

FLUID FILTERING UNIT AND SYSTEM

FIELD OF THE DISCLOSED SUBJECT MATTER

The present disclosed subject matter is concerned with a filtering unit and filtering assemblies making use of same. The disclosed subject matter is further concerned with filter unit mechanisms.

More particularly, the disclosed subject matter is concerned with filtration units and assemblies configured with a rinsing mechanism for rinsing the filtration media. More specifically, the disclosure relates to so called *self cleaning* or *self rinsing* filtration systems, with a *reverse flush* or *back flush* configuration.

Filters and filtration systems in accordance with the disclosed subject matter may be used for filtering different fluid media, including gaseous material and different liquids such as fresh water, irrigation water, sea water, contaminated water including sewage, emulsions, viscous liquids, with the range of fluid pressure and other parameters thereof being substantially unlimited.

BACKGROUND OF THE DISCLOSED SUBJECT MATTER

Filtration systems are long in use for a variety of purposes and exist in a wide diversity of configurations.

Self-cleaning filter systems are configured for rinsing (cleaning) the filtration media effectively without the need to open and dismantle the unit for cleaning the filter unit and the filtration media manually.

Self-cleaning filter systems are also known in the art. For example, US 4,655,911 discloses a liquid filtering device, particularly for water irrigation installations, comprising a housing with inlet and outlet ports, a filter assembly within the housing, which comprises a filter member of a hollow elongated cylindrical configuration and a support member about which the filter member is adapted to spin during reverse, flushing liquid flow from the outlet to the inlet of the housing, characterized by a rotatable sprinkler member provided in an annular space between the

outer surface of the support member and the inner surface of the filter member, and by valve means for feeding the liquid from the outlet to the sprinkle member, causing the latter to rotate and spray liquid jets therearound against the said inner surface of the filter member.

U.S. 7,192,528 discloses an apparatus, comprising a ring disc filter system having a housing, a stack of ring disc filter elements in the housing with an inlet and an outlet for fluid to flow from the inlet through the stack of filter elements and outwardly to the outlet, a plurality of spine legs internally of said stack of ring disc elements, a fluid diverter to direct fluid during normal filtering operations from the inlet through the ring disc filter elements to create a filtering action, the improvement comprising: a. a spray tube positioned internally of said spine legs and having a plurality of fluid orifices therethrough axially spaced along the length thereof; b. said spray tube being disposed inwardly of said stack of ring disc filter elements for directing fluid outwardly through said ring disc filter elements to flush impurities into the housing; c. an outlet for discharging the fluid with impurities from the apparatus; and d. a compression plate assembled on said spray tube for normally holding the filter elements together for filtering out impurities in the fluid; and said compression plate and said spray tube being movable together in response to fluid pressure flowing upwardly in the spray tube to relieve pressure on the filter elements to thereby open the spaces between the filter elements to facilitate the flushing action.

SUMMARY OF THE DISCLOSED SUBJECT MATTER

According to a first of its aspects, the present disclosure relates to a fluid filtration assembly configured with a backflow rinsing mechanism.

The following is a list of terminology used throughout the specification and claims:

Fluid – any flowable matter, i.e. gas or liquid, regardless its purpose, degree of contamination, particle size, viscosity, pressure or any other parameters. Hence, herein in the specification and claims the term fluid is used in its broadest sense.

Filter unit – a unit comprising one or more fluid filtering media, of one or more types, through which raw fluid is passed for filtration thereof;

Filtering media – any form of filtering material and configuration, e.g. a compacted stack of filtering disks, a filtering screen (i.e. a fine mash of material), a thread-type cylinder, etc.;

Cleaning unit – a structure comprising one or more fluid ports extending opposite a filtering unit, for applying a fluid jet and/or applying suction there against, to remove dirt and particles from a fluid filtering media;

Raw fluid (identified in the relevant drawings by 'R' indexed arrows) - denotes a fluid (gas or liquid) to be filtered;

Rinsing fluid (identified in the relevant drawings by 'C' indexed arrows) - denotes a fluid (gas and/or liquid) used for rinsing/flushing the filter unit or filtering media or other components of the filter assembly. It should be noted that in some cases filtered fluid serves as a rinsing fluid;

Filtered fluid (identified in the relevant drawings by 'F' indexed arrows) - denotes the fluid/liquid obtained after a filtration process, namely after removing particles and contaminating matter;

Propulsion fluid (identified in the relevant drawings by 'P' indexed arrows) - denotes a fluid (gas and/or liquid) used as an hydraulic/pneumatic propulsion agent used for displacing one or both of a filter unit and cleaning unit in either or both axial or rotary orientation. The rinsing fluid, according to several configurations, may also function as a propulsion fluid.

According to the first aspect of the disclosed subject matter there is disclosed a fluid filtration assembly comprising a housing configured with one or more filter units extending in fluid flow communication between a raw fluid inlet port and a filtered fluid outlet port; a filter rinsing assembly being in fluid communication with a rinsing fluid inlet port; and propulsion fluid inlet port being in flow communication with a propulsion mechanism for propelling one or both of the filter rinsing assembly and the filter unit with respect to one another.

It is appreciated that the filter media in a filtration system according to the present disclosed subject matter can be any type of filtering media such as a stack of filtering disks, a filtering screen (i.e. a fine mash of material) or a thread-type cylinder, and the following illustrated examples are by no means limited to any one or more exemplified filtering media, or other.

However, according to a particular example, the filtration media is a thread-type filter, comprising a thread tensionally coiled over a support member and constituting a fine filtration media. Such a filtration media is configured as a thread cartridge.

Any one or more of the following features and designs can be configured with a filtration system according to the presently disclosed subject matter, independently or in combination:

- The fluid ports can facilitate for more than one function, depending on a particular performance of the filtration assembly at a given time;
- Either one or both of the filtration media and the filter rinsing assembly are configured for at least one of revolving motion and linear displacement;
- revolving motion either or both of the filtration media and the filter rinsing assembly can be continuous (i.e. unidirectional) or reciprocal;
- filtration through the filtration media can take place in a radially inwards or radially outwards direction;
- the rinsing assembly is configured for removing dirt and particles from the fluid filtering media. This can be configured by emitting a jet of fluid against the filtering media or by applying suction forces. According to a particular configuration there is disclosed a combined operation comprising rinsing and suction, simultaneous or intermittent structure comprising one or more fluid ports extending opposite a filtering unit, for applying a fluid jet and/or applying suction there against, to remove dirt and particles from a fluid filtering media;
- the filtration media can be configured as a one stage filter, or a multi-stage filter, i.e. comprising two or more filtration medias;

It is further noted that in some cases material filtered (sorted, separated) from the raw fluid is the material of interest, wherein the system functions as a '*sorting system*'.

Furthermore, hereinafter propulsion of either the filtering unit or the rinsing assembly (either/or revolving and axial displacement) may be facilitated by any sort of mechanism, e.g. hydraulic/ pneumatic/ electric/ electromagnetic arrangements, i.e. pistons, turbines solenoids, etc.

Respective inlet ports and outlet ports may serve for more than one function. For example, a certain port may function at one stage as a raw fluid inlet port and at another stage may function as a waste/rinsing outlet port.

A fluid jet for cleaning/rinsing the filtration media can be applied at any shape, using appropriate jet nozzles, e.g. pointed jet, elongate jet, etc. it is noted that a jet having a small cross-section area typically provides higher pressure rendering rinsing more effective. However, using small jets requires an adequate screening system for displacing either or both of the filtration media and the one or more jets, with respect to one another, so as to obtain optimal coverage of a cleaning process.

As opposed to pointed (local/concentrated) jets, there may be configured one or more elongate shaped jets with revolving displacement of either or both of the filtration media and the one or more jet members. Likewise, one or more annular or sartorial jets can be applied, however again requiring axial displacement of either or both of the filtration media and the one or more jet members.

According to another aspect of the disclosed subject matter there is provided a tensioning/loosening mechanism for respective tensioning/loosening the coiled threads of a thread-type filtering cylinder, between a filtering mode and a rinsing mode, respectively. It is appreciated that according to some particular configurations the filtering media is tensioned during rinsing thereof and is slack during a filtering mode.

The thread tensioning mechanism for controlling tension of coiled threads of a thread-type filtering cylinder, comprises an array of thread sports axially extending and being radially displaceable between a tensioned filtering mode and a loose rinsing mode, respectively.

Any one or more of the following features and designs can be applied, independently or in combination, with a thread tensioning mechanism of the present disclosed subject matter:

- the thread supports are longitudinal segments which at the loose rinsing mode are radially retracted such that longitudinal edges of neighboring longitudinal segments adjoin one another, and at the tensioned filtering mode longitudinal edges of neighboring longitudinal segments are spaced;
- at least some of the thread supports are configured with thread positioning members, said members transecting a longitudinal axis of the filtering cylinder;

- the tensioning mechanism is configured with a mechanism for converting axial motion in a longitudinal axis into radial motion in plane normal to said longitudinal axis;
- a displacing end plate is provided at respective ends of the tensioning mechanism, said end plates being coaxial with and axially displaceable about a longitudinal axis of the filtering cylinder and bearing against end edges of the longitudinal segments, wherein one or both of the end plates and the end edges are configured with a tapering surface, whereby axial displacement of the end plates entails radial displacement of the longitudinal segments;
- the thread supports comprise an array of spaced apart fixed longitudinal support members and an array of rotatably disposed support beams interposed between the support members, said support beams radially projecting between said support beams substantially to the same extent as of said support members, wherein at the tensioned mode said support beams extend substantially equally distanced between two neighboring support members and at the loose mode said support beams extend adjacent one of two neighboring support members;
- the thread supports comprises an array of longitudinal support members having an external thread engaging surface extending parallel to the longitudinal axis and an inside surface inclined with respect to the longitudinal axis and being slidably disposed over an equally inclined carrier member, whereby axial displacement of one or both of the support members and the carrier member towards one another entails radial expansion of the support members, and axial displacement of one or both of the support members and the carrier member away from one another entails radial retraction of the support members;
- the support members are longitudinal bars slidably retained within tapering grooves axially configured over cylindrical carrier member.

According to yet another aspect of the disclosed subject matter there is provided a core structure for supporting thread coils of a thread-type filtering cylinder, whilst facilitating adequate fluid flow there through.

Thus, there is provided a core structure for supporting thread coils of a thread-type filtering cylinder, said core structure comprising a ridged cylindrical structure configured with a plurality of axially extending spacers radially projecting from an external surface defined by the cylindrical structure, defining a filtration space between said external surface and a perimeter defined by said plurality of spacers, said filtration space being in flow communication with one or both an inside space within the cylindrical structure and end plates of the cylindrical structure.

Any one or more of the following features and designs can be applied, independently or in combination, with a core structure of the present disclosed subject matter:

- the external surface is an external face of a cylindrical tubular member;
- the external surface is defined by an array of coaxially disposed rings supported by the longitudinal spacers;
- the end plates radially project beyond the spacers and a plurality of openings are axially formed in the end plates, facilitating fluid flow communication with the filtration space.

The disclosed subject matter is also aimed at providing fluid filtration system comprising a housing accommodating a plurality of filtration units parallelly disposed within the housing, and a cleaning assembly within the housing, wherein one or both of the filtration units and cleaning assembly are rotatably and/or axially disposed within the housing to facilitate rinsing of filtering media of the filter units.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the different aspects of the disclosed subject matter, and to see how it may be carried out in practice, embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

Fig. 1 is an isometric view, partially cutout, of a filter assembly wherein the raw fluid flows from an outside surface of a fixed filter unit to an inside space thereof and further configured with an internal hydraulic rotary cleaning unit;

Fig. 2 is an isometric view, partially cutout, of a filter assembly wherein the raw fluid flows from an outside surface of a rotary filtering unit into a central space thereof, and further fitted with a static cleaning unit;

Figs. 3A and 3B are isometric views, partially cutout, of a filter assembly similar to that disclosed in Fig. 2 with filtered fluid selectively directed for hydraulic propulsion of the rotary cleaning unit, wherein:

Fig. 3A illustrates the filter assembly at a filtering stage; and

Fig. 3B illustrates the filter assembly at a rinsing stage;

Fig. 4 is an isometric view, partially cutout, of a filter assembly wherein rinsing the filter unit takes place by hydraulic propulsion of the filter unit, with external supply of rinsing fluid;

Figs. 5A and 5B are isometric views, partially cutout, of a filter assembly wherein filtering takes place from an outside surface of the filter unit, and rinsing takes place by propelling the filtering unit by filtered fluid serving also as a rinsing fluid, wherein:

Fig. 5A illustrates a filtering state of the filter assembly; and

Fig. 5B illustrates a rinsing state of the filter assembly;

Fig. 6A is a modifications of the example illustrated in Figs. 5, illustrating the assembly at a filtering state thereof; and

Fig. 6B illustrates the assembly of Fig. 6A at a rinsing state thereof, with propelling motion imparted by fluid jets;

Fig. 7A is an isometric view, partially cutout, of a filter assembly wherein the filter unit is a multistage assembly comprising a stack of filtering disks and a thread cylinder;

Fig. 7B is a partially exploded view of Fig. 7A;

Fig. 8A is an isometric view, partially cutout, of a filter assembly wherein the filtering unit is a multistage unit comprising a filter screen and a thread cylinder;

Fig. 8B is a partially exploded view of Fig. 8A;

Fig. 9 is an isometric view, partially cutout, of a filter assembly fitted with a static filter unit and a hydraulic cleaning unit revolving externally over said filter unit;

Fig. 10 is an isometric view, partially cutout, of a filter assembly fitted with a static filter unit and an internal cleaning unit fitted with a plurality of suction nozzles displaceable about the filter unit;

Fig. 11 is an isometric view, partially cutout, of a filter assembly fitted with a static filter unit and an internal cleaning unit fitted with a plurality of jet emitting nozzles;

Figs. 12 is an isometric view, partially cutout , of a filter assembly wherein the filter unit is axially displaceable against a static cleaning unit fitted with a plurality of jet emitting nozzles, wherein:

Fig. 12A illustrates a filtering state; and

Fig. 12B illustrates a rinsing state;

Figs. 13 is an isometric view, partially cutout, of a filtering assembly wherein the filter unit is static and a cleaning unit comprises a jet emitting assembly axially displaceable within the static filter unit, wherein:

Fig. 13A illustrates a filtering state; and

Fig. 13B illustrates a rinsing state;

Figs. 14 to 20 are directed to different configurations of thread-type filtering cylinders configured with a tensioning/loosening mechanism, wherein:

Figs. 14A to 14F are directed to a filter cylinder configured with radially displaceable axial tensioning mechanism;

Figs. 15A to 15E are directed to a thread-type filter cylinder configured with a sectorial array of thread supports axially displaceable between a tensioned position and loose position;

Figs. 16A to 16F are directed to a thread-type filter cylinder wherein tension/loosening of the threads is facilitated by virtue of a rotatable cog-like cylinder;

Figs. 17A to 17D are directed to a thread-type cylinder support configured with cleaning apertures and axial flow passes;

Figs. 18A to 18D are a modification of the thread-type filter cylinder support seen for example in Figs. 17;

Figs. 19A to 19D are still a modification of a thread-type filter cylinder support seen for example in Figs. 17; and

Figs. 20A to 20F are directed to yet a configuration of a filtration assembly, according to the disclosed subject matter.

DETAILED DESCRIPTION OF EMBODIMENTS

Attention is first directed to Figs. 1-13 of the drawings directed to a first aspect of the present disclosed subject matter, concerned with a filtration assembly and various cleaning/rinsing modes thereof.

In the following drawings, the following indexing for fluids is used:

Raw fluid - identified in the relevant drawings by hollowed arrows;

Rinsing fluid - identified in the relevant drawings by hatched arrows;

Filtered fluid - identified in the relevant drawings by solid arrows;

Propulsion fluid - identified in the relevant drawings by dotted arrows.

It is appreciated that the filter unit in the following examples may be any type of filtering media such as a stack of filtering disks, a filtering screen (i.e. a fine mash of material) or a thread-type cylinder.

Turning now to Fig. 1 of the drawings there is illustrated a filter assembly generally designated **100** comprising a rigid, pressure resistant, housing **104** composed of a base member **106** and a domed cover **108** articulated thereto e.g. by bolts, welding, clamps and the like.

The housing is configured with an inlet port **116** suited for coupling to a source of raw water (not shown). A filter unit generally designated **120** is fixedly secured within the housing **104**, wherein the filter unit **120** is a closed structure filtering media **122**, namely comprising a top cover **124**, and is secured to a filter unit mount **130** fitted at a bottom portion of the housing base **106**, rigidly accommodating a support ring **136** of the filter unit **120**.

It is appreciated that the filter unit **120** may be any type of filtering media such as a stack of filtering disks, a filtering screen (i.e. a fine mash of material) or a thread-type cylinder, etc.

According to one particular example, However, according to a particular example, the filtration media is a thread-type filter, comprising a thread tensionally coiled over a support member and constituting a fine filtration media. Such a filtration media is configured as a thread cartridge configured for fine filtration.

Extending at a lowermost portion of the base member **106** there are a plurality of openings constituting an outlet port **140** being in flow communication with a space **144** within the filtering unit **120**, said outlet port **140** serving for collecting the filtered fluid as will be disclosed hereinafter in further detail. Whilst illustrated at a lowermost portion of the base member **106**, it is noted that the outlet ports may extend also at any level above the lowermost portion of the base member.

A rotary cleaning/rinsing unit generally designated **150** is rotatably supported within the space **144** inside the filter unit **120**. The cleaning unit **150** comprises a central stem **154** rotatably secured at its bottom **156** to a central support hub **158** serving as a

rinsing fluid inlet and propulsion fluid inlet. A plurality of rinsing sprinkler arms **160** (only two seen in the example of Fig. 1) are articulated to the central stem **154** and are in flow communication therewith, said sprinkler arms **160** comprising a plurality of rinsing jet nozzles **164** extending radially off side to thereby give rise to rotation propulsion of the cleaning unit **150**.

At a filtering stage of the filter **100**, raw fluid e.g. a designated by arrow **170** enters the space **102** of the filter housing through inlet port **116** and owing to pressure of the raw fluid it is forced to pass through the filtering media **122** resulting in filtration of the fluid whereby filtered fluid represented by solid arrows **178** now collects within the inner space **144** of the filter unit **120** and dirt such as particles, contaminating agents and the like, collect at the external surface **128** of the filter unit **120** and at the bottom of the filter housing **104**. The filtered fluid (such as water) will then exit through the openings of the outlet port **140**, as designated by solid arrows **178**.

At a cleaning/rinsing state of the filter **100**, fluid ingress through inlet port **116** is seized and then a fluid (e.g. fresh water) serving both as rinsing fluid (indicated by hatched arrow **182**) and propulsion fluid (indicated by dotted arrow **180**) is provided through a central inlet **156** (coaxial with outlet port **140**). The rinsing fluid (i.e. liquid in the present example) enters the rinsing stem **154** and the arms **160** thereof, resulting in generating of tangent force which eventually will cause the rinsing assembly **150** to rotate about a longitudinal axis thereof as represented by arrow **173**, with a plurality of jets of rinsing liquid emitting through the nozzles **164** in direction of hatched arrows **175**, thus rinsing dirt and particles from the external surface **128** of the filter unit **120**. The rinsing fluid and the propulsion fluid are then allowed to drain through the port **116** (which at the filtrating stage discussed above served as an inlet port and at the cleaning/rinsing state serves as an outlet, for which purpose this port is temporarily disconnected from the supply of raw fluid, not shown).

It is appreciated that the filtering assembly is configured with a filtering media compacting/releasing mechanism (e.g. **245** in Fig. 2) for compacting and arresting the filtering media as needed at the filtering stage, whilst releasing pressure and allowing the filtering media to expand (and rotate about the longitudinal axis, in those cases where the filtering unit rotates during rinsing). This applies in fact to all the examples of Figs. 2 to 8.

The embodiment illustrated in Fig. 2 is generally designated **200** and shares the general structure of the filter assembly illustrated in connection with Fig. 1 and for sake of clarity like elements have been designated with like reference numbers however shifted by 100.

In the embodiment of Fig. 2 the filter unit **220** is also of the configuration fixedly secured within the housing **204** wherein filtering of the raw fluid takes place in a direction from the outside of the filter unit **220** to its inside space **244** in the same manner as discussed in connection with the example of Fig. 1.

Thus, it is apparent that for a specific filtering assembly configuration there exist two operation modes, one wherein the filtering unit is fixed whilst the rinsing assembly rotates with respect to the filtering unit and emits jets of rinsing fluid there against, and the second wherein the filtering unit is rotatable about its longitudinal axis, whilst the rinsing assembly is fixed with respect thereto and emits jets of rinsing fluid against the revolving filtering unit.

However, in the example of Fig. 2, the cleaning unit **250** comprises a sprinkler arrangement configured of axially extending, flute-like sprinkler arms **160**, each configured with a plurality of rinsing jet nozzles **264** facing towards the outside surface **228** of the rotary filter unit **220** and towards the turbine **236**. The rotary filter unit **220** is secured at its bottom end by the turbine arrangement **236**. The sprinkler arms **160** being in flow communication with a combined rinsing fluid inlet port and propulsion fluid inlet port designated **280** configured as an annular port coaxially extending over the rinsing fluid outlet port **276**. A nozzle **267** applies a jet of fluid against the turbine **236**, resulting in revolving the cleaning unit **250** upon applying of fluid through the sprinkler arms **160**.

In the filtering stage raw fluid **270** (represented by hollowed arrows) is introduced through inlet port **216** and the pressurized fluid then passes the filtering media **222** (which, as already explained hereinabove, may be of any type namely a thread-type cylinder, a stack of filtering disks, a filtering screen and the like) resulting in filtration of the fluid. The filtered fluid then flows out in direction of solid arrows **276** through the outlet port **276**.

The rinsing stage takes place by admitting combined rinsing fluid (arrows **281**) and propulsion fluid (arrows **283**) in through the uniform inlet port **280**, resulting in propulsion of the rotary cleaning unit **250** so as to revolve about the longitudinal axis of

the filter, wherein jets of rinsing fluid immerse through nozzles **264** to clean the filtering media **222**, wherein an amount of the rinsing fluid flows out through the outlet **276** and residual fluid and dirt particles may be removed from the housing **204** through the inlet port **216** (upon disconnecting from the supply of raw fluid) (not shown).

Turning now to the embodiment illustrated in Figs. 3A and 3B there is illustrated a filter assembly **300** which is seemingly similar to the filter assembly **200** of Fig. 2 however, differing in that the rotary cleaning unit **350** is propelled by an internal hydraulic turbine **336** and further by the provision of a one-way valve **390** facilitating fluid flow only of fluid in direction towards the outlet port **376**, as will be discussed hereinafter.

The arrangement is such that in the filtering stage of the filter **300** (Fig. 3A) the one-way valve **390** is open to facilitate fluid flow of filtered fluid in direction of the solid arrows **375** whereby raw fluid (hollowed arrows **379**) entering the housing **304** through the inlet port **316** is forced through the filtering media **322** into the internal space **344** of the filter unit **320**, wherein the filtered fluid (solid arrows **375**) then flows out of the filter assembly **300** through a central outlet port **376** configured at a lowermost portion of the housing, extending in flow communication with the internal space **344** of the filter unit **320**.

Turning now to Figs. 3B, when it is desired to clean/rinse the filter assembly **300**, the one-way valve **390** is closed by the fluid pressure, resulting in disconnected a fluid flow path between the central space **344** within the filter unit **320** and the outlet port **376**. In this position rinsing fluid (indicated by hatched arrows **380**) and serving also as propulsion fluid (indicated by dotted arrows **382**) are now admitted through the outlet port **376** (now serving as an inlet port) into the chamber **387**, resulting in rotation of the rotary filter unit **320** by virtue of the internal hydraulic turbine **336** causing the filter unit **320** to rotate about the longitudinal axis of the assembly. The rinsing fluid (hatched arrows **380**) immerses, in the form of cleaning jets through the cleaning jet nozzles **364** formed on the sprinkler arms **360** of the cleaning unit **350** for cleaning the external surface **328** of the filtering media **322**, as well as the internal surface **329**, whereby the rinsing fluid designated by hatched arrows **380** flows through the filtering media **322** into the internal space **379** (annular-shaped and coaxial over the central space **344** of the filter unit **320**) and where the rinsing fluid may then egress into the

space **302** of the housing from which it is removed through the inlet port **316** upon disconnecting from the raw fluid supply.

Whilst the description of Figs 3A and 3B refers to a rotary filtering unit and a stationary cleaning unit, it is apparent, as already mentioned hereinabove, that the same configuration may be used, however with a stationary filtering unit and a revolving cleaning unit, *mutatis mutandis*.

Turning now to the embodiment of Fig. 4 there is illustrated a filter assembly **400** with a housing **404** fitted with an inlet port **416** configured for coupling to a raw fluid supply source (not shown) and a central filter unit designated **420** coaxially extending about a central axis of the filter assembly **400** and defining an internal space **444** such that fluids flowing into the space **402** of the filter assembly **400** are forced through the filtering media **422** upon which the fluid is filtered and then may exit through the outlet port at **476**.

Coaxially extending about the outlet port **476** there is an annular-shaped rinsing fluid inlet (hatched arrows **480**) serving also as a propulsion fluid inlet (dotted arrows **482**), whereby the propulsion fluid entering is directed to a rotational hydraulic turbine **436** generating rotary motion which in turn imparts rotary motion to the filtering media **422** whereas the rinsing fluid extends into a space **431** between the filtering media **422** and a central support core element **435**. The pressurized rinsing fluid applied through jet nozzles **433** rinses the filtering media **422** (from an inside surface thereof) allowing the dirt to collect at the bottom portion **406** of the space **402** of housing **404**, which dirt and debris, together with the rinsing fluid may then be withdrawn through the inlet port **416** (upon disconnecting from the raw material supply source).

Turning now to Figs. 5A and 5B there is illustrated a filter assembly **500** according to which filtration takes place radially inwards through the filtering media, whilst rinsing takes place in an opposite sense.

According to this example, the housing **504** is configured with an inlet port **516** and is fitted with a centrally positioned filter unit **520** comprising a filtering media **522** mounted over a hydraulic turbine unit **536** and configured for rotation about a longitudinal axis of the assembly. Received within the filter unit **520** there is a support core structure **535** defining an internal space **544** and an annular, coaxial space **531** extending between the filtering media **522** and the core member **535**, wherein the central core member **535** is partitioned by a selective fluid flow path at **575** fitted with a

one-way valve **590** facilitating fluid flow only in direction from the chamber **531** towards the intermediate chamber **593** towards the outlet port **576**.

The arrangement is such that the one-way valve **590** selectively opens flow port **595** and is displaceable between an open position (Fig. 5A) and a closed position (Fig. 5B).

At a filtering stage of this example, as illustrated in Fig. 5A, raw fluid (hollowed arrows **523**) enters the main space **502** of the filter assembly **500** via inlet port **516** and is then forced through the filtering media **522** and then out, as filtered fluid (solid arrows **525**) through the flow port **595** into the intermediate chamber **593**. The filtered fluid then exits through the outlet port **576**. At the filtering stage of Fig. 5A the one-way valve **590** is at its open position namely displaced from the flow port **595** to facilitate fluid flow of the filtered fluid (solid arrows **525**) therethrough.

Turning now to Fig. 5B the filter assembly **500** is illustrated at its rinsing stage, whereupon the one-way valve **590** is displaced upwards to thereby seal the flow apertures **595**. At this stage, the supply of raw fluid (hollowed arrows **523**) is disconnected to the inlet port **516** whilst rinsing fluid (hatched arrows **580**) and propulsion fluid (dotted arrows **582**) are introduced into the filter assembly **500** through the outlet port **576** (now serving as an inlet port).

The propulsion fluid (dotted arrows **582**) is applied to the hydraulic turbine **536** through jet nozzles **535** fitted on lateral arms **537**. The turbine **536** will now revolve about the longitudinal axis of the filter assembly, entailing revolution of the filter media **522** along with it. The propulsion fluid flows as indicated by dotted arrows **582** impinging against the impeller of the hydraulic turbine **536**. The rinsing fluid (hatched arrows **580**) then flows into the intermediate chamber **593**, into the annular space **531** and then exits radially outwards through the filtering media **522** to rinse it from any dirt and particles which may have accumulated thereto, wherein the rinsing fluid and dirt are then drained through the inlet port **516**.

With further attention now be made to Figs. 6A and 6B there is illustrated yet another example of a filter assembly in accordance with the present invention generally designated **600**.

In this example, which is principally similar to that disclosed in the example of Figs. 5A and 5B, the filtering unit **622** revolves by the provision of jet generating nozzles **637** directed against the filtering unit **622** and configured for generating a vector

of force in a substantial radial direction for cleaning and a vector of force in a substantial tangent direction, whereby the rinsing fluid (hatched arrows) is tangentially emitted from said nozzles 637 in direction of arrows 639 (Fig. 6B), as a result of which the filtering unit 622 revolves about its longitudinal axis.

Figs. 7 of the drawings illustrates a different example of a filter assembly in accordance with the present disclosed subject matter generally designated 700 and comprising a housing 704 configured near its bottom with an inlet port 716 connectable to a source of raw fluid supply (not shown).

The housing 704 comprises an outlet port 776 with an annular, coaxially extending combined rinsing fluid inlet port 780 and propulsion fluid inlet port 782.

A filter unit generally designated 720 is fixedly received within the housing 704 and comprises a central support 735 supporting a cylindrical thread-type filter unit 721 extending coaxially within a stack of filtering disks 723 compacted and pressed by a top mount 739 compacting the filtering unit and support it in place over a central support 758 extending from a lower portion of the housing 704 extending from the outlet port 776 and being in flow communications therewith.

A space 731 extending between the stack of filtering disks 723 and the cylindrical thread-type filter 721 accommodates a pair of rinsing columns 760, each configured with a plurality of gat emitting nozzles 764 extending along the filter unit 720 and opposite the stack of filtering disks 723 and the thread-type cylindrical filter 721. However, it is appreciated that there may be one or more rinsing columns.

Furthermore, the central support column 735 comprises a plurality of rinsing nozzles 767 facing the internal surface 769 of the thread-type filter 721 for rinsing thereof.

A filtering process takes place by introducing raw fluid in direction of hollowed arrows 770 through the inlet port 716 into the space 702 of the filter assembly 700 whereby the raw fluid passes through a first filtering stage namely the stack of filtering disks 723 into the intermediate space 731 and then is further filtered by the thread-type cylindrical filter 721, wherein the filtered fluid then flows in direction of arrows 791 into the outlet chamber 799 and then out through the outlet port 776.

When it is now desired to rinse the filter assembly 700, the raw fluid supply is disconnected and rinsing fluid (hatched arrows 780) which serves also as propulsion fluid (dotted arrows 782) are now forced through the port into the intermediate rinsing

chamber **789**, wherein the fluid jets tangentially impinging against (or at least having tangentially directed vectors) the filtering unit **720** result in revolving of the filtering unit **720**. Rinsing fluid (hatched arrows **782**) emitted through the nozzles **764** and apertures **767** of the central hubs **735** simultaneously rinse the stack of filtering disks **723** and the thread-type filter **721**. The tangentially directed fluid jets extend all or a portion of the length of the filtering unit **720**. It is also an option that several nozzles are so directed so as to generate a tangential vector for generating revolving force and other nozzles are directed for rinsing the filtering unit **720**. The rinsing fluid and dirt may then be drained through the inlet port **716** upon disconnecting it from the supply of raw fluid.

Turning now to Figs. 8A and 8B there is illustrated a filter assembly generally designated **800** being substantially similar to that disclosed in connection with the filtering assembly **700** illustrated in connection with Figs. 7A and 7B. The principle difference residing in that the filter unit generally designated **820** is a two-stage filter unit comprising as a first filtering stage configured as a filter mash (screen of material such as plastic, steel, and the like, supported by a rigid, reinforced skeleton-like structure) designated **823**, coaxially mounted over a cylindrical thread-type cylindrical filter **821** serving as a second stage filter.

Filtering through the filter assembly **800** and its rinsing take place in a similar fashion as disclosed in connection with Figs. 7A and 7B.

Fig. 9 is directed to a modification of a filtering assembly in accordance with the disclosed subject matter generally designated **900**.

The principles of operation of the filter assembly **900** resemble in a way those of the configuration illustrated in connection with Fig. 2 of the drawings, namely wherein filtration takes place radially inwards about the filtering unit **920** and the rinsing process takes place in the same direction by means of a cleaning unit **950** comprising a rotatable sprinkler configured with a plurality of rinsing jets and being rotatable about the external surface **928** of the filter unit **920**.

The housing **904** is fitted with an inlet port **916** and a filtered fluid outlet port at **976**. Rinsing fluid **980** and propulsion fluid **982** are introduced through a uniform inlet port **931** configured at a top of the housing **904**, said inlet extending through a hydraulic turbine **936** towards the two sprinkler arms **960** extending axially and spanning the entire length of the filtering unit **920** wherein the sprinkler arms **960** are configured with a plurality of jet nozzles **964** directed against the external surface **928** of the filter unit

920 (which in the particular example is a thread-type cylindrical filter though, as discussed hereinbefore, may be any other type of filtering media).

The rinsing fluid **980** flows through the turbine **936** giving rise to generation of revolutionary forces to the sprinkler arms **960**, said fluid then continues to the nozzles **964** with jets emitted for cleaning the filtering media **920**. The dirty water during a rinsing process may be drained from the filter assembly through the inlet port **916** dirt and any other contaminating matter with some of the rinsing fluid draining through the outlet port **976**.

As can further be seen in Fig. 9, the filter unit **920** is fixedly supported within the housing **904** by means of a support bracket **930** integrally extending from a bottom surface of the housing **904** rigidly supporting the filter unit **920**.

Whilst in the examples discussed hereinbefore, the cleaning process takes place by revolution of one or both of the filtering unit and a cleaning unit, in the examples illustrated hereinafter in connection with Figs. 10-13 cleaning/rinsing takes place by applying also axial displacement of one (or both) of the filter unit and cleaning unit.

With reference being made first to Fig. 10, there is illustrated a filter assembly generally designated **1000** comprising a housing **1004** configured of a bottom portion **1006** fixedly secured to a top portion **1008** and defining together an internal space **1002**. Extending from the bottom portion **1006** there is a downward hub **1003** a raw fluid inlet port **1016** extending into an inlet chamber **1019**. Extending from the space **1002** of the filter housing **1004** there is provided an outlet port **1076**.

Fixedly supported within the housing **1004** there is a cylindrical filter unit **1020** which may be any sort of filtering media though in the particular example a thread-type cylindrical filter is illustrate. The filter **1020** is secured within the housing **1004** defining an internal filtering space designated **1044**.

Supported by the hub **1003** there is a cleaning unit assembly generally designated **1050** comprising a cylindrical rod **1053** supported within the hub **1003** and configured for combined rotational displacement and axial reciprocal displacement about the longitudinal axis thereof by means of a hydraulic turbine **1036**. It is noticed that a lowermost end of the stem **1053** is coupled to a hydraulic piston **1059** (received within a partitioned compartment **1061** dead-end of tubular section **1063**) for imparting reciprocal axial displacement to the stem **1053**. The hub **1003** is partitioned by a wall **1067** giving rise to a lower chamber **1069** in which the turbine **1036** is provided.

As can be seen in the drawings, the top chamber **1019** is in direct flow communication with the internal space **1044** of the filter unit **1020** and the hollow stem **1053** is fitted with a plurality of suction nipples **1091** extending in close proximity with an internal surface **1027** of the filter unit **1020** wherein the suction nipples **1091** are in flow communication with the internal volume **1097** of the hub **1053** which in turn is in flow communication with the turbine **1036** by openings **1087**. The lower chamber **1069** is in flow communication with a rinsing fluid outlet port **1043**.

In use, during a filtering stage of the filter assembly **1000**, raw fluid (hollowed arrows) **1070** enters the system through the inlet port **1016** and then flows through the inlet chamber **1019** into the internal space **1044** of the filter unit **1020**. The raw fluid is then forced through the filter unit **1020** wherein the filtered fluid (solid arrows) flows out into the space **1002** and then out through outlet port **1076** to be consumed.

During a rinsing process suction is applied through the rinsing fluid outlet port **1043**, wherein rinsing fluid (hatched arrows) /propulsion fluid (dotted arrows) is sucked through the suction nipples **1091** towards the hydraulic turbine **1087** and where reciprocal axial displacement of the central stem **1053** takes place side by side with the rotary motion thereof, whereupon the suction nipples **1091** travel about the internal surface **1027** of the filtering media **1020** cleaning and removing dirt and undesired material therefrom. The rinsing fluid flows through the space **1097** of the central hub **1053** and then out through the rinsing fluid outlet port **1043** directly to the atmosphere or to a dedicated reservoir.

The example illustrated in Fig. 11 resembles that illustrated in connection with Fig. 10 in its structure, configuration and its rinsing/cleaning mode. However, contrary to the previous example, in the embodiment of Fig. 11, the filter assembly **1100** has a raw fluid inlet port **1116** extending directly into a lower portion **1106** of the housing **1104** namely into the space **1102** of the filter assembly **1100**. The filtered fluid outlet port **1176** extends from the downward extending support **1103** wherein the chamber **1119** is in flow communication with the inside space **1144** of the filter unit **1120**.

Accordingly, a filtering process takes place by introducing raw fluid (hollowed arrows) **1170** through the inlet port **1116**, said raw fluid flowing into the space **1102** and then forced through the filter unit **1120** wherein the filtered fluid (solid arrows) enters the space **1144** and then drains downward through chamber **1119** and out through the outlet port **1176**.

The rinsing/cleaning assembly **1150** is identical with that disclosed in connection with the example of Fig. 10 and attention is directed to the explanation and disclosure made with reference to Fig. 10. Thus, an external source of rinsing fluid is required.

Yet another example is illustrated in connection with Figs. 12A and 12B. In accordance with this example, there is provided a filter assembly generally designated **1200** comprising a housing **1204** fitted with a filtered fluid outlet port **1276**. A filter unit generally designated **1220** is axially displaceable within the space **1202** of the housing **1204** whilst a rinsing/cleaning assembly **1250** is stationary secured within the housing **1204**, the operation of which will be discussed hereinafter.

Extending downwardly from the housing **1204** there is a sleeve **1203** accommodating a raw fluid supply tube **1207** configured with a raw fluid inlet port at **1216**, said tube **1207** being a rigid hollow stem extending through a port **1209** into the internal space **1244** of the filter unit **1220**. Thus, it is appreciated that filtration process takes place by applying the raw fluid through the filter unit **1220** radially outward in direction of arrows **1211** wherein the filtered fluid **1279** flows out through the filtered fluid outlet port **1276**. The cleaning/rinsing unit **1250** comprises a nozzle supporting ring **1269** secured to the inner wall of the housing **1204** and provided with a plurality of jet nozzles **1264** radially facing inwardly, and being in flow communication with a rinsing fluid inlet port **1280** fitted on an outer surface of the housing **1204**.

A propulsion unit comprises a hydraulic piston designated **1259** fitted with a pair of propulsion inlet/outlet propulsion fluid ports **1282A** and **1282B** for imparting the hollow stem **1207** with reciprocal axial displacement about a longitudinal axis of the assembly.

In a cleaning/rinsing process rinsing fluid is pressurized through the rinsing fluid inlet port **1280** resulting in jets of rinsing fluid emitted through the nozzles **1264** radially inwardly directed propulsion fluid introduced periodically through the propulsion fluid ports **1282A** and **1282B** causes the rod **1207** to axially reciprocate resulting in turn in axial displacement of the filter unit **1220** such that the jets of rinsing fluid emitted from the nozzles **1264** apply rinsing jets substantially about the external surface **1228** of the filter unit **1220**, whereby the rinsing fluid and dirt may then be drained through the outlet port **1276** and **1216** (Fig. 12B).

Turning now to the example illustrated in Figs. 13A and 13B there is illustrated a filtering assembly designated **1300** comprising a housing **1304** fitted with an inlet port **1316** extending into the inside space **1302** of the filter assembly **1304**.

A filter unit generally designated **1320** is fixedly secured within the housing **1304** and is configured for filtering fluid in a radially inward direction as represented by arrows **1391** and as will be discussed hereinafter.

Extending downwardly from the housing **1304** there is a support hub **1303** defining an outflow chamber **1319** which is in flow communication with the inside space **1344** of the filtering unit **1320** via a plurality of apertures **1340**, which chamber **1319** extends to the filtered fluid outlet port **1376**.

Received within the support hub **1303** is a rinsing/propulsion hollow tube **1353** fitted with a combined rinsing fluid inlet and propulsion fluid inlet **1380**.

Received within the fixed stem **1353** and axially displaceable therewithin in a reciprocal manner there is a rinsing rod **1379** being in flow communication with the rinsing fluid inlet port **1380**, with a rinsing plate **1350** fitted at its top end and configured with a plurality of radially extending rinsing nozzles **1351** extending in close proximity to the internal surface **1327** of the filter unit **1320**.

During a filtering process (Fig. 13A) raw fluid **1370** is introduced through inlet port **1316** into the space **1302** upon which it is forced through the filter unit **1320**, into the internal space **1344** and then admitted out through the apertures **1340**, into intermediate chamber **1319** and out through the filtered fluid outlet port **1376**.

In the rinsing/cleaning stage, as illustrated in Fig. 13B, rinsing/propulsion fluid is introduced through the combined rinsing fluid/propulsion fluid inlet **1380** of the stem **1353** resulting in upward displacement of the rod **1379** and its articulated cleaning disk **1350** whilst the rinsing fluid entering through the nozzles **1351** applies cleaning jets against the inside surface **1327** of the filter unit **1320**. Reciprocal axial displacement of the cleaning unit **1350** is obtained by a hydraulic piston (not shown), however the operation of which being self-explanatory for imparting reciprocal axial displacement of the cleaning unit. The rinsed fluid with the dirt and contaminating particles may then drain through the openings **1340** into the space **1319** and then out through the port **1376** whilst fluid residing in the space **1302** may be drained through the port **1316**.

Turning now to Figs. 14-20 there are illustrated several examples of configuration of thread-type filtering cylinders configured with a tensioning/loosening

mechanism. Such a mechanism is required in order to convert the thread-type filtering cylinder between a filtering mode and a rinsing mode. It is desired that during a filtering mode the threads of a thread-type filtering cylinder extend tensioned substantially reducing or eliminating slack of the thread to thereby improve the filtering capacity of the filter cylinder so as to entrap fine particles of material. However, at a rinsing state, it is desired to slack, to a certain extent, the threads of a thread-type filter unit to facilitate rinsing fluid to remove the dirt collected on and between the threads during the filtering process. However, it is desired that during the rinsing process the threads maintain their order and that upon re-tensioning of the threads, into the filtering mode, the threads are kept in order so as to maintain the filtering parameters of the thread-type filtering cylinder.

For sake of simplicity, in the following figures (namely Figs. 14-20 directed to the thread/loosening mechanism) the threads are not illustrated.

Turning first to Figs. 14A-14F there is illustrated a thread-type spindle generally designated **1500** is illustrated and comprises a cylindrical hub **1510** formed of a substantially rigid material (e.g. polymers, metal, etc.) and configured with a plurality of throughgoing apertures **1514** extending substantially in a radial direction between the external surface **1518** of the hub **1510** and its inner surface **1520**. The hub **1510** is supported between a top bracket **1526** and a bottom bracket **1528** which in turn are provided with a sealing ring **1532** used for sealing engagement with a filter unit support/arresting element of the filter assembly (not shown). The throughgoing apertures **1514** facilitate for fluid flow of fluid during filtration process and rinsing process.

A plurality of fixed support rods **1540** axially extend and are fixedly secured at their respective ends to the top bracket **1526** and bottom bracket **1528**, wherein the fixed support rods are substantially equi-radially and equi-angularly disposed about a longitudinal central axis **X** of the filter cylinder **1500**.

A plurality of radially displaceable tension bars **1546** are provided, each extending between a pair of neighboring support rods **1540**, said tension bars **1546** configured with a rounded tip **1550**, said tension bars having their tips **1550** extending substantially parallel to the longitudinal axis of the filter cylinder, though their rear end **1552** is wedge-like shaped having a narrow upper portion and widening toward the bottom.

The tension bars **1546** ride over a axial displacing member **1564** having a substantially flat inner surface **1566** and a tapering outer surface **1568** configured with a plurality of axial, tapering grooves, each slidably accommodating a tension bar **1546**, said grooves and respective tension bars being wedge-like and extend at an opposite sense to each other.

The arrangement is such that axial displacement of the axial displacing member **1564** entails corresponding radial displacement of the tension bars **1546** between a filtering state (Figs. 14A, 14B and 14C) wherein the tension bars **1546** radially project slightly between neighboring support rods **1540**, resulting that a cord of thread **1570** extending between two neighboring support rods **1540** is now divided into two cords **1572A** and **1572B**, thus increasing the overall diameter of the wound filtering thread and tensioning it. This is obtained by axially displacing the axial displacing member **1564** axially in direction of arrow **1580** (Fig. 14A) against the axially supported tension bars **1546**.

When it is now desired to shift the thread-type filter cylinder **1500** into the rinsing mode (Figs. 14A, 14D, and 14E) the displacing member **1564** is displaced in direction of arrow **1582** (Fig. 14D) resulting in retraction of the tension bars **1546**, as a result of which the tips **1540** disengage from the cord of thread **1570**, thus reducing tension and allowing some slack between the threads of the thread-type filter cylinder.

A different configuration of a thread-type filter cylinder tensioning/loosening mechanism is illustrated in Figs. 15A-15E, generally designated **1600** and comprises a hub composed of a plurality of sectorial segments **1602** each configured with a slanted top and bottom inside surface **1606** and further each provided with a plurality of thread-type placing ridges **1610** wherein the filtering threads are wound over and between the ridges **1610** so as to prevent them from axial displacement about the sectorial segments **1602**. Between two adjoining ridges **1610** there extends a valley **1612**, said valleys provided with an opening **1616** to facilitate fluid flow into the central space **1620** of the thread-type filter cylinder **1600**. The filtering threads are coiled about the filter cylinder in manner such that they do not radially project beyond the ridges **1610**.

Each of the sectorial segments **1602** is radially displaceable, to a limited extent and the arrangement is such that the plurality of sectorial segments **1602** constitute together the cylindrical shape of the filter cylinder spindle as can be seen in Fig. 15A. The sectorial segments **1602** are supported at their respective top and bottom ends by

conical cap members **1670** serving also as the axial displacing members wherein said conical cap members **1670** taper at their edge substantially equally as the inclined surfaces **1606** of the sectorial members **1602**.

At the filtering mode of the filter cylinder **1600** of Figs. 15B and 15C, the conical cap members **1670** are axially displaced towards one another in direction of arrows **1678** resulting in radial outward displacement of the sectorial segments **1602** in direction of arrows **1680** (Fig. 5C) thus, tensioning the filtering thread (not shown). In this position the filtered fluid may be flown through the filtering threads with the openings **1616** facilitating for fluid flow of the filtered fluid.

Turning now to the cleaning mode as illustrated in Figs. 15D and 15E, the conical cap members **1670** are displaced away from one another in direction of arrows **1686** resulting in contraction of the sectorial segments **1602** in direction of arrows **1690** (Fig. 5E) thus allowing some slack of the filtering threads to facilitate rinsing/cleaning thereof, as discussed hereinabove in connection with previous examples.

Further attention is now directed to Figs. 16A-16F illustrating a modification of the tensioning/loosening mechanism discussed in connection with the configuration of Figs. 14A-14F.

In accordance with the example of Figs. 16, the thread-type filter cylinder generally designated **1700** comprises a plurality of coaxially extending fixed support rods **1740** equi-distantly spaced from one another as can be seen in particular in Figs. 16B and 16E. The support rods **1740** remain fixed in place by virtue of a top bracket **1726** and a bottom bracket **1728** which in turn are configured for being fixedly and sealingly received within the filter assembly (not shown) wherein the thread-type filter threads (not shown) are wound about the support rods **1740** however to an extent that they do not project beyond the perimeter of the top and bottom brackets.

Rotatably received within the spindle there is a tensioning cylinder **1764** coaxially received within the thread-type filter cylinder **1700** and being angularly displaceable between a tensioned, filtering position (Figs. 16A-16B and 16C) and a slack, loose position namely a rinsing position (as illustrated in Fig. 16B, 16E and 16F) wherein the angular displacement of the tensioning cylinder **1764** is approximately half the angular distance between two neighboring support rods **1740** designated by angle α .

The tension cylinder **1764** is configured with a plurality of through going apertures **1714** through which filtered fluid flows during the process of filtration and

through which rinsing of the filter threads may take place, as said apertures **1714** extend into the central space **1720** of the filter cylinder.

An outer surface of the tensioning cylinder **1764** is provided with a plurality of axially extending tension bars **1746**, each configured with a rounded tip **1750**, said tips being radially almost equal to support rods **1740**.

In the filtering position (Figs. 16A to 16C) the filtering thread is tensioned over the support rods **1740** and the tips **1750** of the projections **1764** extend substantially intermediate between neighboring support rods **1740** such that the thread is tensioned over two cords **1772A** and **1772B** (Fig. 16C) thus increasing the tension of the filtering thread. However, upon angular displacement of the tensioning cylinder **1764** in direction of arrow **1759** (Fig. 16E) the tension bars displace to a position neighboring respective support rods **1740**, thus giving rise to a position in which there is one major cord **1779** and one minor cord **1781** (Fig. 16F) such that the filter thread is now slack over the support rods **1740**.

Tensioning the filtering thread back into the filtering mode takes place by rotation of the tensioning cylinder **1764** in a direction reversed to that indicated by arrow **1759**.

Figs. 17-19 illustrate different configurations of thread-type cylinder supports which on the one hand provide adequate support of the filtering thread wound thereabout and, on the other hand, permit effective filtering therethrough and rinsing as may be required.

In the configuration of Figs. 17A-17F there is illustrated a cylinder support (which may be referred to as a bobbin or winding hub or spindle), generally designate **1900**. The cylinder support **1900** is configured of a rigid material (setting as an example plastic material, metal or any other suitable material taking into consideration strength and the environment at which the device is configured to be for use, as well as configurations of cost-effectiveness, etc.). The cylinder support **1900** comprises a cylindrical surface **1904** with a plurality of axial ribs **1908** equally distributed over the cylindrical support and extending the entire length thereof, extending under a top bracket **1912** and a bottom bracket **1914**, said brackets being of a greater diameter than the cylindrical support with the radially projecting ribs **1904** wherein in use it is typical that the filtering thread (not illustrated) occupies the thickness t (Fig. 17C) namely does not project beyond the width of the top and bottom brackets. It is noticeable that the top

and bottom brackets are fixed over the radially projecting ribs **1908** giving rise to a gap **1928** extending between the cylindrical surface **1904** and an inner surface **1932** of the top and bottom brackets (best seen in Fig. 17D) wherein the gap **1928** facilitates effective fluid flow in direction of arrow **1940** whereby fluid flow of filtered fluid or of rinsing fluid can easily pass at the gap (designated **g** at the cylindrical surface under the filtering threads, and designated **1928** between the cylindrical surface and the top and bottom brackets).

Turning now to Figs. 18A-18D there is illustrated a cylinder support in accordance with a modification generally designated **2000** and comprising a cage-like cylindrical structure composed of a plurality of axially extending bars **2008** supported over a plurality of support rings **2012** in a rigid manner which may be obtained by injection molding, welding and the like, depending on the material of which the rigid structure of the cylinder support is manufactured. This construction gives rise to a lattice-type configuration facilitating effective fluid flow between an inside space **2020** and an outside surface of the thread-type filter. The lattice extends between a top bracket **2022** and a bottom bracket **2024**, both brackets projecting radially whereby the filtering thread (not shown) is typically wound about the lattice and does not radially project from the top and bottom brackets namely does not exceed thickness **t** illustrated in Fig. 18B.

It is appreciated that a cylinder support **2000** of the type disclosed in connection with Figs. 18 is suitable for a thread-type filter cylinder wherein filtration and rinsing may take place in either direction i.e. radially inwardly or outwardly, whereby a flow gap extends between the innermost layer of the threads and the troth members, said gap designated **g** (Fig. 18D) further facilitates fluid flow of the rinsing or filtered fluid.

The configuration of Figs. 19A-19D resembles that of Figs. 17 however, fluid flow is facilitated into the center space **2120** through a plurality of openings **2128**. According to the configuration of Figs. 19 the cylindrical support **2100** comprises a cylinder configured with a substantially smooth cylindrical surface **2118** configured with said apertures **2128**, and a plurality of longitudinal, axially extending ribs **2132** extending between a top bracket **2136** and a bottom bracket **2138**, wherein said brackets extend radially beyond the radial dimension of the ribs **2132** such that the filtration thread (not shown) typically does not exceed the thickness **t** (Fig. 19B) i.e. does not radially extend beyond the diameter of the top and bottom brackets.

The structure of the cylindrical support **2100** illustrated in Figs. 19 is also of the type suitable for facilitating filtering flow and rinsing flow in either radially inward or radially outward direction.

Turning now to figures 20A to 20F there is illustrated a concept of filtration assemblies according to which each filtration assembly comprises a plurality of filtering units, typically disposed in a parallel array and configured with a one or more rinsing/cleaning units according to any of the examples disclosed hereinbefore.

Figures 20A to 20D illustrate a first example of a filtration system generally designated **3000** comprising a housing **3002** accommodating a plurality of filtering units **3006** parallelly disposed, equally distanced from a longitudinal axis **X**, wherein each of the filtering units is articulated to an externally disposed gear mechanism **3012** coupled in turn to a rotary motor **3014**, configured for rotating each of the filtering units **3006** about its respective longitudinal axis **X'** (parallel to the longitudinal axis **X**). In the present example the rotary motor **3014** is an electrically operated mechanism, though it may just as well be hydraulically or pneumatically operated.

Similar to the previous examples, the housing **3002** is further configured with a raw fluid inlet port **3022**, a flushing fluid inlet port (not seen, however coupled to a rinsing fluid supply line **3052** discussed hereinafter) , a flushing fluid outlet port **3026** and a filtered fluid outlet port **3028**, the later extending from a filtered fluid outlet chamber **3030**.

The central rinsing/cleaning mechanism **3034** is in the form of a multi-armed, (star-like shaped) sprinkler mounted on an externally threaded central rail **3038** which in turn is coupled to the gear mechanism **3012** for imparting it rotary motion. The sprinkler **3034** is formed at its hub **3042** with an internal threading **3044** corresponding with the threading of rail **3038**, whereby a plurality of longitudinally extending cords **3049** prevent the sprinkler **3034** from rotation as the central rail **3038** rotates, resulting in reciprocal axial displacement of the sprinkler **3034** about the threaded rail **3038**. A reversing mechanism is provided for either reversing direction of rotation of the threaded rail **3038** each time the sprinkler **3034** reaches one of its respective ends, or a reversing mechanism is provided at the hub **3042** and the threaded rail **3038** is configured with two opposing threads, as known *per se*.

The arms **3046** of the central rinsing/cleaning mechanism **3034** are fitted with a jet applying nozzle **3048** at their remote ends (extending in close proximity to the

external surfaces of the filtering units **3006**), being in flow communication with a rinsing fluid supply line **3052** (which in the present example is a flexible hose coupled to the rinsing fluid supply port **3024**).

In operation, the filtration system **3000** operates similar to the disclosure referred to in connection with the examples of Figs. 1 to 13, however with increased filtering capacity, where each filtering unit **3006** functions according to any of the filtering modules discussed hereinabove, where the filtered fluid is directed from each filtering unit **3006** to the filtered fluid outlet port **3028**, and then out through the filtered fluid outlet port **3028**. When it is required to rinse the filtering units **3006**, rinsing fluid is applied through the rinsing fluid inlet port **3024** resulting in jets of rinsing fluids through nozzles **3048** towards the external surface of the filtering units **3006**, whilst imparting rotary motion to the central rail **3038** and to the filtering units **3006** by the gear mechanism **3012** and rotary motor **3014**. As a result of the combined reciprocal axial displacement of the sprinkler **3034** and revolving of the filtering units **3006**, rinsing thereof is obtained, wherein filtered fluid is then drained through filtering fluid outlet port **3026**.

The example of Fig. 20E is similar to the previous example however differs in that it further comprises filtering units **3060** disposed in between the radially extending sprinkler arms **3064** of the rinsing mechanism generally designated **3064**, in addition to a plurality of peripheral filtering units **3061**. The sprinkler arms **3064** are configured with jet applying nozzles **3066** provided at the distal ends of the sprinkler arms **3064** and directed for rinsing the peripheral filtering units **3061**, and jet applying nozzles **3068** directed for rinsing the filtering units **3060**. In this example too, the cleaning sprinkler unit is reciprocally axially disposable and the filtering units **3060** and **3061** revolve about their longitudinal axis.

Figure 20F illustrates a filtration station generally designated **3080** comprising a plurality (four in the present example) of filtration systems **3082** of the type discussed hereinabove in connection with Figs. 20A to 20D, which in turn comprise a plurality of filtration units each constructed and operates as discussed hereinabove in connection with Figs. 1 to 13. The filtration systems **3082** may be coupled to fluid supply and outtake lines in series or in parallel.

CLAIMS:

1. A thread tensioning mechanism for controlling tension of coiled threads of a thread-type filtering cylinder, said tensioning mechanism comprises an array of thread supports, axially extending and being radially displaceable between a tensioned filtering
5 mode and a loose rinsing mode, respectively.
2. A thread tensioning mechanism according to claim 6, wherein the thread supports are longitudinal segments which at the loose rinsing mode are radially retracted such that longitudinal edges of neighboring longitudinal segments adjoin one another, and at the tensioned filtering mode longitudinal edges of neighboring
10 longitudinal segments are spaced.
3. A thread tensioning mechanism according to claim 6, wherein at least some of the thread supports are configured with thread positioning members, said members transecting a longitudinal axis of the filtering cylinder.
4. A thread tensioning mechanism according to claim 6, wherein the tensioning
15 mechanism is configured with a mechanism for converting axial motion in a longitudinal axis into radial motion in plane normal to said longitudinal axis.
5. A thread tensioning mechanism according to claim 9, wherein a displeasing end plate is provided at respective ends of the tensioning mechanism, said end plates being coaxial with and axially displaceable about a longitudinal axis of the filtering cylinder
20 and bearing against end edges of the longitudinal segments, wherein one or both of the end plates and the end edges are configured with a tapering surface, whereby axial displacement of the end plates entails radial displacement of the longitudinal segments.
6. A thread tensioning mechanism according to claim 6, wherein the thread supports comprise an array of spaced apart fixed longitudinal support members and an
25 array of rotatably disposed support beams interposed between the support members, said support beams radially projecting between said support beams substantially to the same extent as of said support members, wherein at the tensioned mode said support beams extend substantially equally distanced between two neighboring support members and at the loose mode said support beams extend adjacent one of two
30 neighboring support members.

7. A thread tensioning mechanism according to claim 9, wherein the thread supports comprises an array of longitudinal support members having an external thread engaging surface extending parallel to the longitudinal axis and in inside surface inclined with respect to the longitudinal axis and being slidingly disposed over an
5 equally inclined carrier member, whereby axial displacement of one or both of the support members and the carrier member towards one another entails radial expansion of the support members, and axial displacement of one or both of the support members and the carrier member away from one another entails radial retraction of the support members.
- 10 8. A thread tensioning mechanism according to claim 12, wherein the support members are longitudinal bars slidingly retained within tapering grooves axially configured over cylindrical carrier member.
9. A core structure for supporting thread coils of a thread-type filtering cylinder, said core structure comprising a ridged cylindrical structure configured with a plurality
15 of axially extending spacers radially projecting from an external surface defined by the cylindrical structure, defining a filtration space between said external surface and a perimeter defined by said plurality of spacers, said filtration space being in flow communication with one or both an inside space within the cylindrical structure and end plates of the cylindrical structure.
- 20 10. A core structure according to claim 14, wherein the external surface is an external face of a cylindrical tubular member.
11. A core structure according to claim 14, wherein the external surface is defined by an array of coaxially disposed rings supported by the longitudinal spacers.
12. A core structure according to claim 14, wherein the end plates radially project
25 beyond the spacers and a plurality of openings are axially formed in the end plates, facilitating fluid flow communication with the filtration space.