DISCHARGE S i

A liquid treatment apparatus (10) for treating a liquid mixture comprising a carrier liquid and one or more contaminants comprises a reservoir (12) having a separating chamber (14) and a discharge chamber (16) in fluid communication with the separating chamber (14). The separating chamber (16) separates contaminants from the carrier liquid on the basis of difference in specific gravity to produce a treated carrier liquid (18) and a lower specific gravity fraction (20) that floats on the treated carrier liquid (18). The discharge chamber (16) receives both the treated carrier liquid (18) and the lower specific gravity fraction (20) and is provided with an outlet (22) for the lower specific gravity fraction (20) and an outlet (24) for the treated carrier liquid (18). The discharge chamber (16) has a maximum liquid level L higher than a maximum liquid level of the separating chamber (14). A shroud (28) is located in the chamber (16) and has an open upper end (30), an open lower end (32), and an opening (34), shroud (28) intermediate the ends (30) and (32). The upper end (30) is located at a position within the discharge chamber (16) above a maximum liquid level L within the chamber (16). Accordingly, no liquid is able to flow over the upper end (30) into the shroud (28). The treated water outlet (24) has an upper end (36) disposed inside of the shroud (28) but below the upper end (30). The treated water (18) passes into the shroud (28) through both the open lower end (32) and the intermediate opening (34). The treated water is able to flow over the upper end (36) and down through the treated water outlet (24) for discharge from the discharge chamber (16).
LIQUID TREATMENT APPARATUS

Field of the Invention

5 The present invention relates to a liquid treatment apparatus, and in particular, but not exclusively, a liquid treatment apparatus for treating washing liquid from a parts washing machine.

Background of the Invention

10 A parts washing machine comprises a cabinet defining a washing chamber and a tank holding a volume of washing liquid. The liquid is drawn from the tank and sprayed via a manifold into the washing chamber to clean articles placed therein. The liquid then drains back into the tank. Contaminants, such as oil, dirt, metal filings and the like washed from the articles become entrained in the liquid and flow back into the tank. In order to maintain washing efficiency the contaminants should be removed from the liquid and the tank purged from time to time.

20 The handling and disposal of used washing liquid in the parts washing machine is also subject to stringent regulation. For example, it is not permitted to simply pump used cleaning liquid into drains unless the liquid contains less than a prescribed amount of various contaminants. Accordingly specialist waste water handling regimes need to be followed which by their very nature add cost to the operators and users of parts washing machines.

In order to reduce the handling of used washing liquid it is known to also provide stand alone separators that are plumbed to the parts washing machine for the purposes of removing contaminants from the cleaning liquid held within the tank. This assists in extending the time between purging of the tank. Often, at that time the separator will also require cleaning and/or maintenance.

The present invention was developed with a view to attempting to alleviate or minimise the difficulty and costs involved in handling used cleaning liquid and extending the life of cleaning liquid in a parts washing machine. However as it will be apparent from the following description, embodiments of the invention
are not limited to use with parts washing machines and may indeed be used for treating liquid derived from a variety of machines, apparatus or processes.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

In the claims of this application and in the description of the invention, except where the context requires otherwise due to express language or necessary implication, the words "comprise" or variations such as "comprises" or "comprising" are used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

Summary of the Invention

According to the present invention there is provided a liquid treatment apparatus for treating a liquid mixture comprising a carrier liquid and one or more contaminants, the apparatus comprising:

- a reservoir having a separating chamber and a discharge chamber in fluid communication with, and downstream of, the separating chamber;
- the separating chamber being arranged to separate the contaminants from the carrier liquid on the basis of a difference in specific gravity to produce a treated carrier liquid and at least a lower specific gravity fraction that floats on the treated carrier liquid;
- the discharge chamber receiving the lower specific gravity fraction and the treated carrier liquid and provided with an outlet for the lower specific gravity fraction and an outlet for the treated carrier liquid, and wherein the discharge chamber has a maximum liquid level higher than a maximum liquid level of the separating chamber.

The separating chamber may be arranged so that, when in use, maximum liquid level within the separating chamber increases in the downstream direction.

The discharge chamber may be configured so that a surface area of a liquid contained at the maximum liquid level of the discharge chamber is less than a
surface area of a liquid contained at the maximum level of the separating chamber.

The reservoir may be configured to have a depth that increases in a downstream direction. The discharge chamber may be configured to have a depth that is below a maximum depth of the separating chamber.

The separating chamber may be arranged to separate contaminants having a higher specific gravity than the carrier liquid from the liquid mixture to produce a higher specific gravity fraction that sinks in the reservoir.

The liquid treatment apparatus may comprise an inlet manifold providing fluid communication between a supply of the liquid mixture and the separating chamber, the inlet manifold provided with an intermediate portion that is disposed above the maximum liquid level of the separating chamber.

The treatment apparatus may further comprise a breather hose in fluid communication with the intermediate portion, the breather hose venting the intermediate portion to atmospheric pressure.

The discharge chamber may comprise a shroud having an open lower end, an open upper end, and an intermediate opening between the lower end and the upper end wherein the treated carrier liquid can flow through the intermediate opening into the shroud.

The treated carrier liquid outlet may have an open upper end located inside the shroud and below the upper end of the shroud.

The apparatus may be provided with a lower specific gravity contaminant outlet disposed in the discharge chamber outside of the shroud and having an upper end at a level between the upper end of the shroud and the upper end of the treated carrier liquid conduit.

The discharge chamber may comprise a purge outlet.
The purge outlet may comprise an open upper end located inside the shroud and above the lower end of the shroud. The upper end of the purge outlet is at a level below a minimum depth of the separating chamber.

5 The liquid treatment apparatus may further comprise a flow director disposed in the reservoir adjacent a location where the inlet manifold connects to the reservoir whereby the liquid mixture entering the reservoir through the inlet manifold is deflected by the deflector plate to generate a flow along an upper surface of the separating chamber and a flow along a lower surface of the separating chamber.

The liquid treatment apparatus may further comprise a plurality of coalescing plates disposed in the separating chamber and through which a substantial volume of the liquid mixture flows prior to reaching the discharge chamber.

15 The liquid treatment apparatus according to any one of claims 1 - 16 comprising a flushing manifold configured to direct a flushing liquid into the reservoir chamber to enable flushing of the reservoir.

20 A second aspect of the invention provides a parts washing machine comprising: a washing chamber; a tank for holding a supply of washing liquid; a washing manifold for spraying washing liquid from the tank onto articles to be cleaned held in the washing chamber; and a liquid treatment apparatus according to the first aspect in fluid communication with the tank wherein liquid from the tank can be passed through the liquid treatment apparatus to produce treated washing liquid, wherein the treated washing liquid is returned to the tank.

30 The parts washing machine may comprise a skimming device disposed in the tank and a conduit providing fluid communication between the skimming device and separating chamber of the liquid treatment apparatus, wherein liquid treated by the liquid treatment apparatus is skimmed from an upper surface of washing liquid held in the tank.

35 The skimming device may comprise a sleeve made of a pliable material having an inlet and an outlet and a float disposed about the inlet.
The skimming device may comprise a spreading device arranged to hold a portion of the sleeve between the inlet and the outlet open.

The parts washing machine may comprise a contaminants tank wherein the outlet for the lower specific gravity fraction is in fluid communication with the contaminants tank.

The outlet for the treated carrier liquid may be in fluid communication with the tank holding the washing liquid.

The purge outlet may be coupled by a drain conduit to the tank holding the washing liquid, and wherein the parts washing machine further comprises a drain valve disposed in the drain conduit wherein the drain valve can be selectively opened and closed to respectively allow and block fluid communication between the tank holding the washing liquid and the reservoir.

The parts washing machine may comprise an internal cover for the tank holding the washing liquid, and a linkage system coupled between the internal cover and the drain valve wherein when the internal cover is in a position covering the washing liquid tank the linkage system closes the drain valve and when the internal cover is in a lifted position the linkage system opens the drain valve.

The parts washing machine may comprise a first pump which is operable to transfer liquid from the washing liquid tank to the washing manifold and a second pump for transferring liquid from the washing liquid tank to the inlet manifold of the liquid treatment apparatus.

The washing liquid tank may be in selective fluid communication with the flushing manifold.

The parts washing machine may comprise a flushing conduit providing fluid communication between the first pump and the flushing manifold and a flushing valve in the flushing conduit wherein washing liquid is transferred from the washing liquid tank by the first pump through the flushing conduit to the flushing manifold when the flushing valve is open.
Brief Description of the Drawings

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

5 Figure 1 is a first angle perspective view of an embodiment of a liquid treatment apparatus;
Figure 2 is an opposite angle perspective view of the liquid treatment apparatus shown in Figure 1;
10 Figure 3 is a plan view of the liquid treatment apparatus;
Figure 4 is a first end view of the liquid treatment apparatus;
Figure 5 is a second end view of the liquid treatment apparatus;
Figure 6 is a view of section AA of Figure 3;
Figure 7 is a view of section BB of Figure 3;
15 Figure 8 is a representation of internal components of the liquid treatment apparatus;
Figure 9 is a representation of a parts washing machine with which the apparatus may be coupled and used;
Figure 10 is a further representation of the parts washing machine;
20 Figure 11 is a representation of the apparatus coupled to the parts washing machine; and,
Figure 12 is a schematic representation of a skimmer sock that may be incorporated in a parts washing machine.

Detailed Description of Preferred Embodiments

With reference to the accompanying drawings, a liquid treatment apparatus 10 for treating a liquid mixture comprising a carrier liquid (such as water with detergent), and one or more contaminants (such as oil, sand particles and metal filings) comprises a reservoir 12 having a separating chamber 14 and a discharge chamber 16 in fluid communication with, and downstream of, the separating chamber 14. The separating chamber 16 is arranged to separate contaminants from the carrier liquid on the basis of difference in specific gravity so as to produce a treated carrier liquid, depicted by arrows 18 in Figure 7, and a lower specific gravity fraction, depicted by dots 20 in Figure 7, that floats on the treated carrier liquid 18. The discharge chamber 16 receives both the treated carrier liquid 18 and the lower specific gravity fraction 20 and is
provided with an outlet 22 for the lower specific gravity fraction 20 and an outlet 24 for the treated carrier liquid 18. As is readily apparent from Figures 1, 2, 6 and 7 the discharge chamber 16 has a maximum liquid level L higher than a maximum liquid level of the separating chamber 14.

Referring to Figure 6 and 7, the liquid level within the separating chamber 14 increases in the downstream direction. This is achieved by forming the separating chamber 14 with an upper surface 26 that is inclined upwardly in a downstream direction. The upper surface is formed in part by the bottom surface of a foam block 27 attached to a lid 29 that is placed on an opening 31 in the separating chamber 14. The block 27 is dimensioned so that its bottom surface is substantially co-planar with the inside surface of a top wall 33 of the separating chamber 14. However, the maximum liquid level within the separating chamber 14 remains below the maximum liquid level within the discharge chamber 16. Accordingly, the lower specific gravity fraction 20 is encouraged to flow toward and into the discharge chamber 16 and floats on top of the treated carrier liquid 18 in the discharge chamber 16.

A shroud 28 which in essence comprises a length of pipe is disposed in a vertical plane within the discharge chamber 16 and is formed with an open upper end 30 and an open lower end 32. An opening 34 is also formed in the shroud 28 intermediate the ends 30 and 32. The upper end 30 is located at a position within the discharge chamber 16 above a maximum liquid level L within the chamber 16. Accordingly, no liquid is able to flow over the upper end 30 into the shroud 28.

The treated water outlet 24 which is in the form of a conduit has an upper end 36 disposed inside of the shroud 28 but below the upper end 30. The treated water 18 passes into the shroud 28 through both the open lower end 32 and the intermediate opening 34. The treated water is able to flow over the upper end 36 and down through the treated water outlet 24 for discharge from the discharge chamber 16. (As explained in greater detail below, when the apparatus is used to treat wash liquid in a parts washer, the treated water from outlet 24 is directed back to a wash water tank of the parts washer.)

The lower specific gravity fraction outlet 22 comprises a funnel having a widened upper end 38 that is at a level below the upper end 30 of the shroud
28 but above the upper end 36 of the treated water outlet 24. The outlet 22 while located in the discharge chamber 16 is outside of the shroud 28 as seen most clearly in Figures 3 and 8.

It will be appreciated that due to the location of the intermediate inlet 34 the lower specific gravity fraction 20 is unable to enter the shroud 28 and sits on top of the treated carrier liquid within the discharge chamber 16 below the upper end 30 of the shroud 28. Assuming the lower specific gravity contaminants build up to a level above the upper end 38 of the outlet 22, they will flow through the outlet 22 out of the discharge chamber 16. The contaminants may be directed to a collection tank.

An inlet manifold 40 is coupled to an end wall 42 of the reservoir 12 distant the discharge chamber 16. The inlet manifold 40 is plumbed to an opening 44 located approximately in the centre of the wall 42. The liquid mixture to be treated (for example wash water from a parts washing machine) is pumped through the inlet manifold 40 through the opening 44 and into the reservoir 12. Located between the inlet 44 and the discharge chamber 16 is a treatment cell in the form of a coalescing plate separator 46. The liquid mixture must pass through the separator 46 prior to flowing into the discharge chamber 16. The separator 46 separates contaminants from the liquid mixture on the basis of difference in specific gravity. Thus lower specific gravity contaminants such as oil that have separated from the mixture form the lower specific gravity fraction 20. Similarly, higher specific gravity contaminants such as metal filings and dirt that are separated from the liquid mixture and sink to form a higher specific gravity fraction 48, represented by crosses in Figure 7.

More particularly the coalescing plate separator comprises a plurality of PVC corrugated sheets which attract small oil drops in the liquid passing through the separator 46. The small oil drops coalesce on the surface of the plates to form larger drops that can slide up the surface and break free, rising quickly to become entrained in, and form, the lower specific gravity fraction 20 flowing across the top of the chamber 14 to the chamber 16. In addition small particles or solid material coated with oil is attached to the plates but slide to the bottom of the plates due to their higher specific gravity and mass. These finally fall from the bottom of the plates to form settled solids in the fraction 48. One
example of a coalescing plate separator that may be incorporated in the apparatus 10 is one of the Brentwood AccuPac® coalescing plate packs.

As is readily apparent from Figures 6 and 7 the depth of the reservoir 12 increases in the downstream direction. Thus the discharge chamber 16 has a depth greater than the depth of the separating chamber 14. This increase in depth in the downstream direction is manifested by a planar bottom wall 50 of the reservoir 12 that slopes downwardly in the downstream direction.

A purge outlet 52 is provided in the discharge chamber 16 for purging the reservoir 12 and discharging the fraction 48. The outlet 52 has an upper end 54 that is located inside of the shroud 28 and above the lower end 32. Additionally, the upper end 54 is above the minimum depth of the separating chamber 14.

The inlet manifold 40 is formed with an intermediate portion in the form of an inverted U bend 56. The intermediate portion 56 extends above the maximum water level within the separating chamber 14 and indeed above the maximum liquid level L within the discharge chamber 16. A breather tube 58 is in fluid communication with the intermediate portion 56 and vents the inlet manifold 40 to atmosphere. This is achieved by coupling an opposite end of the breather tube 58 to a removable cover plate 60 that is placed over the discharge chamber 16. An air filled void 62 exists between the upper liquid level within the discharge chamber 16 and the cover plate 60. The void 62 is at atmospheric pressure.

A deflection plate 64 (see Figures 7 and 8) is located inside the separating chamber 14 upstream of the separator 46 and in alignment with the opening 44. The deflection plate 64 acts to spread the flow of liquid mixture entering the reservoir 12 to provide a flow generally across the entire depth of the separating chamber 14 and in particular the coalescing plate separator 46. It is believed that this may also create a flow in the downstream direction along the upper surface 26 and the bottom wall 50 to assist in migrating or sweeping the lower specific gravity fraction 20 and the higher specific gravity fraction 48 toward the discharge chamber 16.
The apparatus 10 also incorporates a flushing manifold 66 to enable cleaning of the interior of the reservoir 12 and in particular the coalescing plate separator 46. The flushing manifold 66 comprises a pipe 68 located on the outside of the reservoir 12 and in fluid communication with an intermediate pipe 70 and two parallel end pipes 72. The two end pipes 72 extend transversely through the separating chamber 16 on either side of the opening 40 and between the separator 46 and the wall 44. The pipes 72 are provided with a plurality of openings or nozzles to spray a flushing fluid (typically a combination of pressurised air and water) represented by lines 74 across and through the separator 46. The pipe 70 also extends transversely through the reservoir 12 but at a location between the discharge chamber 16 and a downstream end of the separator 46. The pipe 70 is also provided with a plurality of outlets or nozzles that direct the flushing fluid 76 in a downward direction toward the bottom wall 50.

Removable end caps 71 (see Figure 8) are attached to ends of the pipes 70 and 72 and are accessible from outside the reservoir 12. The end caps 71 can be removed from time to time to enable cleaning of the pipes 70 and 72.

A valve 78 is placed in the outlet 50. When the apparatus 10 is in normal operation, the valve 78 is shut to prevent the discharge of any liquid through the outlet 52. However when the apparatus 10 is being flushed (i.e. cleaned), the valve 78 is opened and the flushing fluid passed through the flushing manifold 66 to clean the inside of the apparatus 10 and in particular the coalescing plate separator 46 and the internal walls of the reservoir 12 can subsequently be purged through the outlet 52.

It will be appreciate that due to the relative positioning of the outlet 42, shroud 28, and sloping bottom wall 50, it is not possible to completely empty the reservoir 12 during a flushing or cleaning cycle. A small volume of liquid will remain within the reservoir 12. This acts to trap any remaining lower specific gravity fraction (for example oil) within the reservoir 12.

The apparatus 10 may be used in conjunction with a parts washing machine in a manner similar to that described in Applicant's international publication no. WO 2007/093001, the contents of which is incorporated herein by way of reference.
Figures 9, 10 and 11 illustrate an embodiment of the apparatus 10 coupled with a parts washing machine 90. The parts washing machine 90 comprises a cabinet 92 having a pivoting lid 94. The cabinet 92 defines a washing chamber 96 in which articles to be cleaned are held, and a tank 98 for holding a volume of cleaning liquid used to wash the parts, this liquid typically comprising a mixture of water and quick break detergent. Inside the cabinet 92 is a turn table basket 100 (shown in a raised position in Figure 10) in which the parts to be cleaned are held, and a manifold 102 for spraying cleaning liquid onto the parts.

Cleaning liquid from the tank 98 can be drawn by a pump 104 via a conduit 106 (see Figure 11). The pump 104 has an outlet 108 to which is plumbed a two way valve 110. The valve 110 has one port connected to a conduit 112 that supplies the cleaning liquid to the manifold 102. A second port of the valve 110 is coupled to a discharge conduit 114 in which is disposed a discharge valve 116.

A linkage system 118 couples the lid 94 to the valve 110. The linkage 118 operates to move the valve 110 to a wash position in which the valve 110 places the conduit 112 in fluid communication with the outlet 108 so that cleaning liquid is directed via the pump 104 to the manifold 102. However when the lid 94 is moved to an open position the linkage system 118 moves the valve 110 to a discharge position where it isolates the conduit 112 from the outlet 108 and places the discharge conduit 114 in communication with the outlet 108 so that cleaning liquid from the pump 104 is directed to the discharge valve 116.

The apparatus 10 is attached to the parts washer 90 and is able to treat liquid from the tank 98 by virtue of: an oil skimmer 123 that floats in the tank 98 and is attached to a conduit 122 that in turn is plumbed to an inlet of a transfer pump 120 and a hose 119 connecting an outlet of the pump 120 to the inlet manifold 40. Thus, when the pump 120 is operated, liquid from the tank 98 is drawn through the conduit 122 and directed into the reservoir 12 by the inlet manifold 40. Due to the operation of the oil skimmer 123 the liquid supplied to the inlet manifold is highly concentrated in oil and other lower specific gravity contaminants contained in the tank 98.
The skimmer 123 depicted in Figure 10 is a bellows type skimmer which is typically made from a plurality of pieces of material that are stitched together to form a bellows or concertina like structure.

Figure 12 depicts an alternate form of skimmer 123' that may be incorporated in the parts washer irrespective of whether or not the liquid treatment apparatus 10 is coupled to the parts washer 90. The skimmer 123' comprises a sleeve or sock 142 made from a self collapsing or pliable material such as a silicone mesh membrane, and having an inlet 144 at one end, and an outlet 146 at an opposite end. A float 148 is disposed about the inlet 144 and provides buoyancy for the skimmer 123' so that the inlet 144 is substantially at the level of a liquid in which the skimmer is disposed. A spreading device 150 is arranged to hold a portion of the sock 142 between the inlet 144 and the outlet 146 open. This prevents the sock 142 from collapsing upon itself which may restrict or in a worse case scenario block flow of liquid through the skimmer 123'.

In this particular embodiment, the spreading device 150 comprises a ring 152 of a relatively rigid material that extends about the outside of the sock 142 and is coupled to the sock by a plurality of clamps or clips 154. However in an alternate embodiment, the spreading device 150 may be placed inside of the sock 142. When placed inside the sock, the spreading device 154 need not necessarily be in the form of a ring 152. For example the spreading device may have configurations such as a square, or a wagon wheel, or a star. The device 150 may be placed approximately midway between the inlet 144 and the outlet 146. If desired, two or more spreading devices may be incorporated. In yet a further embodiment, a structure similar to a longitudinal helical spring may be inserted into the sock 142 to maintain the sock in an open condition.

A flushing conduit 125 (Figure 11) provides fluid communication between the outlet 108 of the pump 104 downstream of the valve 110 on a side in communication with the conduit 114 and the flushing manifold 66. The conduit 125 may be either upstream or downstream of valve 116. A valve 127 is placed in the conduit 125 near a control panel 129 of the parts washer 90.

The outlet 22 of the apparatus 10 through which the lower specific gravity fraction flows out of the discharge chamber 16 is connected by conduit 97 to a
contaminants tank 124 supported on the parts washer 90. The treated water outlet 24 is coupled via a conduit 99 back to the tank 98. Thus the cleaned liquid from the apparatus 10 is directed back into the tank 98. The outlet 52 of the apparatus 10 is connected via the valve 78 to a drain conduit 79 back to the tank 98. The valve 78 is connected via a linkage system 128 to an internal cover 133 (see Figure 10) of the tank 98. When the lid 94 is open and the internal cover 133 lifted, the linkage system 128 opens the valve 78 so that the contents of the reservoir 12 can drain via the outlet 52 and drain conduit back into the tank 98.

During a normal washing cycle of the parts washer 90, cleaning liquid is being circulated by the pump 104 from the tank 98 to the manifold 102. The transfer pump 120 is typically OFF during the washing cycle. However when it is desired to treat the cleaning liquid within the tank 98, the transfer pump 120 is activated so as to draw the cleaning liquid from the tank 98 through the apparatus 10. The pump 120 is typically activated while the main pump 104 is OFF. The cleaning liquid passes through the separating chamber 14 to separate lower and higher specific gravity fractions which then pass to the discharge chamber 16. The lower specific gravity fraction which typically comprises oil with entrapped dirt flows through the outlet 22 to the contaminant tank 124. The higher specific fraction settles at the bottom of the reservoir 12, and the cleaned or treated wash water is returned to the tank 98 via the outlet 24. During this process, the separating chamber 14 is flooded (i.e. completely filled with liquid) while the discharge chamber 16 is filled to the level between the upper end 38 of the outlet 22 and 36 of the shroud 28 thereby leaving a void 62.

The activation of the transfer pump 120 may be on a timer basis or by computer control which may for example activate the transfer pump 120 for say 10 minutes after the completion of a normal wash cycle of the parts washer 90, or alternately operate the pump 120 outside of normal business hours. While the transfer pump 120 may be activated during a normal washing cycle (i.e. while the pump 104 is ON) it is believed efficiency of the treatment apparatus 10 is maximized when the liquid within the tank 98 is stagnant which ordinarily would occur when the pump 104 is OFF.
In order to service and clean the inside of the apparatus 10, a liquid is sprayed into the reservoir 12 via the flushing manifold 66. This liquid is supplied from the tank 98 of the parts washer 90 and is delivered to the flushing manifold 66 by the pump 104 and conduits 125 and 131 when the valve 127 is open and the valve 110 is in the discharge position. The flushing fluid is directed at pressure through the separator 46 and also flushes the inside of the bottom wall 50.

During the flushing process, the valve 78 is open to allow the flushed contents of the reservoir 12 to flow into the tank 98. Due to the positioning of the upper end 54 of the outlet 52, the lower end 32 of the shroud 28 and the slope of the bottom wall 50, it will be appreciated that not all of the liquid within the reservoir 12 will be able to escape through the outlet 52. A small volume of liquid will remain within the reservoir 12. Specifically, a small amount of the lower specific gravity fraction (i.e. contaminants that are lighter than the cleaning liquid) will remain within the reservoir 12. When the apparatus 10 is next used to treat the water, this remaining lower specific gravity fraction will float to the top of the reservoir 12 and be discharged via the outlet 22.

During the flushing process, the flushing fluid may pass through the breather hose 58 and be discharged into the discharge chamber 16.

When the transfer pump is OFF and the reservoir 12 filled (e.g. between treatment cycles) the breather tube 58 acts to prevent siphoning of fluid from the reservoir 12 back through the transfer pump 120 in the event of a leaking seal within the pump 120. This occurs because the breather tube 58 is in fluid communication with atmospheric pressure in the void 62 and due to the intermediate portion 56 of the inlet manifold 40 being raised above the liquid level.

When the apparatus 10 is coupled with a parts washer 90, to form an integrated unit the operation of the apparatus 10 and in particular its servicing can be integrated with that of the parts washer 90. In particular, the integrated unit can be structured so that every time the parts washer 90 is serviced, the separator 10 is also serviced. This may be achieved by the following operating sequence.

Firstly, the lid 94 of the parts washer 90 is opened then the turn table basket 100 and the tank cover 133 are lifted. Lifting the lid 94 and the tank cover 133 will cause linkage 118 to operate to switch the valve 110 to the discharge
position providing fluid communication between the pump 104 and the discharge valve 116; and also operate the linkage 128 to open the valve 78. This allows all liquid within the reservoir 12 to drain into the main tank 98. During this period which may be set to for example 10 - 20 seconds, the parts washer 90 and the treatment apparatus 10 are disabled i.e. the pumps 104 and 120 will not operate. An indicator such as a light may then illuminate on the control panel 129 of the washing apparatus 10 to instruct an operator to open the valve 127 and "press start". The pump 104 then pumps water through (a) the conduit 125, valve 127 and conduit 131 to the flushing manifold to thereby flush the reservoir 12 and separate 26; and (b) through the discharge valve 116 thus purging the tank 98. The pump 104 operates on a timer (e.g. for 10 seconds) until the reservoir 12 is filled and then turns OFF. At this time a further indicator on the control panel 129 on the parts washer 90 illuminates providing the operator with a message to "close the valve 127 and press start".

Now the pump 104 operates to drain the remaining water from the tank 98 through the discharge valve 116. Once the water is discharged from the tank 98, the cover plate of the tank is closed, the lid 94 closed and the tank 98 refilled.
Claims:

1. A liquid treatment apparatus for treating a liquid mixture comprising a carrier liquid and one or more contaminants, the apparatus comprising:
   a reservoir having a separating chamber and a discharge chamber in fluid communication with, and downstream of, the separating chamber;
   the separating chamber being arranged to separate the contaminants from the carrier liquid on the basis of a difference in specific gravity to produce a treated carrier liquid and at least a lower specific gravity fraction that floats on the treated carrier liquid;
   the discharge chamber receiving the lower specific gravity fraction and the treated carrier liquid and provided with an outlet for the lower specific gravity fraction and an outlet for the treated carrier liquid, and wherein the discharge chamber has a maximum liquid level higher than a maximum liquid level of the separating chamber.

2. The liquid treatment apparatus according to claim 1 wherein the separating chamber is arranged so that, when in use, maximum liquid level within the separating chamber increases in the downstream direction.

3. The liquid treatment apparatus according to claim 1 or 2 wherein the discharge chamber is configured so that a surface area of a liquid contained at the maximum liquid level of the discharge chamber is less than a surface area of a liquid contained at the maximum level of the separating chamber.

4. The liquid treatment apparatus according to any one of claims 1 - 3 wherein the reservoir is configured to have a depth that increases in a downstream direction.

5. The liquid treatment apparatus according to any one of claims 1 - 4 wherein the discharge chamber is configured to have a depth that is below a maximum depth of the separating chamber.

6. The liquid treatment apparatus according to any one of claims 1 - 5 wherein the separating chamber is arranged to separate contaminants having a higher specific gravity than the carrier liquid from the liquid mixture to produce a higher specific gravity fraction that sinks in the reservoir.
7. The liquid treatment apparatus according to any one of claims 1 - 6 comprising an inlet manifold providing fluid communication between a supply of the liquid mixture and the separating chamber, the inlet manifold provided with an intermediate portion that is disposed above the maximum liquid level of the separating chamber.

8. The liquid treatment apparatus according to claim 7 comprising a breather hose in fluid communication with the intermediate portion, the breather hose venting the intermediate portion to atmospheric pressure.

9. The liquid treatment apparatus according to any one of claims 1 - 8 comprising a shroud having an open lower end, an open upper end, and an intermediate opening between the lower end and the upper end wherein the treated carrier liquid can flow through the intermediate opening into the shroud.

10. The liquid treatment apparatus according to claim 9 wherein the treated carrier liquid outlet has an open upper end located inside the shroud and below the upper end of the shroud.

11. The liquid treatment apparatus according to claim 9 or 10 comprising a lower specific gravity contaminant outlet disposed in the discharge chamber outside of the shroud and having an upper end at a level between the upper end of the shroud and the upper end of the treated carrier liquid conduit.

12. The liquid treatment apparatus according to any one of claims 1 - 11 wherein the discharge chamber comprises a purge outlet.

13. The liquid treatment apparatus according to any one of claims 9 - 11 wherein the discharge chamber comprises a purge outlet having an open upper end located inside the shroud and above the lower end of the shroud.

14. The liquid treatment apparatus according to claim 13 wherein the upper end of the purge outlet is at a level below a minimum depth of the separating chamber.
15. The liquid treatment apparatus according to any one of claims 7 - 14 comprising a flow director disposed in the reservoir adjacent a location where the inlet manifold connects to the reservoir whereby the liquid mixture entering the reservoir through the inlet manifold is deflected by the flow director to generate a flow along an upper surface of the separating chamber and a flow along a lower surface of the separating chamber.

16. The liquid treatment apparatus according to any one of claims 1 - 15 comprising a plurality of coalescing plates disposed in the separating chamber and through which a substantial volume of the liquid mixture flows prior to reaching the discharge chamber.

17. The liquid treatment apparatus according to any one of claims 1 - 16 comprising a flushing manifold configured to direct a flushing liquid into the reservoir chamber to enable flushing of the reservoir.

18. A parts washing machine comprising:
   a washing chamber;
   a tank for holding a supply of washing liquid;
   a washing manifold for spraying washing liquid from the tank onto articles to be cleaned held in the washing chamber; and
   a liquid treatment apparatus according to any one of claims 1 - 17 in fluid communication with the tank wherein liquid from the tank can be passed through the liquid treatment apparatus to produce treated washing liquid, wherein the treated washing liquid is returned to the tank.

19. The parts washing machine according to claim 18 comprising an skimming device disposed in the tank and a conduit providing fluid communication between the skimming device and separating chamber of the liquid treatment apparatus, wherein liquid treated by the liquid treatment apparatus is skimmed from an upper surface of washing liquid held in the tank.

20. The parts washing machine according to claim 19 wherein the skimming device comprises a sleeve made of a pliable material having an inlet and an outlet and a float disposed about the inlet.
21. The parts washing machine according to claim 20 wherein the skimming device comprises a spreading device arranged to hold a portion of the sleeve between the inlet and the outlet open.

22. The parts washing machine according to any one of claims 18 - 21 comprising a contaminants tank wherein the outlet for the lower specific gravity fraction is in fluid communication with the contaminants tank.

23. The parts washing machine according to any one of claims 18 - 22 wherein the outlet for the treated carrier liquid is in fluid communication with the tank holding the washing liquid.

24. The parts washing machine according to any one of claims 18 - 23 wherein the purge outlet is coupled by a drain conduit to the tank holding the washing liquid, and wherein the parts washing machine further comprises a drain valve disposed in the drain conduit wherein the drain valve can be selectively opened and closed to respectively allow and block fluid communication between the tank holding the washing liquid and the reservoir.

25. The parts washing machine according to claim 24 further comprising an internal cover for the tank holding the washing liquid, and a linkage system coupled between the internal cover and the drain valve wherein when the internal cover is in a position covering the washing liquid tank the linkage system closes the drain valve and when the internal cover is in a lifted position the linkage system opens the drain valve.

26. The parts washing machine according to any one of claims 18 - 25 comprising a first pump which is operable to transfer liquid from the washing liquid tank to the washing manifold and a second pump for transferring liquid from the washing liquid tank to the inlet manifold of the liquid treatment apparatus.

27. The parts washing machine according to claim 26 wherein the washing liquid tank is in selective fluid communication with the flushing manifold.

28. The parts washing machine according to claim 27 comprising a flushing conduit providing fluid communication between the first pump and the flushing
manifold and a flushing valve in the flushing conduit wherein washing liquid is transferred from the washing liquid tank by the first pump through the flushing conduit to the flushing manifold when the flushing valve is open.
INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2008/001761

A. CLASSIFICATION OF SUBJECT MATTER

<table>
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<tr>
<th>Int. Cl.</th>
<th>GB 240705 1 A (SAIT, GRAHAM ANDREW [GB]) 20 April 2004</th>
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<td></td>
<td>See abstract; figures 1-3, 5, 6, 9 and 10; page 1, line 4- page 2, line 15; page 2, line 24- page 6, line 10; page 7, lines 11-21; page 8, line 13- page 10, line 24; and claims.</td>
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<td>See abstract; page 1, lines 3-7; page 2, line 14- page 4, line 1; page 6, line 12- page 9, line 17; and claims.</td>
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B. FIELDS SEARCHED

According to International Patent Classification (IPC) or to both national classification and IPC.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C

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
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  "P" document published prior to the international filing date but later than the priority date claimed

Date of the actual completion of the international search: 26 February 2009

Date of mailing of the international search report: 12 MAR 2009

Name and mailing address of the ISA/AU

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Authorized officer

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Form PCT/ISA/210 (second sheet) (July 2008)
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<td>A</td>
<td>US 63 18387 B1 (MCCLURE et al.) 20 November 2001. See abstract; figures 1-4; column 1, line 62- column 2, line 5; column 2, lines 23-62; column 3, lines 5-37; column 4, line 19- column 5, line 19; and claims.</td>
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<td>US 3552405 A (APEL, FRED B.) 5 January 1971. See abstract; figures 1, 2, 6 and 7; column 1, line 50- column 2, line 51; column 2, line 64- column 3, line 61; and claims.</td>
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| US 3552405                             | NONE                 |

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX