



- (51) International Patent Classification:
A61C 17/14 (2006.01) A61C 17/12 (2006.01)
- (21) International Application Number:
PCT/NO2008/000344
- (22) International Filing Date:
26 September 2008 (26.09.2008)
- (25) Filing Language: English
- (26) Publication Language: English
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- (81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,
CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ,

EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— with international search report (Art. 21(3))

(54) Title: WATER SEPARATOR

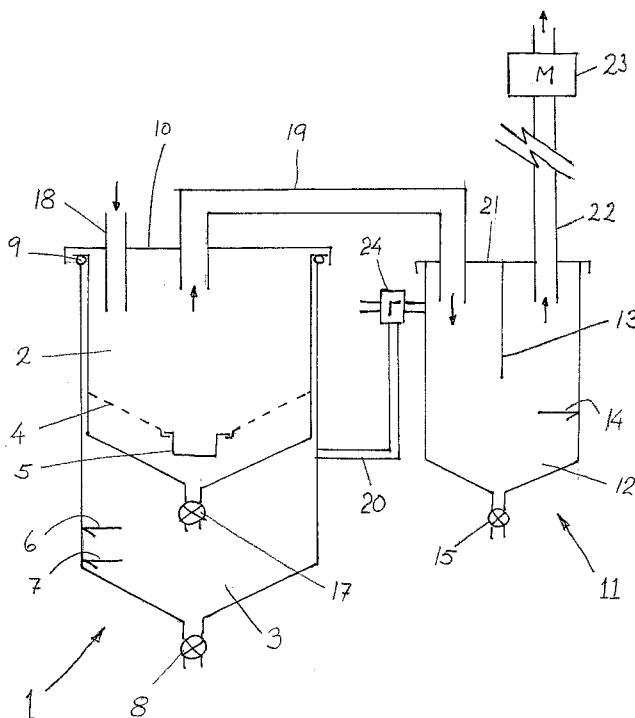


FIG. 1

(57) Abstract: Water separator for continuous separation of water, air and particles, said separator comprising an inlet pipe (18) for receipt of a mixture of water, air and particles simultaneously from several sources such as dental surgeons etc. an outlet pipe (22) being connected to a suction motor (23), an upper chamber (2) being connected with a lower chamber (3) by a valve (17) in the bottom of the upper chamber (2), the lower chamber (3) normally being closed by a check valve (8) in the bottom, a three-way valve (24) located in an air connection pipe (20) being adapted to establish a connection between the upper (2) and lower (3) chambers in a first position and closing said connection to the upper chamber and allowing atmospheric air to enter into the lower chamber (3) in a second position, and the upper chamber (2) comprising a coarse filter (4) capturing particles from the liquid flow to the lower chamber (3), where the water separator comprises two tanks, a main tank (1) and a safety tank (11), which are connected through a connection pipe (19) from the upper chamber (2) in the main tank (1) to the safety tank (11) and through the air connection pipe (20) from the lower chamber (3) in the main tank to the safety tank (11), that the inlet pipe (18) is through the lid of the main tank (1), that the outlet pipe (22) is through the lid of the safety tank (11), and the safety tank (11) normally being closed by a check valve (15) in the bottom.

Water separator

5 The present invention is related to a water separator for continuous separation of water, air and particles.

Separators of the above type are used by dentists, dental surgery as well as in other areas such as water absorbers, where the object is to separate air from water and particles which are sucked into a piping system.

10 Such apparatus is well known and in use by dentists sucking saliva from the mouth of patients during works in the oral cavity.

Some of the problems with known art is that the apparatus often need to be stopped because of the necessity of emptying the “waste-water” separator tank because it is full, irrespective of state of the operation. They are often rather voluminous and
15 complex in their design which also complicate the cleaning maintenance.

In an attempt to overcome these problems a new design was introduced in the international application WO 2006/043817 by Fridthjof Moe. In this application a single waste-water separator tank, divided into two chambers, was used to solve some of the problems above. However, new features created new issues. The vacuum pump on top of
20 the waste-water separator tank have a tendency to malfunction or be permanently damaged. The reason for this is the very high content of water, in the form of dense mist. The mist create water droplets in the vacuum motor/pump which in the end lead to that the vacuum motor fail. Another problem is that the drainpipe/valve in the lower chamber becomes clogged up and the waste-water separator tank do not empty. The vacuum pump
25 will in the most favourable situation stop and not start again before someone has emptied the tank, or in worst case start to pull waste-water directly into the vacuum motor/pump. As to maintenance of the waste-water separator tank, the inlet pipe enter through the wall of the tank and this makes it cumbersome and time consuming to dismantle.

Further examples of known art can be found in US 4 564 374 A, US 4 293 300
30 A, US 4 684 345 A and EP 0387774 A2.

It therefore is an object for the present application to provide an apparatus which reduce the chance for failure of the vacuum motor/pump and which at the same time provide a tank which is easy to maintain and thus provide a reliable and secure tool for waste-water separation. Above all it is an object to provide an apparatus which can work
35 continuously without the need to stop the apparatus for emptying the tank.

The above objects are achieved with the waste-water separator tank according to the present invention as defined by the features stated in the claim.

The drawing discloses schematically a vertical section of the apparatus according to the invention.

The apparatus comprises two waste-water separator tanks, a main tank 1 and a safety tank 10.

The main tank 1 comprises of a lid 10, an upper chamber 2 and a lower chamber 3. The upper chamber 2 is created by putting a smaller tank inside the main tank 1. The upper edge of this smaller tank has a lip which rest on top of the upper edge of the main tank 1 or on a ridge (not shown) created on the wall inside the main tank 1. Between the outside wall of the smaller tank and the inside wall of the main tank 1 there exist at least one sealing element 9. The upper chamber 2 comprises a coarse filter 4 and an opening at the bottom/lowest end with a valve 17 controlling the flow out of the upper chamber 2. The coarse filter 4 can either rest on some ridges in the wall of the chamber or be fixed, either permanently or releasable. The filter 4 has an opening in the centre where upon a loose or releasable coarse filter cup 5 is placed. The lower chamber 3 comprises of at least one level switch 6,7 a check valve 8 controlling the liquid flow out of the lower chamber 3 and an outlet to an air connection pipe 20. Two pipes enters through the lid 10, one inlet pipe 18 and a connection pipe 19.

The safety tank 11 with an opening at the bottom/lowest end, comprises of a lid 21, at least one chamber 12 which is partly divided by a wall 13, at least one level switch 14, a check valve 15, at the bottom/lowest end, controlling the liquid flow out of the safety tank 11 and an outlet to the air connection pipe 20. Two pipes enters through the lid 21, the connection pipe 19 and an outlet pipe 22.

A mixture to be separated is guided into the inlet pipe 18 and may comprise water, air, dust, blood as well as residues of flesh from the mouth. The inlet pipe 18 is guiding the mixture of water and air against the cylindrical wall of the upper chamber 2 thereby allowing water, dust, blood and such to fall down, whereas the air is escaping upwardly through the connection pipe 19 through the lid of the main tank 1.

The mixture of water, dust, blood etc. passes through the coarse filter 4 which will capture the larger particles and allowing the smaller particles and liquid to pass through. The smaller particles and liquid will be collected at the bottom of the upper chamber and led through the opening and the valve 8 in the bottom of the upper chamber 2 and into the lower chamber 3.

In one embodiment the filter 4 is shaped as a cone with the narrow end pointing downwards with a hole in the middle. The hole is covered by a filter cup 5 which rest in the hole of the filter 4. Thus when any particles are stopped by the filter 4, they will be carried down to the filter cup where they will rest. Thus when the filter 4 need to be cleaned, it may be sufficient just to empty the filter cup, rather than dismantling the whole filter.

A suction motor/pump 23 is connected with the outlet pipe 22 on top of the safety tank 11. This suction motor/pump 23 will create an under pressure in the safety tank 11 and thus through the connection pipe 19, also in the upper chamber 2.

Between the main tank 1 and the safety tank 11 there is an air connection pipe 20 with a three way valve 24 connected to it. This arrangement will connect the lower chamber 3 with the safety tank 11 in normal position and thus the upper chamber 2 through the connection pipe 19. This will maintain the same under pressure in the upper chamber 2 as in the lower chamber 3.

The lower chamber 3 is normally closed at the bottom by the check valve 8, thereby allowing the lower chamber 3 to be filled up with water and possibly smaller particles having passed through the coarse air filter 4 and the valve 17.

When the lower chamber 3 is filled up to a specified level, a level switch 6 activates the three-way valve 24 to close the connection between the safety tank 11 and the lower chamber 3. This will let air into the lower chamber 3 and create a differential pressure over the valve 17. The valve 17 will then automatically close due to the under pressure in the upper chamber 2. The pressure in the lower chamber 2 will then return to atmospheric or higher pressure and release the check valve 8 which will open and drain the content of the lower chamber 3 until the water level in the lower chamber 3 reaches a lower level switch 7. This will then activate the three-way valve 24 for it to return to the normal position and thereby closing the air supply to the lower chamber 3 and connecting the under pressure of the safety tank 11 to the lower chamber 3.

When the same pressure is reached in the upper 2 and the lower 3 chambers, the valve 17 will open and waste-water which in the meantime has been collected in the upper chamber 2 will drain down into the lower chamber 3. The normal operation mode is then re-established as the safety tank 11 is connected with the lower chamber 3 through the three-way valve 24 and the air connection pipe 20. Due to the under pressure the check valve 8 at the bottom of the lower chamber 3 will close.

The process will then continue in an automatic manner allowing the lower chamber 3 to be emptied during a constant supply of water and mixture through the inlet pipe 18.

A level switch 14 is arranged in the safety tank 3. If the surface of the content in the upper chamber 2 rises to an undesired level during emptying of the lower chamber 3 the connection pipe may start to suck water from the upper chamber 2 and feed the safety tank with waste-water rather than humid air. The level switch 14 will then deactivate the suction motor 13 and an audible and/or visible alarm will be given to indicate that the apparatus need attention. The purpose of the level switch 14 is to avoid the suction motor 23 to suck in water or highly humid air and thus fail or be permanently damaged. The check valve 15 in the bottom of the safety tank is working in the same manner as the check valve in the bottom of the main tank. When the suction motor 23 stop, any waste-water in the bottom of the safety tank will drain out as the under pressure disappear.

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Patent Claims

5 1. Water separator for continuous separation of water, air and particles, said separator comprising an inlet pipe (18) for receipt of a mixture of water, air and particles simultaneously from several sources such as dental surgeons etc. an outlet pipe (22) being connected to a suction motor (23), an upper chamber (2) being connected with a lower chamber (3) by a valve (17) in the bottom of the upper chamber (2), the lower chamber
10 (3) normally being closed by a check valve (8) in the bottom, a three-way valve (24) located in an air connection pipe (20) being adapted to establish a connection between the upper (2) and lower (3) chambers in a first position and closing said connection to the upper chamber and allowing atmospheric air to enter into the lower chamber (3) in a second position, and the upper chamber (2) comprising a coarse filter (4) capturing
15 particles from the liquid flow to the lower chamber (3), **characterised in** that the water separator comprises two tanks, a main tank (1) and a safety tank (11), which are connected through a connection pipe (19) from the upper chamber (2) in the main tank (1) to the safety tank (11) and through the air connection pipe (20) from the lower chamber
20 (3) in the main tank to the safety tank (11), that the inlet pipe (18) is through the lid of the main tank (1), that the outlet pipe (22) is through the lid of the safety tank (11), and the safety tank (11) normally being closed by a check valve (15) in the bottom.

2. Water separator according to claim 1, **characterised in** that the lower chamber (3) comprises a level switch (6) adapted to place the three way valve (24) in the second position when the water level in the lower chamber (4) reaches the level switch (6).

25 3. Water separator according to claim 2, **characterised in** that the lower chamber (3) comprises a lower level switch (7) below the first level switch (6), being adapted to return the three way valve (24) to the first position when the water level in the lower chamber (3) reaches the lower level switch (7).

30 4. Water separator according to claim 1, **characterised in** that the coarse filter (4) has the shape of a funnel and has a hole in the centre to receive a filter cup (5) which will be resting in this hole.

5. Water separator according to claim 3, **characterised in** that the safety tank (11) comprises a level switch (14) adapted to stop the suction motor (23) and to give an alarm.

35 6. Method of controlling a water separator according to claims 1-5, where said upper level switch (6) being activated by the water surface reaching said upper level switch (6) causing the three-way valve (24) to close the connection to the upper chamber (2) and allowing atmospheric air to enter into the lower chamber (3), the valve (17) in the upper chamber (2) thereby closing due to the under pressure in the upper chamber (2) through the safety tank (11), the check valve (8) opening due to the atmospheric pressure

in the lower chamber (3) thereby allowing the content of the lower chamber (3) to be drained until the surface of the content in the lower chamber (3) reaches the lower level switch (7) said switch activating the three-way valve (24) to return to the first position for normal operation, **characterised in** that said level switch (14) in the safety tank (1) being
5 activated by water surface reaching said level switch (14) causing the suction motor to be stopped abruptly and an alarm signal being sent.

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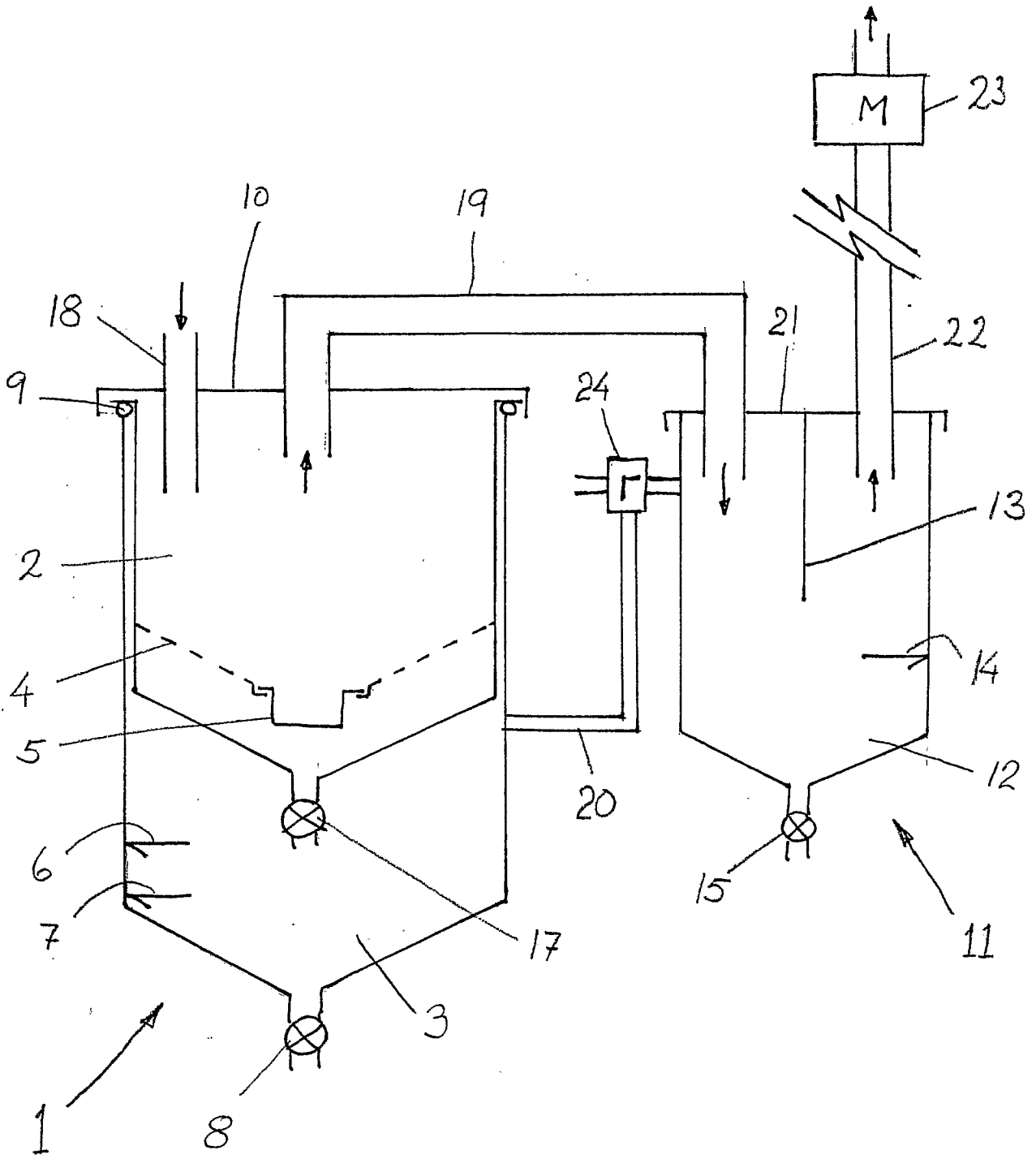


FIG. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO2008/000344

A. CLASSIFICATION OF SUBJECT MATTER

IPC8: A61C 17/14 (2006.01), A61C 17/12 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC8: A61C, A61M, B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPOQUE: EPODOC, WPI. PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2006/043817 A1 (FRIDTHJOF MOE), 27 April 2006 (27.04.2006)	1-6
Y	US 3017886 (ELBERT O. THOMSON), 23 January 1962 (23.01.1962), figures 3 and 4, column 2, column 3, column 4	1-6
Y	US 3912638 (EVERETT E. BEAUBIEN), 14 October 1975 (14.10.1975), figure 1, column 1	4
A	US 3768478 (IRA J. FERTIK ET AL), 30 October 1973 (30.10.1973), figures 5, 8, 9 and 10, column 3, column 4	1



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

"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

23 Mars 2009

Date of mailing of the international search report

27/03/2009

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NO2008/000344

Patentdocument cited in search report	Publication date	Patent family member	Publication date
WO 2006/043817 A1	27/04/2006	EP 1819294 A1 NO 20072556 A	22/08/2007 29/06/2007
US 3017886	23/01/1962	None	
US 3912638	14/10/1975	None	
US 3768478	30/10/1973	None	