A filter system (10) comprising a filter medium (11) for filtering contaminants from a process fluid, having a filtration side on which contaminants collect and a filtrate side from which filtrate flows; a counter-flow generator (20) located on the filtrate side that directs a localised stream of counter-flow fluid (23) from the filtrate side to the filtration side of the filter medium (11) to thereby dislodge the contaminants from the filtration side of the filter medium (11), wherein the localised stream (23) traverses a substantial proportion of the filter medium (11). The filter system (10) optionally further comprises a clearing-flow generator (30) or like means located on the filtration side of the filter medium (11) which clears contaminants from the filter medium (11).
### FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

<table>
<thead>
<tr>
<th>Code</th>
<th>Country</th>
<th>Code</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>Albania</td>
<td>RS</td>
<td>Spain</td>
</tr>
<tr>
<td>AM</td>
<td>Armenia</td>
<td>FI</td>
<td>Finland</td>
</tr>
<tr>
<td>AT</td>
<td>Austria</td>
<td>FR</td>
<td>France</td>
</tr>
<tr>
<td>AU</td>
<td>Australia</td>
<td>GA</td>
<td>Gabon</td>
</tr>
<tr>
<td>AZ</td>
<td>Azerbaijan</td>
<td>GB</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>BA</td>
<td>Bosnia and Herzegovina</td>
<td>GE</td>
<td>Georgia</td>
</tr>
<tr>
<td>BB</td>
<td>Barbados</td>
<td>GH</td>
<td>Ghana</td>
</tr>
<tr>
<td>BE</td>
<td>Belgium</td>
<td>GN</td>
<td>Guinea</td>
</tr>
<tr>
<td>BF</td>
<td>Burkina Faso</td>
<td>GR</td>
<td>Greece</td>
</tr>
<tr>
<td>BG</td>
<td>Bulgaria</td>
<td>HU</td>
<td>Hungary</td>
</tr>
<tr>
<td>BJ</td>
<td>Benin</td>
<td>IE</td>
<td>Ireland</td>
</tr>
<tr>
<td>BR</td>
<td>Brazil</td>
<td>IL</td>
<td>Israel</td>
</tr>
<tr>
<td>BY</td>
<td>Belarus</td>
<td>IS</td>
<td>Iceland</td>
</tr>
<tr>
<td>CA</td>
<td>Canada</td>
<td>IT</td>
<td>Italy</td>
</tr>
<tr>
<td>CG</td>
<td>Central African Republic</td>
<td>JP</td>
<td>Japan</td>
</tr>
<tr>
<td>CG</td>
<td>Congo</td>
<td>KE</td>
<td>Kenya</td>
</tr>
<tr>
<td>CH</td>
<td>Switzerland</td>
<td>KG</td>
<td>Kyrgyzstan</td>
</tr>
<tr>
<td>CI</td>
<td>Côte d’Ivoire</td>
<td>KP</td>
<td>Democratic People’s Republic of Korea</td>
</tr>
<tr>
<td>CM</td>
<td>Cameroon</td>
<td>KR</td>
<td>Republic of Korea</td>
</tr>
<tr>
<td>CN</td>
<td>China</td>
<td>KZ</td>
<td>Kazakhstan</td>
</tr>
<tr>
<td>CU</td>
<td>Cuba</td>
<td>LC</td>
<td>Saint Lucia</td>
</tr>
<tr>
<td>CZ</td>
<td>Czech Republic</td>
<td>LI</td>
<td>Liechtenstein</td>
</tr>
<tr>
<td>DK</td>
<td>Denmark</td>
<td>LK</td>
<td>Sri Lanka</td>
</tr>
<tr>
<td>EE</td>
<td>Estonia</td>
<td>LR</td>
<td>Liberia</td>
</tr>
<tr>
<td>LS</td>
<td>Lesotho</td>
<td>LT</td>
<td>Lithuania</td>
</tr>
<tr>
<td>LU</td>
<td>Luxembourg</td>
<td>LV</td>
<td>Latvia</td>
</tr>
<tr>
<td>MC</td>
<td>Monaco</td>
<td>MD</td>
<td>Republic of Moldova</td>
</tr>
<tr>
<td>MG</td>
<td>Madagascar</td>
<td>MK</td>
<td>The former Yugoslav Republic of Macedonia</td>
</tr>
<tr>
<td>ML</td>
<td>Mali</td>
<td>MN</td>
<td>Mongolia</td>
</tr>
<tr>
<td>MR</td>
<td>Mauritania</td>
<td>MW</td>
<td>Malawi</td>
</tr>
<tr>
<td>MX</td>
<td>Mexico</td>
<td>NE</td>
<td>Niger</td>
</tr>
<tr>
<td>NL</td>
<td>Netherlands</td>
<td>NO</td>
<td>Norway</td>
</tr>
<tr>
<td>NZ</td>
<td>New Zealand</td>
<td>PL</td>
<td>Poland</td>
</tr>
<tr>
<td>PT</td>
<td>Portugal</td>
<td>RO</td>
<td>Romania</td>
</tr>
<tr>
<td>RU</td>
<td>Russian Federation</td>
<td>SD</td>
<td>Sudan</td>
</tr>
<tr>
<td>SE</td>
<td>Sweden</td>
<td>SG</td>
<td>Singapore</td>
</tr>
<tr>
<td>SI</td>
<td>Slovenia</td>
<td>SK</td>
<td>Slovak Republic</td>
</tr>
<tr>
<td>SN</td>
<td>Senegal</td>
<td>SZ</td>
<td>Swaziland</td>
</tr>
<tr>
<td>TD</td>
<td>Chad</td>
<td>TG</td>
<td>Togo</td>
</tr>
<tr>
<td>TJ</td>
<td>Tajikistan</td>
<td>TM</td>
<td>Turkmenistan</td>
</tr>
<tr>
<td>TR</td>
<td>Turkey</td>
<td>TT</td>
<td>Trinidad and Tobago</td>
</tr>
<tr>
<td>UA</td>
<td>Ukraine</td>
<td>UG</td>
<td>Uganda</td>
</tr>
<tr>
<td>US</td>
<td>United States of America</td>
<td>UZ</td>
<td>Uzbekistan</td>
</tr>
<tr>
<td>VN</td>
<td>Viet Nam</td>
<td>YU</td>
<td>Yugoslavia</td>
</tr>
<tr>
<td>ZW</td>
<td>Zimbabwe</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FILTER WITH COUNTER FLOW CLEARING

This invention relates to an improved form of filter, and in particular to a filter having a novel means of clearing contaminants from the upstream or filtration side of the filter to thereby increase filtering efficiency.

BACKGROUND

The present invention will have many varied and diverse applications. The scope of the invention will include the filtering of solids from liquids, and filtering of solids entrained in air and the filtering of miscible liquids from process liquids.

The filtration of contaminants from fluids occurs in many applications ranging from industrial, agricultural, medical, food, fibre, effluent treatment, by-product recovery and fluid recycling. For example, in a washing or cleaning process, solids are present in the used fluid and provided that those solids can be removed, the fluid can then be repeatedly reused in the process until requiring eventual disposal.

There are many known conventional filtering techniques, many of which are referred to as "dead-end" filtration. In these conventional "dead-end" filtration processes, as fluid passes through the filter medium, suspended contaminants larger than the pore or aperture size of the filter medium are collected on the upstream side of the filter medium as the filtered fluid passes through the filtered medium. As the amount of contaminant accumulates on the upstream side of the filter medium, the resistance to flow through the filter increases, the volume of fluid passing through the filter medium decreases and the differential pressure across the filter medium increases. This continues until a situation is reached where the accumulation of contaminants on the upstream side of the filter medium has to be removed to enable the filtration process to continue. This "dead-end" point in conventional filtration systems is the reason why some form of cleaning is required. Typical cleaning processes include: back flushing where the direction of fluid flow across the filter medium is reversed;
and mechanical scraping where a scraper traverses the surface of the filter medium to remove contaminants thereby exposing the filter medium to damage. These cleaning processes interrupt the filtering process and therefore introduce further inefficiencies. Furthermore, in some applications it is impractical to clean the filter medium sufficiently frequently to prevent build up of contaminant on the filter medium surface using those cleaning processes and therefore poor filtration efficiencies result.

While there exist numerous types of self-cleaning filters their limitations include: the type of fluid able to be filtered, durability, flow rates and the operational time of the filtration process before shutdown maintenance is required.

It is an object of this invention to overcome the abovementioned problems and to produce a filtration system which more readily and continually clears accumulating contaminants from a filter medium during a filtering process.

SUMMARY OF THE INVENTION

In its broadest form, the invention is a filter system comprising:

a filter medium, for filtering contaminants from a process fluid, having a filtration side on which said contaminants collect and a filtrate side from which filtrate flows;

a counter-flow generator located on said filtrate side that directs a localised stream of counter-flow fluid from said filtrate side to said filtration side of said filter medium to thereby dislodge said contaminants from said filtration side of said filter medium, wherein said localised stream traverses a substantial proportion of said filter medium.

Causing the contaminants that accumulate on the filtration side to dislodge has several advantages. There is a breaking up of any caking that occurs on the filtration side, and the contaminants are dispersed into the process liquid thereby greatly
reducing their concentration in the immediate vicinity of the filter medium when the flow again returns through the filter medium. This has the effect of keeping the pressure differential across the filter medium low. Advantages arising from continuous maintenance of filter medium, no mechanical damage to the filter medium, reduced filter area requirement include limiting the pressure build-up across the filter medium and importantly reduced forces on the filter medium itself. Reduced forces on the filter medium allow additional versatility in the selection of filter medium and reduce the need for structural supports for these filter media. A unitary filter medium only supported at its edges may be used, wherein the filter is unitary in the sense that it is uniform in porosity and homogenous.

The filter medium may be rigid or flexible and may be made from a range of woven or unwoven porous type materials such as paper, fibrous cloth or sheet, steel mesh or polymeric material. Filter medium with large pore sizes such as screens or sieves may also be used.

Preferably the entire filter medium less only the area through which the localised stream of counter-flow flows, is continuously available for filtering contaminants. This produces a more efficient and more compact filtration system.

Preferably the filtration system further comprises a clearing-flow generator located on the filtration side that directs a localised stream of clearing-flow with a velocity component having a direction across an area on the filter medium adjacent the area at which the localised stream of counter-flow flows through the filter medium, and wherein the localised clearing-flow stream moves in unison with the localised counter-flow stream.

The operation of the counter-flow generator (with or without the clearing-flow generator) may be either periodic or continuous.
In a first preferred arrangement the filter systems has a filter medium that is substantially planar and is inclined to the horizontal. In this arrangement the process fluid flows to the upper end of the top side of the incline filter medium and the counter-flow generator comprises at least one fluid outlet orientated to direct counter-flow fluid towards the filter medium across the width of the filter medium and movable in a direction substantially parallel to the filtrate side of the filter medium to continuously traverse a substantial proportion of the filter medium. Underneath the filter medium there is provided a filtrate collection tray. Preferably a clearing-flow generator as described above is also provided.

This first preferred arrangement is particularly suitable for primary filtration and is capable of continuous filtration of process fluids with a high proportion of contaminant.

In a second preferred arrangement the filter medium is substantially cylindrical in shape and the counter-flow generator further comprises a manifold with a plurality of fluid outlets, the manifold being rotatable about an axis within the substantially cylindrical filter medium to thereby provide a means for traversing the filter medium. Preferably a clearing-flow generator as described above is also provided.

In another aspect of this invention applicable to this second preferred arrangement the filter medium is divided into a grid of elements the centres of which bow towards the direction of flow of the filtrate upon sufficient pressure differential across the filter medium and, when exposed to the localised counter-flow stream, invert to bow in the direction of the counter-flow fluid to thereby assist in the dislodgment of the contaminants from the filter medium.

The above described second preferred arrangement works particularly well when the filter system is located within a settling tank for secondary or tertiary filtration.
In a third preferred arrangement the filter system according to the second preferred arrangement is enclosed by a substantially cylindrical vessel having a process fluid inlet orientated so as to provide the process fluid with a velocity having a component tangential to the substantially cylindrical filter medium.

Preferably the process fluid inlet is located at the upper end of the enclosing cylindrical vessel and preferably there is a contaminant discharge point at the lower end of the enclosing cylindrical vessel. With this arrangement contaminants are subject to centrifugal forces which assist to move them radially away from the filter medium.

The counter-flow generator, as previously described for each of the three preferred arrangements, preferably comprises a focused spray jet or a series of focused spray jets which direct a high pressure counter-flow stream towards the filter medium.

Filtration systems according to the invention are able to operate without or with process control systems.

The word contaminant is used throughout this specification and its claims to denote the component of the process fluid that is to be filtered from the process fluid. In many applications the contaminant may be a valuable by-product that can be used after filtration.

In order to fully understand the invention, preferred embodiments will now be described, but it will be realised that the invention is not to be confined or restricted to the precise nature of these embodiments.

DETAILED DESCRIPTION OF THE EMBODIMENTS OF THE INVENTION

Embodiments are illustrated diagrammatically in the accompanying drawings.
Fig 1 shows in perspective view a first embodiment of a filter system according to the invention in which the filter medium is planar;

Fig 2 shows the filter system of Fig 1 in cross-sectional view;

Fig 3a shows a first portion of the filter system of Fig 1 in a detailed cross-section view;

Fig 3b shows a second portion of the filter system of Fig 1 in a detailed cross-section view;

Fig 4 shows a perspective view of a filter system according to a second embodiment of the invention in which the filter medium is cylindrical;

Fig 5 shows a cross-sectional view of the filter system of Fig 4;

Figs 6a, b & c show a variant of a second embodiment of the invention in which the filter medium is divided into a grid of elements, the centres of which bow towards the direction of flow of the filtrate; and

Fig 7 shows a perspective view of a filter system according to a third embodiment of the invention.

In a first embodiment of the invention shown in Figs 1, 2, 3a and 3b the filter system 10 comprises: planar filter medium 11 disposed below weir 13 over which process fluid flows from process fluid tank 12; filtrate collection tray 14; counter-flow generator 20; and contaminant collection tray 15. Process fluid enters the process fluid tank 12 via process fluid inlet 16.

The counter-flow generator 20 comprises a conduit 22 in the form of a pipe with a plurality of fluid outlets 21 which direct a continuous stream of counter-flow fluid across the width of the filter medium towards the filtrate side of the filter medium 11. Filtrate leaves the filter system via filtrate fluid outlet 17.

While various fluid outlets 21 may be used, including nozzles of various designs, focused spray jets have been found to be particularly effective. Figs 1, 2, 3a and 3b show fluid outlets 21 in the form of focused spray jets arranged side by side such that
the resultant counter-flow streams 23 overlap forming a linearly extended counter-flow stream across the width of the filter medium 11.

The counter-flow generator 20 sweeps along the length of the filter medium 11 with a linear speed that is related to the process flow rate and contaminant content of the fluid to be filtered. In this way the dislodgment of contaminants from the filter medium is optimised to ensure that solids do not substantially accumulate on the filter medium 11. Optimally the upwards linear speed of counter-flow generator 20 is relative to the downwards linear speed of counter-flow generator 20 and the downwards linear speed is set to maximise the tumbling of solids down the filter medium 11 and into the filtrate collection tray 14.

The conduit 22 is connected to a pump means (not drawn) which provides sufficient pressure and flow of fluid to the counter-flow fluid outlets 21 to produce a counter-flow stream sufficient to enable efficient dislodgment of contaminants from the filter medium 11. The counter-flow fluid outlets 21 are positioned and directed to provide a continuous localised stream of fluid across the width of the filter medium 11 through the filter medium 11 in a direction substantially normal to the surface of the filter medium 11 and opposite to the flow of filtrate through the filter medium (counter-flow). This localised counter-flow stream 23 continuously dislodges contaminants from the filtration side of the filter medium 11. Counter-flow fluid can either be make-up fluid or filtrate, but in either case has a small volume flow rate in comparison to the total filtrate flow rate. The contaminants which are dislodged by counter-flow stream 23 are removed from the filter medium 11 by a combination of gravity and process fluid flow.

A spray shield 24 may be provided as shown in Figs 2 and 3 (left off Fig 1 for clarity). This both contains counter-flow stream 23 and re-directs it back towards filter medium 11 to assist in clearing the contaminant 18.
Optional clearing-flow generator 30 is located on the filtration side of the filter medium 11 and directs a continuous localised clearing-flow stream 33 across the width of the filter medium 11 at an area on the surface of the filter medium 11 adjacent to the area through which the counter-flow stream 23 flows (shown in Fig 3 as area 34). This action assists in the clearing of the contaminants 18 from the surface of the filter medium 11. Clearing-flow generator 30 comprises a plurality of clearing-flow fluid outlets 31 which are mounted on clearing-flow conduit 32. Clearing-flow generator 30 is preferably arranged to move in unison with counter-flow generator 20.

In operation the counter-flow generator preferably operates continuously for both its upward and downward stroke across the filter medium, however the clearing-flow generator 30 preferably only operates on the downward stroke to assist in the clearing of contaminants from the surface of filter medium 11 and into contaminant collection tray 15. In industries such as the food processing industry the contaminant may be reclaimed which can be collected from collection tray 15 for value-added use.

Fig 3a shows a first portion of the filter system of Fig 1 in which the counter-flow stream enters the process fluid flow. Fig 3b is a similar view further down the inclined filter medium 11 in which the counter-flow stream is outside of the main process fluid flow.

The incline angle of the filter medium 11 can be varied for optimal operation. Generally shallow inclines have been found to be appropriate for fine contaminants and steeper inclines have been found to be more appropriate for larger contaminants. The optimum degree of incline is dependent upon: process flow rate and fluid properties; and the size and density of the contaminants. This first embodiment of the invention has been found to work particularly well in primary filtration of process fluids containing large masses of contaminant per unit volume as immediate separation of contaminant is achievable, in some applications obviating the need for a settling tank.
Filter medium 11 shown in Figs 1, 2 & 3 is a woven stainless steel mesh; however other filter medium such as woven or unwoven porous type materials such as fibrous cloth or sheet, paper or polymeric material may also be used.

The use of flexible filter media in combination with a high pressure counter-flow stream 23 has been found to give an enhanced contaminant clearing effect due to a localised area of the filter medium being bulged upwards by the localised counter-flow stream 23.

Figs 4 and 5 show a second embodiment of the invention in which the filter medium 11 is cylindrical in shape. In this embodiment, counter-flow fluid outlets 21 are mounted on counter-flow conduit 22 which is shaped as shown in Fig 4 for ease of illustration and arranged to rotate about an axis which is approximately coaxial with the axis of the filter medium 11. Motor 25 rotates counter-flow conduit 22 within said filter medium 11 thereby causing the counter-flow stream 23 to continuously traverse the filter medium 11 thereby continuously clearing contaminants from the filtration side of the filter medium 11. Filtrate is removed from within the cylindrical filter medium 11 by filtrate fluid outlet 17. Conduit 22 is connected to a pump means (not drawn) which provides sufficient flow of fluid to the fluid outlets 21 to produce a counter-flow stream sufficient to enable efficient dislodgment of contaminant from the filter medium 11. In this way contaminant does not substantially accumulate on the filter medium 11. The filter system of this second embodiment is preferably mounted within a settling tank 12 which contains the process fluid. A clearing-flow generator may also be used.

Figs 6a, b & c show a variant of the second embodiment of the invention in which the filter medium is divided up into a grid of elements, supported by battens 26, the centres of each filter medium element may bow in the direction of flow of the filtrate as contaminants accumulate. When accumulated contaminants cause a sufficient pressure differential across the filter medium, the fluid outlets 21 of the counter-flow
generator return so as to traverse the filtrate side of the filter medium and the localised countercurrent stream causes the direction of curvature (or bowing) of the filter medium to reverse thereby assist in the dislodgment (fling) of contaminant material away from the filter element 11.

This second embodiment of the invention is ideally suited for secondary or tertiary filtration of a settling tank where the concentration of contaminants is relatively low.

Fig. 7 shows a third embodiment of the invention in which the filter system 10 of Figs 4 & 5 is located within a cylindrical vessel 40 having a process fluid inlet 13, a filtrate fluid outlet 17 and a contaminant outlet 41 through which contaminant is periodically dumped. The longitudinal axis of the filter medium 11 and of the cylindrical vessel 40 is substantially vertical so as to maximise the settling of contaminants under the action of gravity. Process fluid inlet 13 is orientated such that process fluid enters cylindrical vessel 40 tangentially and flows in a circular motion around the filter medium 11. Particles or droplets entering the system which have a density higher than that of the suspending process fluid will separate due to the centrifugal effects generated by the rotating fluid. In this manner the more dense droplets or particles will move radially outwards. This effect lightens the contaminant loading on the filter medium 11 and therefore may negate the requirement for a separate clearing-flow generator. Where a separate clearing-flow generator is used (not shown in Fig. 7), the combined action of the aforementioned circular flow around filter medium 11 induced by the tangential inlet flow with the clearing-flow generator provides a highly effective arrangement for preventing the substantial accumulation of contaminants even with process fluids with relatively high contaminant loadings.

A plurality of the filtration systems according to the invention as described above can be used in series to selectively separate individual contaminants from a process flow.
In some applications a plurality of counter-flow generators will be optimum. Similarly, in some applications a plurality of clearing-flow generators will be optimum.

While the present invention has been described in terms of a preferred embodiment in order to facilitate better understand of the invention, it should be appreciated that various modifications can be made without departing from the principles of the invention. Therefore, the invention should be understood to include all such modifications within its scope.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A filter system comprising:
   a filter medium, for filtering contaminants from a process fluid, having a filtration side on which said contaminants collect and a filtrate side from which filtrate flows;
   a counter-flow generator located on said filtrate side that directs a localised stream of counter-flow fluid from said filtrate side to said filtration side of said filter medium to thereby dislodge said contaminants from said filtration side of said filter medium, wherein said localised stream traverses a substantial proportion of said filter medium.

2. A filter system according to claim 1 wherein the entire filter medium less the area through which said localised stream of counter-flow flows is continuously available for filtering contaminants.

3. A filter system according to claims 1 or 2 wherein said counter-flow fluid is a portion of said filtrate.

4. A filter system according to any of the preceding claims further comprising a clearing-flow generator located on said filtration side that directs a localised stream of clearing-flow fluid with a velocity component having a direction across an area on said filter medium adjacent the area at which said localised stream of counter-flow flows through said filter medium, and wherein said localised clearing-flow stream moves in unison with said localised counter-flow stream.

5. A filter system according to claim 4 wherein said clearing-flow fluid is a portion of said filtrate.

6. A filter system according to claims 1, 2 or 3 wherein:
said filter medium is substantially planar and is inclined from horizontal; said process fluid flows from the upper end of the topside of said inclined filter medium towards the lower end of said filter medium; said counter-flow generator comprises at least one fluid outlet orientated to direct counter-flow fluid towards said filter medium, and moveable in a direction substantially parallel to said filtrate side of said filter medium to continuously traverse a substantial proportion of the said filter medium; and a filtrate collection tray is provided under said filter medium.

7. A filter system according to claim 6 wherein said counter-flow generator produces an elongate counter-flow stream across said inclined filter medium which traverses down and up said inclined filter medium.

8. A filter system according to claims 6 or 7 further comprising a clearing-flow generator located on said filtration side that directs a localised stream of clearing-flow with a velocity component having a direction downwards and across an area on said filter medium adjacent the area at which said localised stream of counter-flow flows through said filter medium.

9. A filter system according to claim 8 wherein said localised clearing-flow stream moves in unison with said localised counter-flow stream during the downwards traverse of said inclined filter medium.

10. A filter system according to claims 6, 7, 8 or 9 wherein said process fluid flows over a weir located adjacent said upper end of the top side of said inclined filter medium thereby providing an evenly distributed process fluid flow onto said filter medium.

11. A filter system according to claims 1, 2, or 3 wherein said filter medium is substantially cylindrical in shape and said counter-flow generator comprises at least one fluid outlet which traverses said filter medium surface.
12. A filter system according to claim 11 wherein said counter-flow generator further comprises a manifold with a plurality of fluid outlets, said manifold being rotatable about an axis within said substantially cylindrical filter medium to traverse said filter medium.

13. A filter system according to claims 11 or 12 wherein said filter is divided into a grid of elements the centres of which bow towards the direction of flow of said filtrate upon sufficient pressure differential across said filter medium and, when exposed to said localised counter-flow, invert to bow in the direction of said counter-flow fluid to thereby assist in the dislodgment of said contaminants from said filter medium.

14. A filter system according to claims 11, 12 or 13 further comprising a clearing-flow generator located on said filtration side that directs a localised stream of clearing-flow fluid with a velocity component having a direction across an area on said filter medium adjacent the area at which said localised stream of counter-flow flows through said filter medium, and wherein said localised clearing-flow stream moves in unison with said localised counter-flow stream.

15. A filter system according to claim 14 wherein said clearing-flow is directed at a tangent to said filter medium.

16. A filter system according to claims 11, 12, 13, 14 or 15 wherein said substantially cylindrical filter medium is located within a settling tank and the longitudinal axis of said filter medium is substantially vertical.

17. A filter system according to claims 11, 12 or 13 further comprising a cylindrical vessel enclosing and substantially coaxial with said filter medium, said vessel having a process fluid inlet orientated so as to provide incoming process fluid with a velocity having a component tangential to said filter medium.
18. A filter system according to claim 16 further comprising a clearing-flow generator located on said filtration side that directs a localised stream of clearing-flow fluid with a velocity component having a direction across an area on said filter medium adjacent the area at which said localised stream of counter-flow flows through said filter medium, and wherein said localised clearing-flow stream moves in unison with said localised counter-flow stream.

19. A filter system according to claims 17 or 18 wherein the longitudinal axis of said filter medium is substantially vertical and said inlet is located at the upper end of said enclosing cylindrical vessel and further comprising an contaminant discharge point at the lower end of said enclosing cylindrical vessel.

20. A filter system according to claim 19 wherein said lower end of said enclosing cylindrical vessel is a frusto-conical section adapted to allow said contaminants to accumulate and be discharged from.

21. A filter system as hereinbefore described with reference to and as illustrated in the accompanying Figures 1 to 3.

22. A filter system as hereinbefore described with reference to and as illustrated in the accompanying Figures 4 to 5.

23. A filter system as hereinbefore described with reference to and as illustrated in the accompanying Figures 4 to 6.

24. A filter system as hereinbefore described with reference to and as illustrated in the accompanying Figures 7.
AMENDED CLAIMS

[received by the International Bureau on 6 March 1998 (06.03.98);
original claims 1-24 replaced by amended claims 1-25 (5 pages)]

1. A filter system comprising:

   a filter medium, for filtering contaminants from a process fluid, having a filtration side on which said contaminants collect and a filtrate side from which filtrate flows;

   a counter-flow generator located on said filtrate side that directs a localised stream of counter-flow fluid from said filtrate side to said filtration side of said filter medium to thereby dislodge said contaminants from said filtration side of said filter medium, wherein said localised stream traverses a substantial proportion of said filter medium;

   a clearing-flow generator located on said filtration side that directs a localised stream of clearing-flow fluid with a velocity component having a direction across an area on said filter medium adjacent the area at which said localised stream of counter-flow flows through said filter medium, and wherein said localised clearing-flow stream moves in unison with said localised counter-flow stream.

2. A filter system according to claim 1 wherein the entire filter medium less the area through which said localised stream of counter-flow flows is continuously available for filtering contaminants.

3. A filter system according to claims 1 or 2 wherein said counter-flow fluid is a portion of said filtrate.

4. A filter system according to claims 1 or 2 or 3 wherein said clearing-flow fluid is a portion of said filtrate.

5. A filter system according to claims 1, 2, 3 or 4 wherein said filter medium is substantially cylindrical in shape and said counter-flow generator comprises at least one fluid outlet which traverses said filter medium surface.
6. A filter system according to claim 5 wherein said counter-flow generator further comprises a manifold with a plurality of fluid outlets, said manifold being rotatable about an axis within said substantially cylindrical filter medium to traverse said filter medium.

7. A filter system comprising:
   a filter medium, for filtering contaminants from a process fluid, having a filtration side on which said contaminants collect and a filtrate side from which filtrate flows;
   a counter-flow generator located on said filtrate side that directs a localised stream of counter-flow fluid from said filtrate side to said filtration side of said filter medium to thereby dislodge said contaminants from said filtration side of said filter medium, wherein said localised stream traverses a substantial proportion of said filter medium;
   wherein said filter medium is substantially planar and is inclined from horizontal;
   said process fluid flows from the upper end of the topside of said inclined filter medium towards the lower end of said filter medium;
   said counter-flow generator comprises at least one fluid outlet orientated to direct counter-flow fluid towards said filter medium, and moveable in a direction substantially parallel to said filtrate side of said filter medium to continuously traverse a substantial proportion of the said filter medium; and
   a filtrate collection tray is provided under said filter medium.

8. A filter system according to claim 7 wherein said counter-flow generator produces an elongate counter-flow stream across said inclined filter medium which traverses down and up said inclined filter medium.

9. A filter system according to claims 7 or 8 further comprising a clearing-flow generator located on said filtration side that directs a localised stream of clearing-flow with a velocity component having a direction downwards and across an area on
said filter medium adjacent the area at which said localised stream of counter-flow flows through said filter medium.

10. A filter system according to claim 9 wherein said clearing-flow generator comprises at least one fluid outlet.

11. A filter system according to claim 10 wherein said clearing-flow generator produces an elongate clearing-flow stream.

12. A filter system according to claim 11 wherein said localised clearing-flow stream moves in unison with said localised counter-flow stream during the downwards traverse of said inclined filter medium.

13. A filter system according to claims 7, 8, 9, 10, 11 or 12 wherein said process fluid flows over a weir located adjacent said upper end of the top side of said inclined filter medium thereby providing an evenly distributed process fluid flow onto said filter medium.

14. A filter system comprising:

a filter medium, for filtering contaminants from a process fluid, having a filtration side on which said contaminants collect and a filtrate side from which filtrate flows;

a counter-flow generator located on said filtrate side that directs a localised stream of counter-flow fluid from said filtrate side to said filtration side of said filter medium to thereby dislodge said contaminants from said filtration side of said filter medium, wherein said localised stream traverses a substantial proportion of said filter medium;

wherein said filter medium is substantially cylindrical in shape and said counter-flow generator comprises at least one fluid outlet which traverses said filter medium surface and
wherein said filter medium is divided into a grid of elements the centres of which bow towards the direction of flow of said filtrate upon sufficient pressure differential across said filter medium and, when exposed to said localised counter-flow, invert to bow in the direction of said counter-flow fluid to thereby assist in the dislodgment of said contaminants from said filter medium.

15. A filter system according to claim 14 wherein said clearing-flow generator comprises at least one fluid outlet.

16. A filter system according to claim 15 wherein said clearing-flow generator further comprises a manifold with a plurality of fluid outlets, said manifold being rotatable about an axis within said substantially cylindrical filter element to traverse said filtration side of said filter medium.

17. A filter system according to claim 15 or 16 wherein said clearing-flow is directed at a tangent to said filter medium.

18. A filter system according to claims 14, 15 or 16 wherein said substantially cylindrical filter medium is located within a settling tank.

19. A filter system according to claims 14, 15, 16, 17 or 18 further comprising a cylindrical vessel enclosing and substantially coaxial with said filter medium, said vessel having a process fluid inlet orientated so as to provide incoming process fluid with a velocity having a component tangential to said filter medium.

20. A filter system according to claim 19 wherein the longitudinal axis of said filter medium is substantially vertical and said inlet is located at the upper end of said enclosing cylindrical vessel and further comprising a contaminant discharge point at the lower end of said enclosing cylindrical vessel.
21. A filter system according to claim 20 wherein said lower end of said enclosing cylindrical vessel is a frusto-conical section adapted to allow said contaminants to accumulate and be discharged from.

22. A filter system as hereinbefore described with reference to and as illustrated in the accompanying Figures 1 to 3.

23. A filter system as hereinbefore described with reference to and as illustrated in the accompanying Figures 4 to 5.

24. A filter system as hereinbefore described with reference to and as illustrated in the accompanying Figures 4 to 6.

25. A filter system as hereinbefore described with reference to and as illustrated in the accompanying Figure 7.
Claim 4 is deleted and its elements are incorporated into amended claim 1. Claims 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 17, 19 and 20 are amended and accordingly renumbered to 2, 3, 4, 7, 8, 9, 12, 13, 5, 16, 17, 18, 19, 20 and 21 respectively. Claims 13, 14 and 18 have been deleted and alternative new claims 6, 10, 11, 14 and 15 are included. Claims 21 to 24 have been renumbered to become claims 22 to 25.

In the International Search Report, all the patents cited by the Examiner were considered of particular relevance to the novelty of claims 1-3, 11-12. These claims have been deleted or otherwise amended and other claims have been added. Some claims have been amended to better distinguish the invention from the cited prior art, and others to better define the invention.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl\(^0\): B01D 35/16, 29/68

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)
B01D 35/16, 29/68

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic database consulted during the international search (name of database and, where practicable, search terms used)
WPAT: COUNTER (W) FLOW: OR COUNTERFLOW: OR OPPOSITE: (S) DIRECTION OR AGAINST OR OPPOSING

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 4 859 335 A (WHYTE) 22 August 1989 See column 1 lines 40-65 &amp; column 3 lines 15-18 and figures 1-5.</td>
<td>1-3, 11-12</td>
</tr>
<tr>
<td>X</td>
<td>WO 96/36416 A (ANDERSON) 21 November 1996 See claims and figures 1-3.</td>
<td>1-3, 11-12</td>
</tr>
<tr>
<td>X</td>
<td>US 5 490 924 A (MACIA et al.) 13 February 1996 See claim 1-9 and figures 1-3.</td>
<td>1-3, 11-12</td>
</tr>
</tbody>
</table>

\[\checkmark\] Further documents are listed in the continuation of Box C

\[\checkmark\] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" 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)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" 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
"X" 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
"Y" 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
2 January 1998

Date of mailing of the international search report
13 JAN 1998

Name and mailing address of the ISA/AU
AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION
PO BOX 200
WODEN ACT 2606
AUSTRALIA Facsimile No.: (02) 6285 3929

Authorized officer
J. Deis
Telephone No.: (02) 6283 2146

Form PCT/ISA/210 (second sheet) (July 1992) copima
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 5 006 136 A (WETTER) 9 April 1991 See column 1 lines 64-68 to column 2 lines 1-38.</td>
<td>1-2, 11-12</td>
</tr>
<tr>
<td>X</td>
<td>GB 2 157 964 A (SWINNEY ENGINEERING LIMITED) 6 November 1985 See whole document.</td>
<td>1-3, 11-12</td>
</tr>
<tr>
<td>X</td>
<td>US 5 152 891 A (NETKOWICZ et al.) 6 October 1992 See column 1 lines 53-68 to column 2 lines 1-49 and figures 1-7.</td>
<td>1-3, 11-12</td>
</tr>
</tbody>
</table>
INTERNATIONAL SEARCH REPORT
Information on patent family members

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ZA 8800848</td>
<td></td>
</tr>
<tr>
<td>WO 96/36416 AU 54938/96</td>
<td></td>
</tr>
<tr>
<td>US 5490924 -</td>
<td></td>
</tr>
<tr>
<td>US 5006136 CA 2005432 CH 677453 EP 378100</td>
<td></td>
</tr>
<tr>
<td>GB 2157964 -</td>
<td></td>
</tr>
<tr>
<td>US 5152891 -</td>
<td></td>
</tr>
</tbody>
</table>

END OF ANNEX