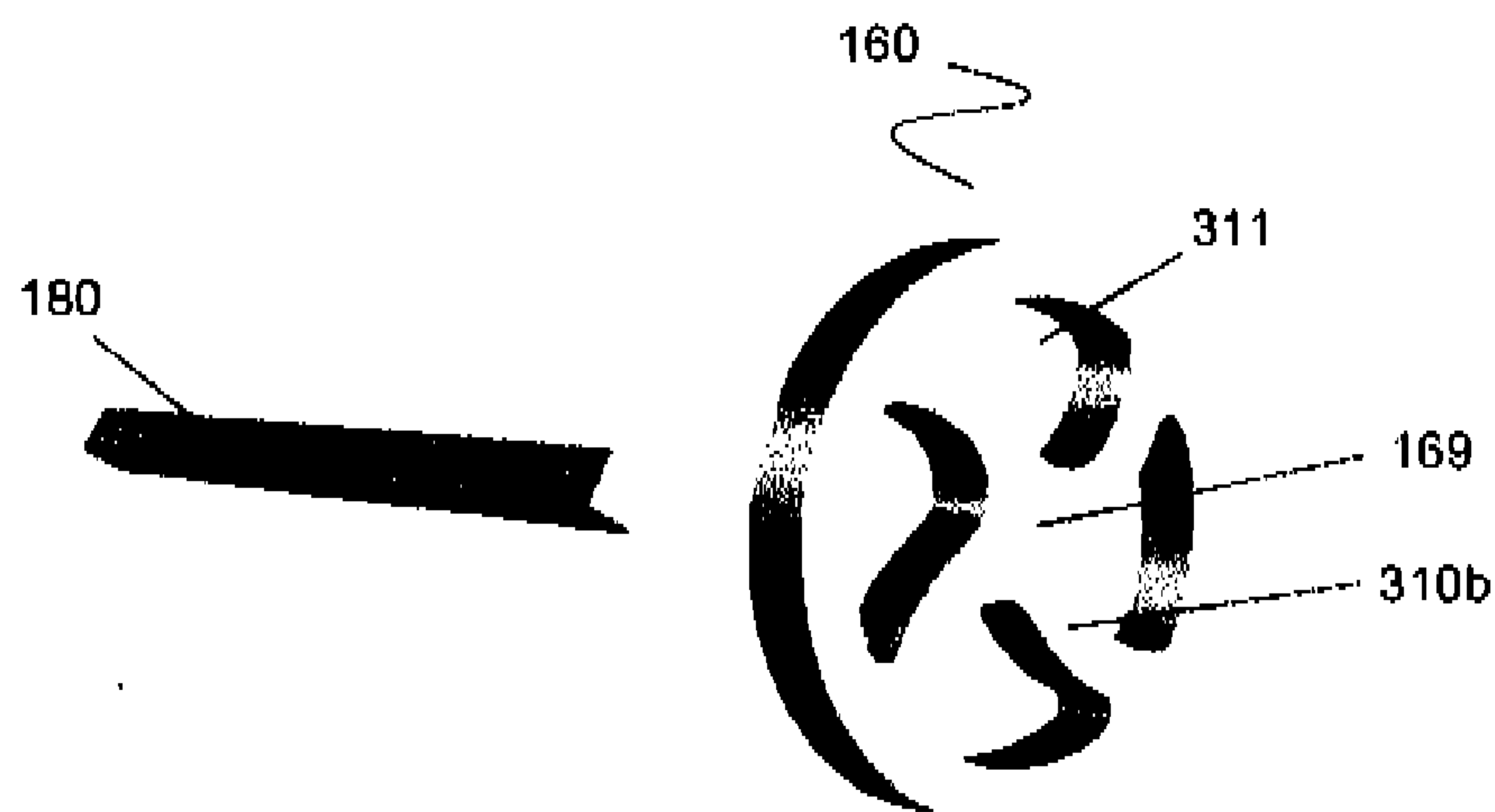


FIG. 3

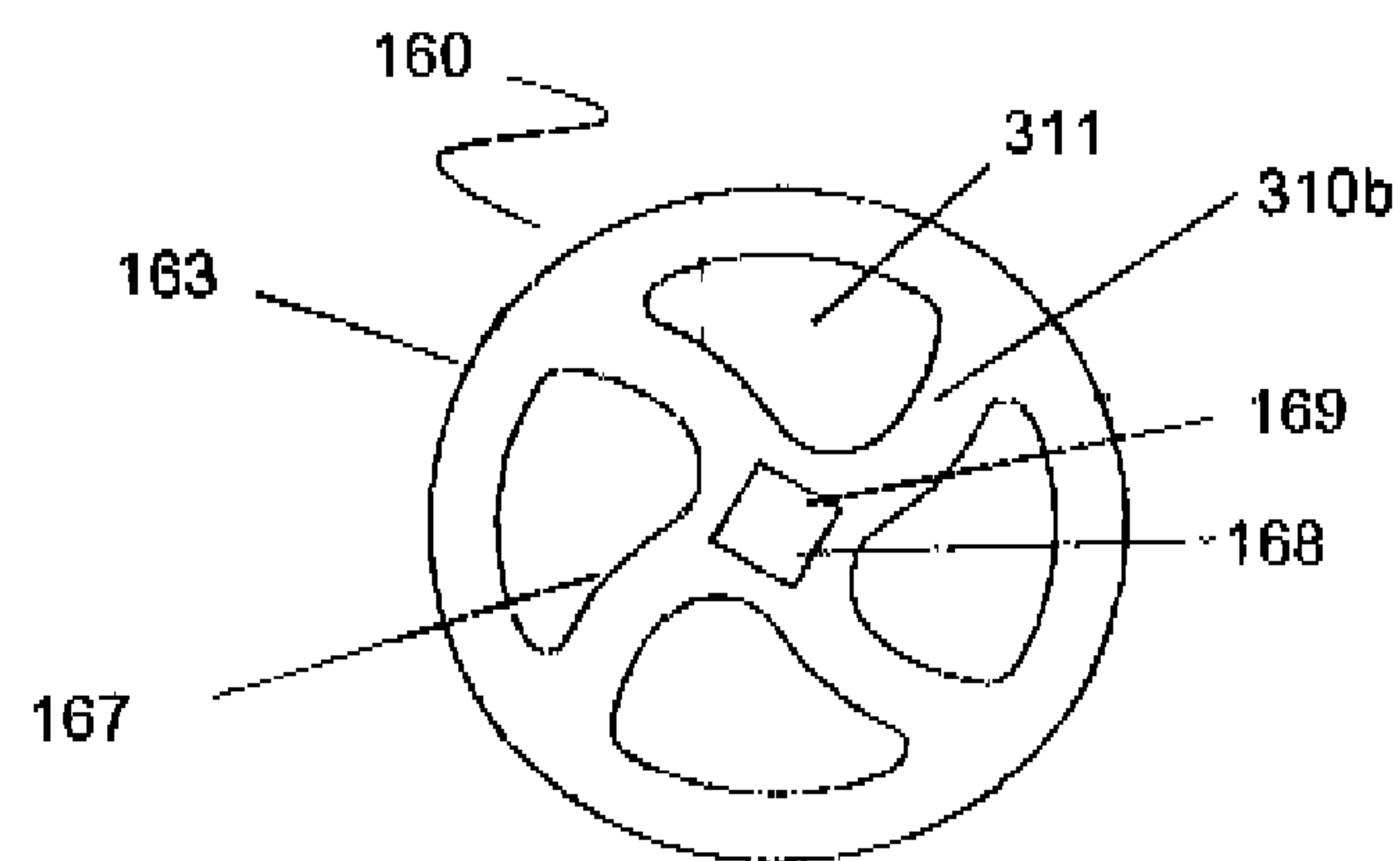


FIG. 4

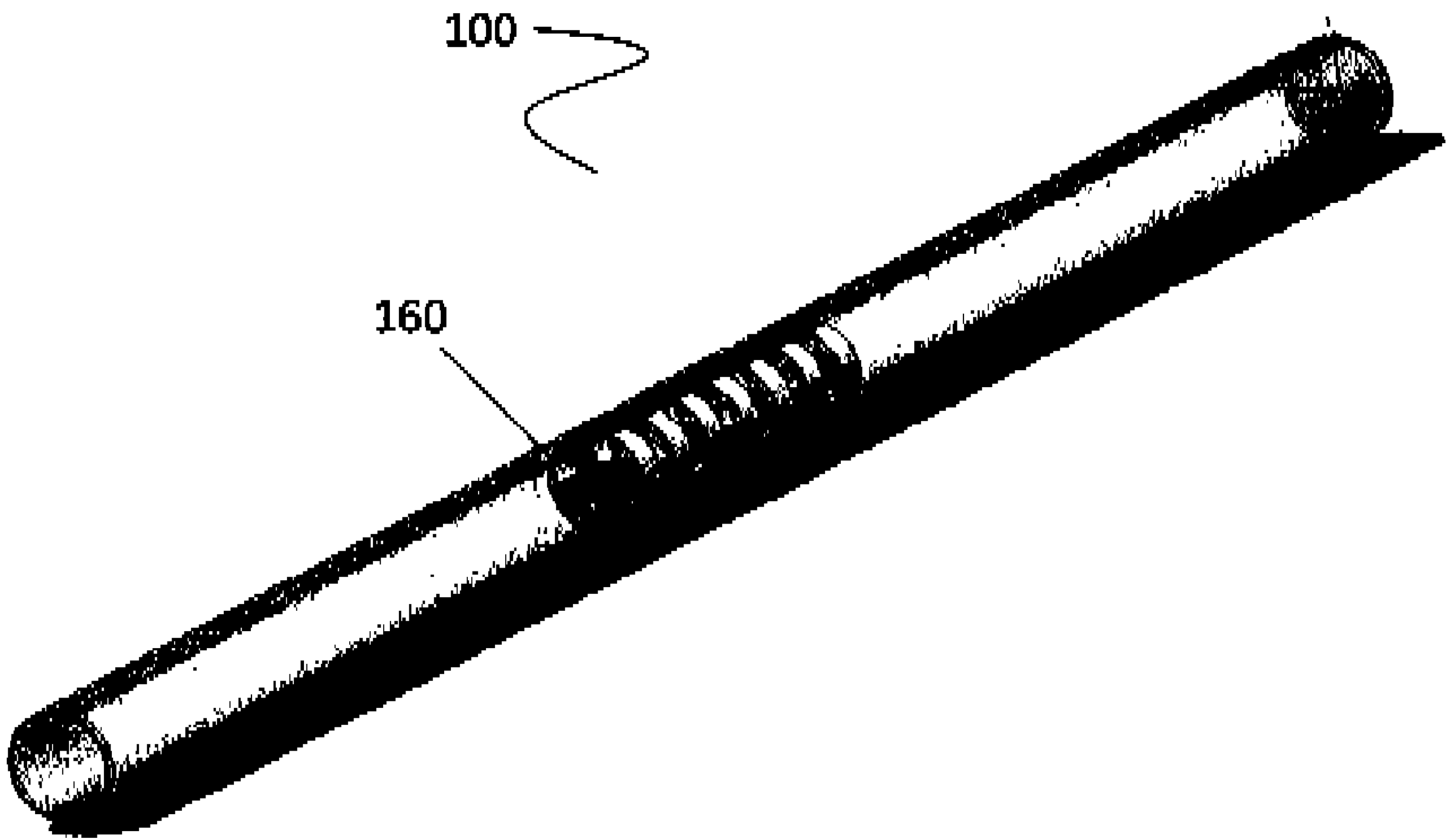


FIG. 5A

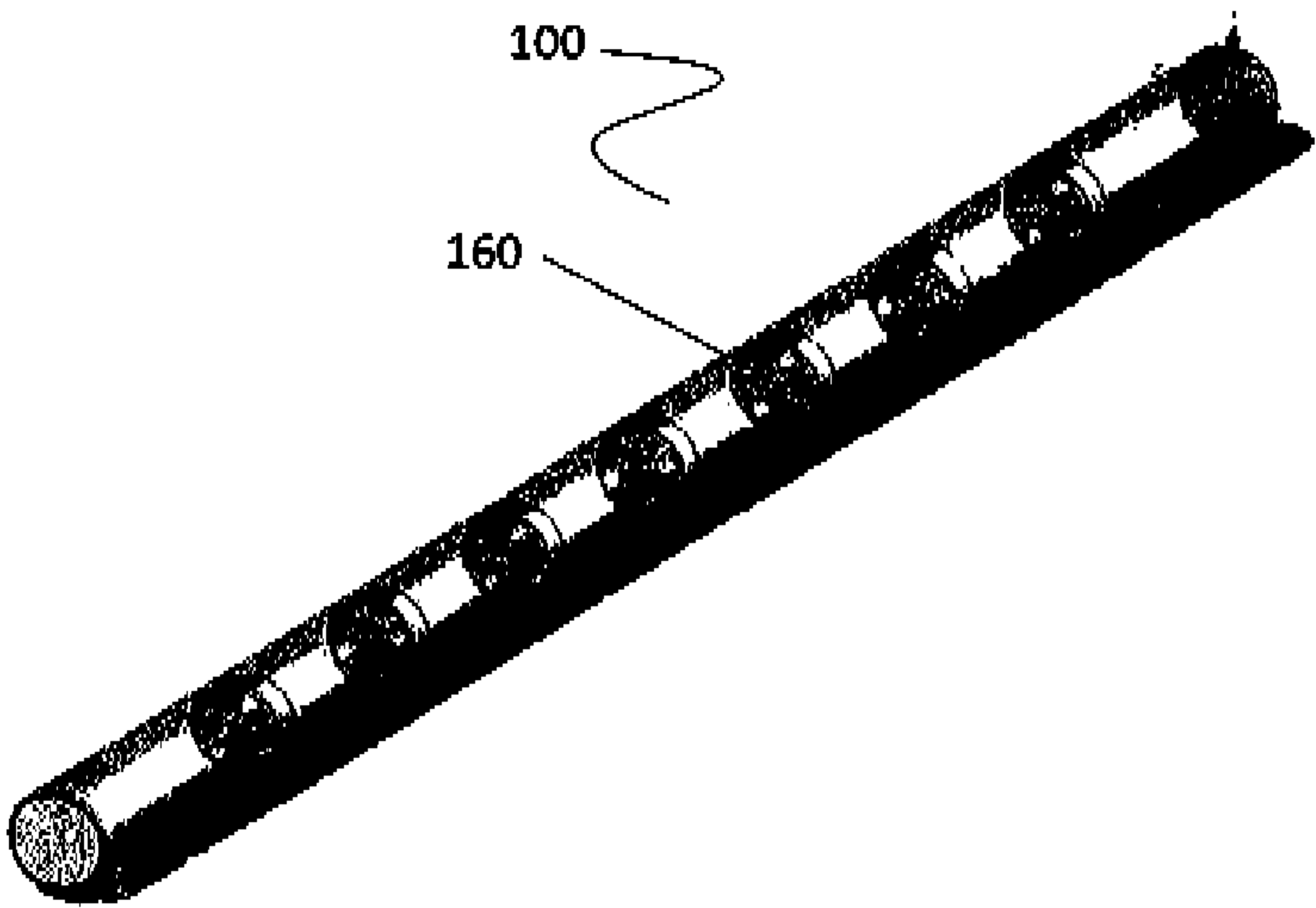


FIG. 5B

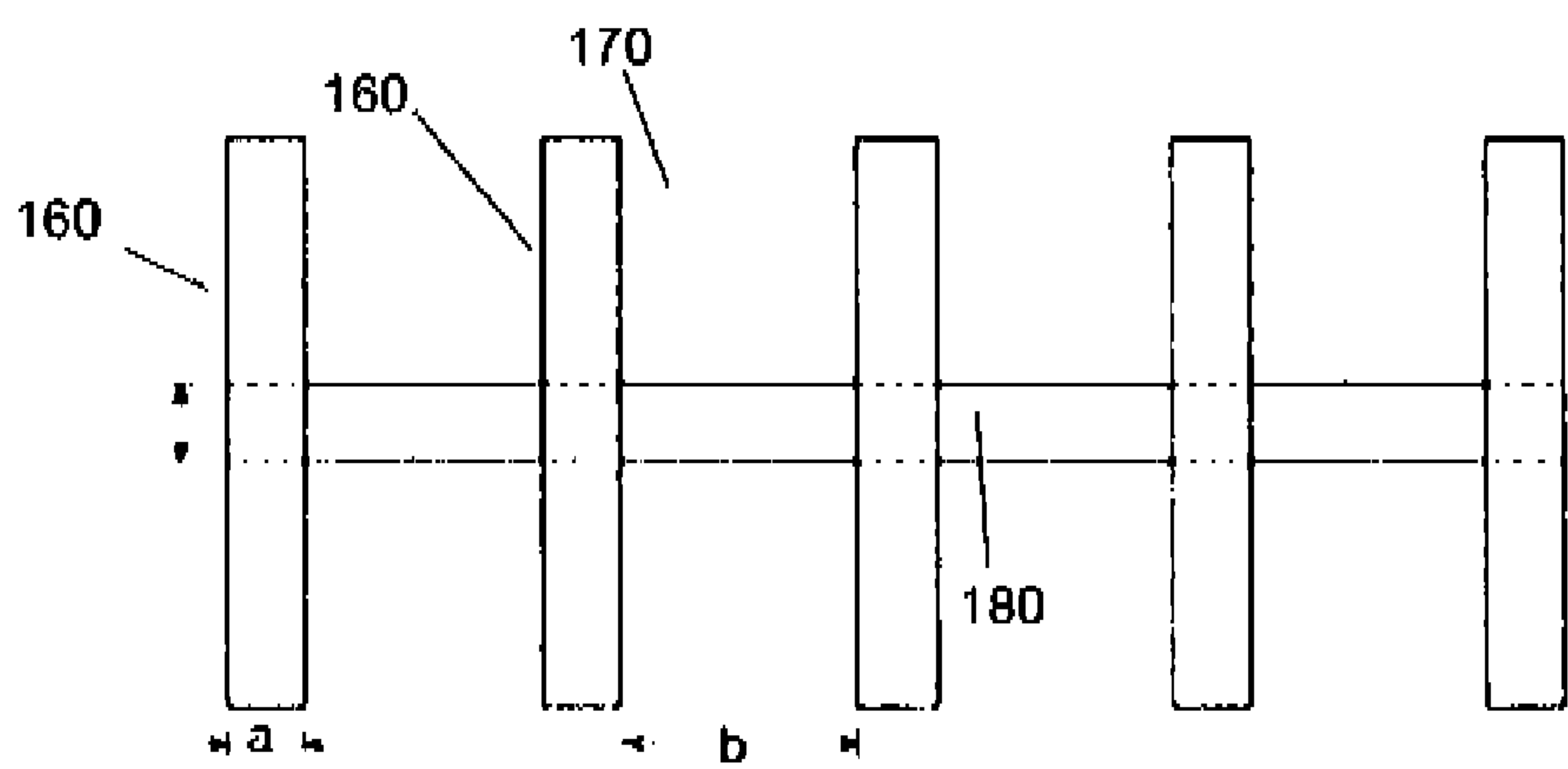


FIG. 6

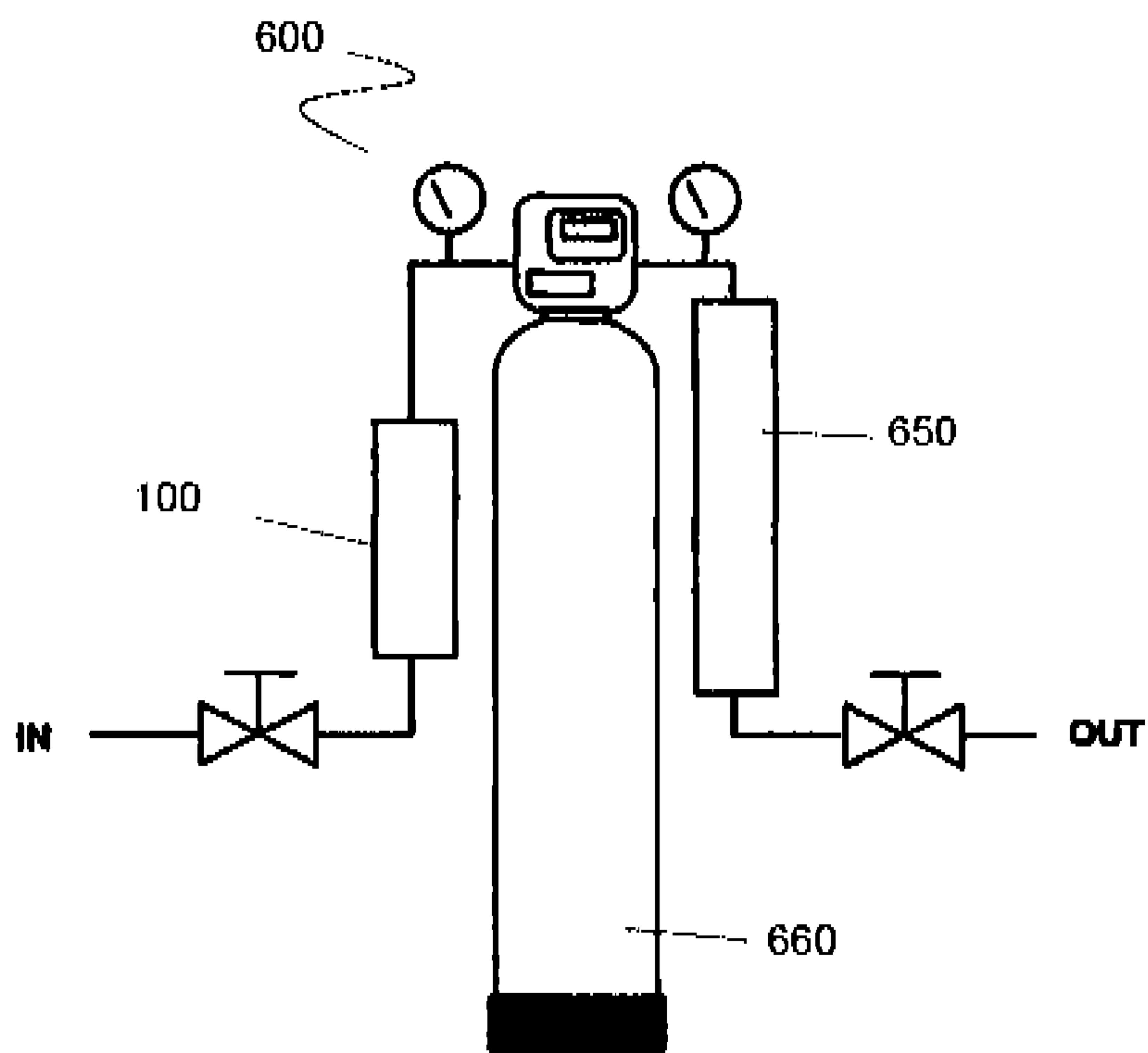


FIG. 7

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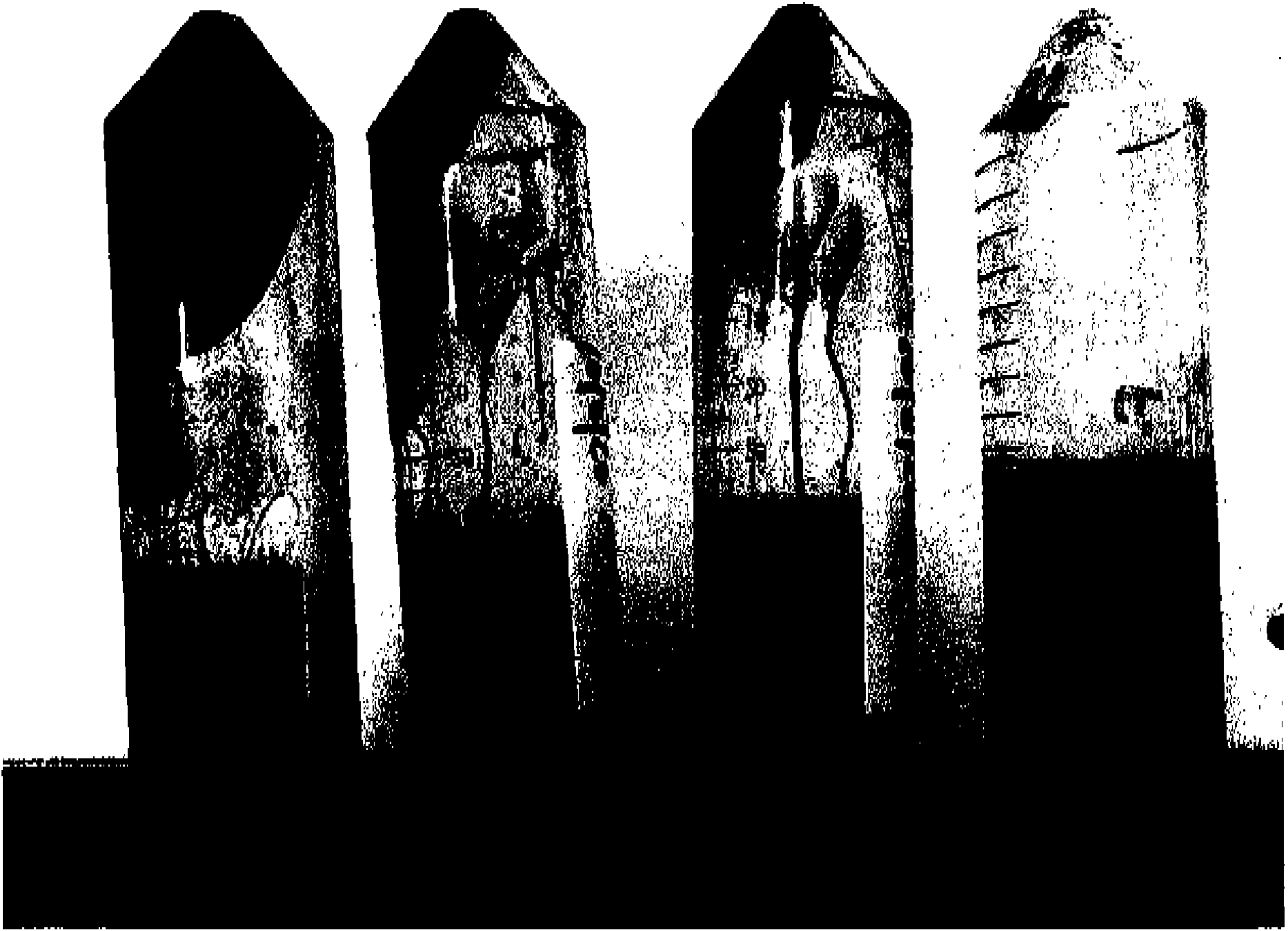


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2020/000132

A. CLASSIFICATION OF SUBJECT MATTER IPC: B01F 5/06 (2006.01) , A61L 2/10 (2006.01) , B01D 17/04 (2006.01) , B01F 3/08 (2006.01) , B01F 3/12 (2006.01) , A61K 9/08 (2006.01) According to International Patent Classification (IPC) or to both national classification and IPC			
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC: B01F (2006.01) ; B01D (2006.01); A61K (2006.01); A61L (2006.01) Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used) Canadian Patent Database; Questel-Orbit; Google Patents Keywords: flow, oil, blending, treatment, gas-gas, liquids, solids, mixer, syringe, tube, static blades, inline static mixer, laminar, turbulent, S, backward, curved, blades, plates, spokes, cast ring impeller, squirrel cage impeller, high pressure multistage barrel pump, reversing flow apparatus, liquid emulsion, mixture, stainless, molybdenum, westfallstaticmixers, h2orx, koflo, Burlington pump, omorismixer, volcrest, stamixco, statmix, ross, mixers.com, softerwater			
C. DOCUMENTS CONSIDERED TO BE RELEVANT			
Category*	Citation of document, with indication, where appropriate, of the relevant passages		Relevant to claim No.
A	US 2018/0134583 A1 (BAUER, WALTER JACOB) 17 May 2018 (17-05-2018) *paras 0002-0004, 0015-0020, 0034-0049, 0050, 0055, 0059-0066, 0076-0087, 0100-0112; figures ALL*		1-15
A	US 2016/0236158 A1 (BAUER, WALTER JACOB) 18 August 2016 (18-08-2016) *paras 0003, 0017-0022, 0036, 0076, 0082; figures 1-10 and 16*		1-15
A	US 2006/0175254 A1 (BAUER, WALTER J.) 10 August 2006 (10-08-2006) *paras 0010, 0017, 0024, 0044, 0050; figures 5-6*		1-15
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.			
* “A” “D” “E” “L” “O” “P”	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance document cited by the applicant in the international application earlier application or patent but published on or after the international filing date document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) document referring to an oral disclosure, use, exhibition or other means document published prior to the international filing date but later than the priority date claimed	“T” “X” “Y” “&”	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art document member of the same patent family
Date of the actual completion of the international search 20 January 2021 (20-01-2021)		Date of mailing of the international search report 03 February 2021 (03-02-2021)	
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476		Authorized officer Jeffrey Mellor (873) 354-9756	

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
 because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claim Nos.: 16-26
 because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

The International Searching Authority has not carried out a search for claims 16-26, under Article 17(2)(b) of the PCT. The description, claims, and/or drawings fail to comply with the prescribed requirements to such an extent that a meaningful search could not be carried out. Claims 16-26 so lack clarity and/or support that a meaningful search over the whole of the claimed scope is impossible.
(continued on Extra Sheet)

3. ☐ Claim Nos.:
 because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

(See Extra Sheet)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos.:

- Remark on Protest**

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

(continuation of Box II.2)

Consequently, the search has been established for the parts of the application which appear to be clear and supported, namely the subject matter of Group A, claims 1-15. The results being claimed in claims 16-26 are asserted in the description but the description lacks support regarding the viability of these claims.

Claims 25 and 26 are directed to a method of medical treatment, which the International Searching Authority is not required to examine under PCT Rule 67.1(iv).

(continuation of Box III)

The claims are directed to a plurality of inventive concepts as follows:

Group A - Claims 1-15 are directed to a reversing flow apparatus (RFA), a system for treating liquid solutions or emulsion using the RFA, a method of producing a mixed solution of liquids or of one or more liquids with one or more solids using the RFA, a method of converting laminar flow to turbulent flow using the RFA, and a liquid or emulsion processed with the RFA;

Group B - Claims 16-18 are directed to a method of breaking an oil-in-water emulsion using the RFA;

Group C - Claim 19 is directed to a method of lowering the viscosity of liquid solution or emulsion containing oil by passing it through the RFA;

Group D - Claims 20 are directed to a method of lowering the boiling point of an original liquid source having kerogens, long-chain hydrocarbons or a mixture thereof, the method comprising passing the original liquid source through the RFA;

Group E - Claims 21-24 are directed to a method of cracking a liquid by passing it through the RFA; and

Group F - Claims 25-26 are directed to a method of, and a use of liquid processed through the RFA for, treating Crohn's disease, a neuropathy or reducing inflammation of joints.

The claims must be limited to one inventive concept as set out in PCT Rule 13.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2020/000132

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US2018134583A1	17 May 2018 (17-05-2018)	CA2983830A1 CN107683261A EP3286142A1 EP3286142A4 JP2018516172A KR20170141225A RU2017140215A RU2017140215A3 RU2738259C2 WO2016168943A1	27 October 2016 (27-10-2016) 09 February 2018 (09-02-2018) 28 February 2018 (28-02-2018) 19 December 2018 (19-12-2018) 21 June 2018 (21-06-2018) 22 December 2017 (22-12-2017) 27 May 2019 (27-05-2019) 14 October 2019 (14-10-2019) 11 December 2020 (11-12-2020) 27 October 2016 (27-10-2016)
US2016236158A1	18 August 2016 (18-08-2016)	US10814290B2 AU2014331497A1 AU2019201646A1 AU2019201646B2 BR112016006226A2 CA2888661A1 CA2888661C CN105592916A CN105592916B EP3052225A1 EP3052225A4 HK1219924A1 IL244386D0 JP2016536139A JP6577474B2 JP2019162633A KR20160067909A MX2016003652A RU2016109447A RU2693136C2 RU2693136C9 WO2015048904A1 ZA201601541B	27 October 2020 (27-10-2020) 17 March 2016 (17-03-2016) 02 May 2019 (02-05-2019) 05 November 2020 (05-11-2020) 01 August 2017 (01-08-2017) 09 April 2015 (09-04-2015) 17 November 2015 (17-11-2015) 18 May 2016 (18-05-2016) 07 April 2020 (07-04-2020) 10 August 2016 (10-08-2016) 31 May 2017 (31-05-2017) 21 April 2017 (21-04-2017) 21 April 2016 (21-04-2016) 24 November 2016 (24-11-2016) 18 September 2019 (18-09-2019) 26 September 2019 (26-09-2019) 14 June 2016 (14-06-2016) 24 June 2016 (24-06-2016) 09 November 2017 (09-11-2017) 01 July 2019 (01-07-2019) 07 October 2019 (07-10-2019) 09 April 2015 (09-04-2015) 26 February 2020 (26-02-2020)
US2006175254A1	10 August 2006 (10-08-2006)	US7906025B2 CA2597113A1 CA2597113C EP1848668A1 EP1848668A4 US2010326926A1 US8454837B2 US2006175253A1 WO2006081683A1 WO2006081688A1	15 March 2011 (15-03-2011) 10 August 2006 (10-08-2006) 18 March 2014 (18-03-2014) 31 October 2007 (31-10-2007) 25 June 2008 (25-06-2008) 30 December 2010 (30-12-2010) 04 June 2013 (04-06-2013) 10 August 2006 (10-08-2006) 10 August 2006 (10-08-2006) 10 August 2006 (10-08-2006)