PCT-IN-3977

A FILTER ASSEMBLY

TECHNICAL FIELD

[1] The present disclosure generally relates to the field of filter assemblies for solutions. In particular, it relates to a filter assembly with a structure designed to minimise the quantity of remnant solution.

BACKGROUND

[2] Background description includes information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication specifically or implicitly referenced is prior art. It is often necessary to filter fluids in laboratories rapidly and without risk of leakage and contamination. This is especially true for biological solutions such as tissue culture media, additives etc. which need to be sterilized before use. In development laboratories, it is often most convenient to use sterilized vacuum filtration devices with an attached filtrate container. Although, large area filter devices such as capsule filters and cartridge filters are available which could be used to achieve the objectives, they suffer from drawback that they involve a considerable set up time as these devices require assembly of tubes and clamps in addition to set up of peristaltic pumps and pressure gauges etc., which makes them tedious to use. Convenience of pouring feed solution and obtaining clarified and sterile filtrate in a few minutes by simply applying vacuum to the device cannot be over emphasized. However, recently developed vacuum filter devices are only available in disc form with limited filter area and possibility of serial filtration is not feasible with such vacuum filter devices.

[3] United States patent application US20030080045 discloses a disposable filtration funnel with integrated pre-filter wherein funnel includes a reservoir for holding unfiltered fluid therein and an outlet, and a final filter disposed between reservoir and outlet, wherein final filter is sealed to funnel to prevent unfiltered fluid from flowing between final filter and outlet. One or more pre-filters are disposed between reservoir and upstream side of the final filter. However, the pre-filter and the final filter do not provide a large area to be effective for large volume filtration.

[4] United States patent US6623631 discloses a cartridge like pleated filter element enclosed in a cylindrical housing that forms an inlet chamber and incorporates inlet fitting for connection to a feed container and addresses the problem of having a large area vacuum

filtration device by employing a pleated filter element. However, necessity of using several hydrophobic membranes in device as disclosed in the instant reference makes it costly and uneconomical.

[5] PCT application PCT/IB2016/052093 discloses a vacuum filtration device that uses a large area filter element. However, because of construction of funnel as disclosed in the instant reference, large area of the filter is rather limited as the filter element should be fitted in neck of filtrate container.

[6] United States patent application US20160310875 discloses a filter device that includes a large area pleated filter element extending below a funnel with a flow director positioned within internal space of the filter element in such a way that fluid flows through the filter element in an inward to outward direction. The flow director directs fluid uniformly onto the filter and helps to keep amount of remnant fluid to a minimum. However, the arrangement results in increase in overall height of the filter device resulting in posing challenge in packing, transporting and storing the assembly, as well as during usage. It also suffers from drawbacks of having large number of components with corresponding cost implication, and not providing large holding space for cells and contaminants on the surface of the filter in view of outward flow direction.

[7] While the above prior art references provide different arrangements for filter element, they suffer from one or another drawback. There is, therefore, a need for vacuum filter devices with large filter area that allow filtration with single or multiple serial filter layers in the same device and that can also be stacked with other filters to make a filtration train to obtain sterile filtrate with least possible loss of valuable materials in the shortest possible time.

[8] All publications herein are incorporated by reference to the same extent as if each individual publication or patent application were specifically and individually indicated to be incorporated by reference. Where a definition or use of a term in an incorporated reference is inconsistent or contrary to the definition of that term provided herein, the definition of that term provided herein applies and the definition of that term in the reference does not apply.

[9] In some embodiments, the numbers expressing quantities or dimensions of items, and so forth, used to describe and claim certain embodiments of the invention are to be understood as being modified in some instances by the term “about.” Accordingly, in some embodiments, the numerical parameters set forth in the written description and attached claims are approximations that can vary depending upon the desired properties sought to be

obtained by a particular embodiment. In some embodiments, the numerical parameters should be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of some embodiments of the invention are approximations, the numerical values set forth in the specific examples are reported as precisely as practicable. The numerical values presented in some embodiments of the invention may contain certain errors necessarily resulting from the standard deviation found in their respective testing measurements.

[10] As used in the description herein and throughout the claims that follow, the meaning of "a," "an," and "the" includes plural reference unless the context clearly dictates otherwise. Also, as used in the description herein, the meaning of "in" includes "in" and "on" unless the context clearly dictates otherwise.

[11] The recitation of ranges of values herein is merely intended to serve as a shorthand method of referring individually to each separate value falling within the range. Unless otherwise indicated herein, each individual value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g. "such as") provided with respect to certain embodiments herein is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention otherwise claimed. No language in the specification should be construed as indicating any non-claimed element essential to the practice of the invention.

[12] Groupings of alternative elements or embodiments of the invention disclosed herein are not to be construed as limitations. Each group member can be referred to and claimed individually or in any combination with other members of the group or other elements found herein. One or more members of a group can be included in, or deleted from, a group for reasons of convenience and/or patentability. When any such inclusion or deletion occurs, the specification is herein deemed to contain the group as modified thus fulfilling the written description of all groups used in the appended claims.

OBJECTS OF THE INVENTION

[13] A general object of the present disclosure is to provide a filter assembly to reduce the quantity of remnant solution.

[14] Another object of the present disclosure is to provide a filter assembly where feed solution can be easily supplied.

[15] Another object of the present disclosure is to provide a filter assembly where filtrate is isolated from feed solution.

[16] Another object of the present disclosure is to provide a filter assembly that can be part of a filter train.

[17] Another object of the present disclosure is to provide a filter assembly that can easily and swiftly be replaced.

SUMMARY

[18] The present disclosure generally relates to the field of filter assemblies for solutions. In particular, it relates to a filter assembly with a structure designed to minimise the quantity of remnant solution.

[19] In an aspect, a filter assembly is disclosed, said assembly comprising a funnel with a filter disposed in it. The funnel has an open top end and tapered walls towards a bottom end. In another aspect, the bottom end is flat and is narrower than the top end.

[20] In another aspect, the funnel holds the feed solution to be filtered. The feed solution can be directly poured into the funnel because of the open top, thereby not requiring special pipes, clamps, valves etc. for transferring feed solution to the filter.

[21] In another aspect, after filtration, the filtrate passes onto the next stage, where the next stage can be a container to hold the filtrate or a further process. The filtrate exits the funnel and filter setup through an outlet disposed at the bottom end of the funnel. In another aspect, the outlet is coupled to a tapered connector, for the passage of filtrate.

[22] In another aspect, the filter assembly further comprises a filter disposed at the bottom of the funnel. The filter can be cylindrical, extending from the bottom of the funnel and along the vertical axis of the funnel. In another aspect, the filter can be of a length such that its height does not exceed the height of the funnel.

[23] In another aspect, the filter is so placed in the funnel that the feed solution enters the filter through the filter surface which faces the walls of the funnel.

[24] In another aspect, generally, as the feed solution is filtered, there remains some quantity of the solution that cannot be filtered. In this case, said solution is referred to as remnant solution. In another aspect, the quantity of remnant solution is a function of the construction of the filter assembly. Feed solution that accumulates at niches from where it cannot access the filter, becomes remnant solution.

[25] In another aspect, remnant solution represents a wastage of material that could otherwise have been useful. Particularly in cases when feed solution contains valuable components, remnant solutions can be an expensive wastage.

[26] In another aspect, in the filter assembly of the present disclosure, efforts are made to reduce quantity of remnant solution by engineering the construction of the filter. In another aspect, the filter is so disposed in the funnel that the diameter of the filter nearly matches the diameter of the bottom end of the funnel, that is, they are nearly flush. This reduces the annular space between the filter and the funnel where feed solution could potentially become remnant solution.

[27] In another aspect, the filter is also disposed at the bottom of the funnel, such that the filter has as low clearance from the bottom end of the funnel as possible, thereby further reducing space for potential accumulation of remnant solution.

[28] In another aspect, the feed solution in the funnel is guided by the tapered walls of the funnel to the filter. The location of the filter, as described, allows for maximum quantity of feed solution to be directed to the filter and minimises the quantity of remnant solution in the funnel.

[29] In another aspect, the filter used is a pleated filter. Pleated filters are better constructed and therefore have longer lives.

[30] In another aspect, the sides of the filter which must not come in contact with the feed solution are capped or sealed in order to prevent the mixing of the feed solution and filtrate. In another aspect, the sides of the filter facing the top and bottom ends of the funnel are capped or sealed.

[31] In another aspect, the filter can have stacked layers, each layer made of individual pleated filters, in order to improve the efficiency of the filter and to be able to filter out smaller particles.

[32] In another aspect, the stacking of filters can cause a pressure drop across them, which can result in a slowed filtration. To overcome this problem, a vacuum pump or any source capable of creating a vacuum is connected to the outlet of the filter, to drive the filtration operation.

[33] In another aspect, the disclosed filter assembly can be incorporated in a filter train, where the filter train comprises a series of filtering operations of various kinds.

[34] In another aspect, in order to improve the life of filters, depth filters are used. They are porous material impregnated within the filters that can further filter solutions and

improving both efficiency and the life of the filters. In another aspect, depth filters can be used with the filter of the disclosed filter assembly.

[35] In another aspect, diatomaceous earth (DE) is used for filtering of various solutions including water and non-aqueous solutions. DE is a fine, porous powder that can be coated on a frame to create a filter. Said filter can be placed ahead of the disclosed filter in order to improve efficiency of the setup.

[36] In another aspect, the design of the filter unit is such that, in the event of the filter getting clogged due to lifetime considerations or due to inconsistencies in the feed solution, the filter unit can be swiftly and easily replaced without significantly affecting productivity.

[37] Various objects, features, aspects and advantages of the inventive subject matter will become more apparent from the following detailed description of preferred embodiments, along with the accompanying drawing figures in which like numerals represent like components.

BRIEF DESCRIPTION OF DRAWINGS

[38] The accompanying drawings are included to provide a further understanding of the present invention and are incorporated in and constitute a part of this specification. The drawings illustrate exemplary embodiments of the present invention and, together with the description, serve to explain the principles of the present invention.

[39] FIG. 1 illustrates cross-section of a filter assembly, in accordance with an embodiment of the present disclosure.

[40] FIG. 2 illustrates an exemplary filtration unit with the filter assembly and a filtrate container connected to a vacuum setup, in accordance with an embodiment of the present disclosure.

[41] FIG. 3A illustrates an exemplary filter assembly with a bottom seal for the filter, in accordance with an embodiment of the present disclosure.

[42] FIG. 3B illustrates an exemplary filter assembly with engineered bottom end of the funnel, in accordance with an embodiment of the present disclosure.

[43] FIG. 4 illustrates an exemplary filtration unit as part of a filter train, in accordance with an embodiment of the present disclosure.

DETAILED DESCRIPTION

[44] The following is a detailed description of embodiments of the disclosure depicted in the accompanying drawings. The embodiments are in such detail as to clearly communicate the disclosure. However, the amount of detail offered is not intended to limit the anticipated variations of embodiments; on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the present disclosure as defined by the appended claims.

[45] If the specification states a component or feature "may", "can", "could", or "might" be included or have a characteristic, that particular component or feature is not required to be included or have the characteristic.

[46] As used in the description herein and throughout the claims that follow, the meaning of "a," "an," and "the" includes plural reference unless the context clearly dictates otherwise. Also, as used in the description herein, the meaning of "in" includes "in" and "on" unless the context clearly dictates otherwise.

[47] Exemplary embodiments will now be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments are shown. These exemplary embodiments are provided only for illustrative purposes and so that this disclosure will be thorough and complete and will fully convey the scope of the invention to those of ordinary skill in the art. The invention disclosed may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Various modifications will be readily apparent to persons skilled in the art. The general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the invention. Moreover, all statements herein reciting embodiments of the invention, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known equivalents as well as equivalents developed in the future (i.e., any elements developed that perform the same function, regardless of structure). Also, the terminology and phraseology used is for the purpose of describing exemplary embodiments and should not be considered limiting. Thus, the present invention is to be accorded the widest scope encompassing numerous alternatives, modifications and equivalents consistent with the principles and features disclosed. For purpose of clarity, details relating to technical material that is known in the technical fields related to the invention have not been described in detail so as not to unnecessarily obscure the present invention.

[48] The use of any and all examples, or exemplary language (e.g., "such as") provided with respect to certain embodiments herein is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention otherwise claimed. No language in the specification should be construed as indicating any non – claimed element essential to the practice of the invention.

[49] Embodiments described herein generally relate to the field of filter assemblies for solutions. In particular, they relate to a filter assembly with a structure designed to minimise the quantity of remnant solution.

[50] In an aspect, a filter assembly is disclosed, said assembly comprising a funnel with a filter disposed in it. The funnel has an open top end and tapered walls towards a bottom end. In another aspect, the bottom end is flat and is narrower than the top end.

[51] In another aspect, the funnel holds the feed solution to be filtered. The feed solution can be directly poured into the funnel because of the open top, thereby not requiring special pipes, clamps, valves etc. for transferring feed solution to the filter.

[52] In another aspect, after filtration, the filtrate passes onto the next stage, where the next stage can be a contained to hold the filtrate or to a further process. The filtrate exits the funnel and filter setup through an outlet disposed at the bottom end of the funnel. In another aspect, the outlet is coupled to a tapered connector, for the passage of filtrate.

[53] In another aspect, the filter assembly further comprises a filter disposed at the bottom of the funnel. The filter can be cylindrical, extending from the bottom of the funnel and along the vertical axis of the funnel. In another aspect, the filter can be of a length such that its height does not exceed the height of the funnel.

[54] In another aspect, the filter is so placed in the funnel that the feed solution enters the filter through the filter surface which faces the walls of the funnel.

[55] In another aspect, generally, as the feed solution is filtered there remains some quantity of the solution that cannot be filtered. In this case, said solution is referred to as remnant solution. In another aspect, the quantity of remnant solution is a function of the construction of the filter assembly. Feed solution that accumulates at niches from where it cannot access the filter, become remnant solutions.

[56] In another aspect, remnant solution represents a wastage of material that could otherwise have been useful. Particularly in cases when feed solution contains valuable components, remnant solutions can be an expensive wastage.

[57] In another aspect, in the filter assembly of the present disclosure, efforts are made to reduce quantity of remnant solution by engineering the construction of the filter. In

another aspect, the filter is so disposed in the funnel that the diameter of the filter nearly matches the diameter of the bottom end of the funnel, that is, they are nearly flush. This reduces the annular space between the filter and the funnel where feed solution could potentially become remnant solution.

[58] In another aspect, the filter is also disposed at the bottom of the funnel, such that the filter has as low clearance from the bottom end of the funnel as possible, thereby further reducing space for potential accumulation of remnant solution.

[59] In another aspect, the feed solution in the funnel is guided by the tapered walls of the funnel to the filter. The location of the filter, as described, allows for maximum quantity of feed solution to be directed to the filter and minimising the quantity of remnant solution in the funnel.

[60] In another aspect, the filter used is a pleated filter. Pleated filters are better constructed and therefore have longer lives. Typically, a pleated filter lasts approximately 90 days.

[61] In another aspect, the sides of the filter which must not come in contact with the feed solution are capped or sealed in order to prevent the mixing of the feed solution and filtrate. In another aspect, the sides of the filter facing the top and bottom ends of the funnel are capped or sealed.

[62] In another aspect, the filter can have stacked layers, each layer made of individual pleated filters, in order to improve the efficiency of the filter and to be able to filter out smaller particles.

[63] In another aspect, the stacking of filters can cause a pressure drop across them, which can result in a slowed filtration. To overcome this problem, a vacuum pump or any source capable of creating a vacuum is connected to the outlet of the filter, to drive the filtration operation.

[64] In another aspect, the disclosed filter assembly can be incorporated in a filter train, where the filter train comprises a series of filtering operations of various kinds.

[65] In another aspect, in order to improve the life of filters, depth filters are used. They are porous material impregnated within the filters that can further filter solutions and improving both efficiency and the life of the filters. In another aspect, depth filters can be used with the filter of the disclosed filter assembly.

[66] In another aspect, diatomaceous earth (DE) is used for filtering of various solutions including water and non-aqueous solutions. DE is a fine, porous powder that can be

coated on a frame to create a filter. Said filter can be placed ahead of the disclosed filter in order to improve efficiency of the setup.

[67] In another aspect, the design of the filter unit is such that, in the event of the filter getting clogged due to lifetime considerations or due to inconsistencies in the feed solution, the filter unit can be swiftly and easily replaced without significantly affecting productivity.

[68] FIG. 1 illustrates cross-section of a filter assembly, in accordance with an embodiment of the present disclosure. In an embodiment, the filter assembly 100 comprises a funnel 104 open at the top end with a wall 108 tapered towards a bottom end. The bottom end is flat and narrower than the top end.

[69] In another embodiment, a filter 102 is disposed at the bottom end, said filter 102 being cylindrical and extending from the bottom end of the funnel 104, vertically along the axis of the funnel 104. In an exemplary embodiment, the filter 102 is a pleated filter. In an aspect, a pleated filter is sturdily constructed with a long life of more than 90 days.

[70] In another embodiment, the bottom end of the funnel 104 forms a seal with the bottom end of the filter 102 such that it does not allow a feed solution to pass through. In another embodiment, the end of the filter 102 facing the top end of the funnel 104 is also sealed by a cap 106 in order to prevent any feed solution from flowing into the space 110.

[71] In another embodiment, the bottom surface of the filter 102 is flush with the bottom end of the funnel such that the difference in heights between the bottom end of the funnel 104 and filter 102 is minimum. In a further embodiment the diameter of the filter 102 is nearly the same as the bottom end such that the annular space between the filter 102 and the tapered walls 108 is minimum.

[72] In another embodiment, the feed solution is poured into the filter assembly 100 directly through the funnel 104. This process is simple and straightforward, and the use of complicated system of specialised pipes, valves and clamps to introduce feed solution to a filter can be avoided.

[73] In another embodiment, the feed solution passes through the filter 102 at the surface facing the tapered wall 108, and an obtained filtrate collects behind the outer surface of filter 102, at space 110. In a further embodiment, an outlet is provided in the bottom end of the funnel for the filtrate the exit the funnel 104 from the space 110.

[74] In an aspect, some quantity of the feed solution is not filtered due to being accumulated at locations from where it cannot access the filter. The remaining solution is

referred to as remnant solution. In another aspect, the quantity of remnant solution is a function of the construction of the filter assembly.

[75] In another aspect, remnant solution represents a wastage of material that could otherwise have been useful. Particularly in cases when feed solution contains valuable components, remnant solutions can be an expensive wastage.

[76] In another embodiment, the structure of the filter assembly 100 is designed such that the tapered wall 108 ends at the closest to the filter 102, meaning that the feed solution is directed by the tapered wall 108 directly to the filter 102. This reduces the locations where remnant solution can potentially accumulate and therefore, reduces the quantity of remnant solution.

[77] In another embodiment, the filtrate from space 110 exits the funnel 104 through the outlet. In another embodiment, the outlet is coupled to a tapered connector 112 through which the filtrate can be collected in a filtrate container or be transferred to a subsequent process.

[78] In another embodiment, the filter 102 can be a stacked filter comprising a number of similar filter stacked in series to provide better filtering capability for small sized particulate matter.

[79] In another embodiment, in order to improve the life of the filter 102, as well as to improve filtering efficiency, the filter assembly 100 can incorporate depth filters. In an aspect, depth filters comprise porous material that are impregnated within the filter 102. The porous material also assists in capturing particulate matter, thereby increasing the efficiency of the process.

[80] In another embodiment, said filter assembly 100 is also provided an option to incorporate a diatomaceous earth ("DE") filter. In an aspect, DE is used for filtering of various solutions including water and non-aqueous solutions. DE is a fine, porous powder that can be coated on a frame to create a filter. Said filter can be placed ahead of the disclosed filter in order to improve efficiency of the setup.

[81] In another embodiment, a septum or a membrane can be provided as a frame onto which DE can be coated to create a DE filter. The DE filter can be placed upstream of the filter 102, as a pre-filter, thereby increasing efficiency of filtering and the life time of the filter 102.

[82] In yet another embodiment, the filter assembly 100 can be configured to be part of a filter train, meaning that it can be part of a series of different filters performing different functions in a sequence.

[83] In an embodiment, the simple design of the filter assembly 100 makes it easy to assemble said assembly 100. In another embodiment, in the event of breakdown of the assembly 100 due to reasons such as clogging of the filter 102, the entire assembly 100 can be replaced swiftly and easily with minimum downtime.

[84] In another embodiment, the funnel structure, including the walls 108, the cap 106 and the tapered connector 112 can be made of a corrosion resistant and non-reactive material such as plastic, glass, certain metal alloys etc.

[85] FIG. 2 illustrates an exemplary filtration unit with the filter assembly and a filtrate container connected to a vacuum setup, in accordance with an embodiment of the present disclosure. In an embodiment, the filtration unit 200 is an exemplary implementation of the filter assembly 100, wherein the filtrate is collected in a filtrate container 202.

[86] In another embodiment, the filtrate container 202 and the filter assembly 100 is mounted on a support structure 206. In a further embodiment, the support structure 206 can be incorporated on a system of rails to be part of a production line.

[87] In another embodiment, the filtrate container 202 is coupled to the filter assembly 100 and the filtrate from space 110 is transferred to container 202 via the tapered connector 112.

[88] In an aspect, particularly when stacked filters are used, there is a significant drop in pressure across the filter. More the number of filters in the stack, higher the pressure drops. This can slow down the rate of filtration.

[89] In another embodiment, in an effort to overcome the problem of pressure drops, a vacuum generator can be used. In an embodiment, the vacuum generator is a vacuum pump. Said pump can be coupled to the filtrate container 202 through connector 204. The vacuum creates a suction force that compensates for the pressure drop across the filter and drives the filtration process.

[90] FIG. 3A illustrates an exemplary filter assembly with a bottom seal for the filter, in accordance with an embodiment of the present disclosure. In an aspect, in order for the filtration of the feed solution to be fruitful, it is imperative that external contaminants be minimised as much as possible. One common source of contamination of the filtrate is the feed solution itself, if the seal between the feed solution and filtrate is not maintained.

[91] In an embodiment, filtrate assembly 300 illustrates an effort to better seal and isolate the filtrate from the feed solution. In another embodiment, a sealant 304 is introduced between the bottom surface 302 of the filter 102 and the bottom plate of the funnel 104.

[92] In another embodiment, the sealant 304 can be any material that is non-corrosive and non-reactive to the feed solution, and acts as an impervious barrier in order to separate the feed solution and the filtrate. Such materials can include but not be limited to silicone, rubber membrane, polyurethane etc.

[93] In an aspect, the assembly 300, however suffers from having an increased clearance height of the filter 102 from the bottom end of the funnel 104. This can potentially cause area at the bottom of the funnel 104 where remnant solution can accumulate.

[94] FIG. 3B illustrates an exemplary filter assembly with engineered bottom end of the funnel, in accordance with an embodiment of the present disclosure. In an embodiment, in order to overcome the limitation posed by assembly 300 insofar as potential increase in remnant solution is concerned, filter assembly 350 is disclosed having a modified bottom end of the funnel 104.

[95] In another embodiment, as in the assembly 300, the bottom surface 352 of the filter 102 and the bottom end of the funnel 104 is sealed together using a sealant 354. In a further embodiment, a part of the bottom plate, of the same diameter as the filter 102 is recessed such that the filter 102 can fit in the recess. Further, the depth of the recess is the same as the thickness of the bottom surface of the filter 102, meaning that the bottom surface of the filter 102 fits exactly in the recess and the clearance height between the bottom end of the funnel 104 and the filter 102 is minimum.

[96] In another embodiment, assembly 350 presents a funnel with a filter, where remnant solution is minimised and separation between feed solution and filtrate is improved.

[97] FIG. 4 illustrates an exemplary filtration unit as part of a filter train, in accordance with an embodiment of the present disclosure. In an embodiment, the filter assembly 100 can be part of a filter train, wherein the filter train is a series of different filters performing different functions in a sequential manner.

[98] In an embodiment, the filtration unit 400 comprises a filter assembly 100 coupled to a filtrate container 202. The setup is mounted on a support structure 206.

[99] In another embodiment, a second filter unit 402 is present such that the filtrate from assembly 100 passes through the second filter 402 from the container 202.

[100] In another embodiment, the filtration unit 400 is coupled to a vacuum generator in order to drive the filtration process.

[101] Thus, the present disclosure provides a filter assembly designed to reduce the quantity of remnant fluid by designing the funnel and locating the filter in such a manner that

the feed solution is directed by the tapered walls of the funnel straight into the filter. The present disclosure further provides a means to better isolate the filtrate from the feed solution.

[102] It should be apparent to those skilled in the art that many more modifications besides those already described are possible without departing from the inventive concepts herein. The inventive patient matter, therefore, is not to be restricted except in the spirit of the appended claims. Moreover, in interpreting both the specification and the claims, all terms should be interpreted in the broadest possible manner consistent with the context. In particular, the terms "includes" and "including" should be interpreted as referring to elements, components, or steps in a non-exclusive manner, indicating that the referenced elements, components, or steps may be present, or utilized, or combined with other elements, components, or steps that are not expressly referenced. Where the specification claims refer to at least one of something selected from the group consisting of A, B, C ....and N, the text should be interpreted as requiring only one element from the group, not A plus N, or B plus N, etc. The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practised with modification within the spirit and scope of the appended claims.

[103] While the foregoing describes various embodiments of the invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof. The scope of the invention is determined by the claims that follow. The invention is not limited to the described embodiments, versions or examples, which are included to enable a person having ordinary skill in the art to make and use the invention when combined with information and knowledge available to the person having ordinary skill in the art.

ADVANTAGES OF THE INVENTION

[104] The present disclosure provides a filter assembly to reduce the quantity of remnant solution.

[105] The present disclosure provides a filter assembly where feed solution can be easily supplied.

[106] The present disclosure provides a filter assembly where filtrate is isolated from feed solution.

[107] The present disclosure provides a filter assembly that can be part of a filter train.

[108] The present disclosure provides a filter assembly that can easily and swiftly be replaced.

PCT-IN-3977

I Claim:

1. A filter assembly comprising:

   a funnel, open at top end and having tapered walls towards a flat bottom end, for holding a feed solution to be filtered, such that, after filtration, a filtrate exits the funnel through an outlet disposed on the bottom end of said funnel; and

   a filter disposed at bottom end of the funnel and along the height of the funnel such that active surface of said filter is facing the walls of the funnel;

   wherein the filter is so disposed as to minimise annular space between said filter and the narrowed walls at bottom end of said funnel, such that maximum feed solution is directed by the tapered walls to the filter, thereby reducing the quantity of remnant solution.

2. The assembly as claimed in claim 1, wherein said filter is a pleated filter.

3. The assembly as claimed in claim 1, wherein the side of the filter facing the top end of the funnel is capped in order to prevent feed solution from entering filter from said side.

4. The assembly as claimed in claim 1, wherein one or more filters are stacked in series to filter particles of smaller size.

5. The assembly as claimed in claim 1, wherein a vacuum pump is connected to said assembly to drive feed solution through the filter rapidly be reducing pressure drop across the filter.

6. The assembly as claimed in claim 1, wherein said assembly is connected in series with one or more different filter assemblies to perform a combination of filtering operations.

7. The assembly as claimed in claim 1, wherein said filter is integrated with one or more depth filters.

8. The assembly as claimed in claim 1, wherein there is a provision for said assembly to incorporate a further one or more diatomaceous earth (DE) filters.

9. The assembly as claimed in claim 1, wherein the funnel is connected to a filtrate container to collect the filtrate, through a tapered output connector.

10. The assembly as claimed in claim 1, wherein said assembly is easily and quickly replaceable in case of breakdown of one or more components of said assembly.

ABSTRACT

The present disclosure provides a filter assembly for reducing the quantity of remnant solution. The assembly comprises a filter disposed at bottom end of a funnel with walls tapering towards the bottom end. The filter and funnel are so designed that the annular space between the filter and the wall at the bottom end is minimum, thereby reducing the potential for remnant solution to accumulate. Further, the filter is sealed to the bottom end of the funnel such that the filtrate is well isolated from the feed solution. The filter assembly can be part of a filter train and can be easily and swiftly replaced in case of a breakdown of any component of the filter assembly.

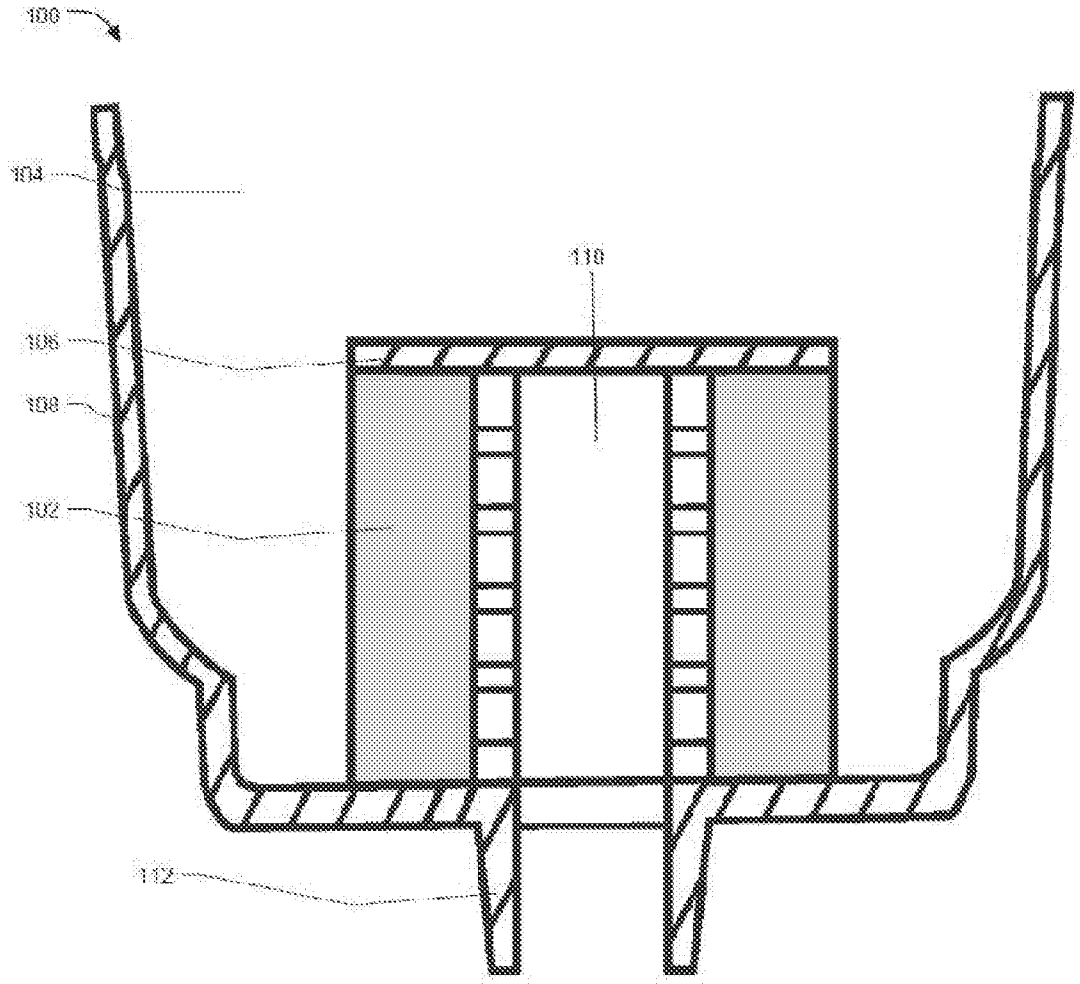

FIG. 1

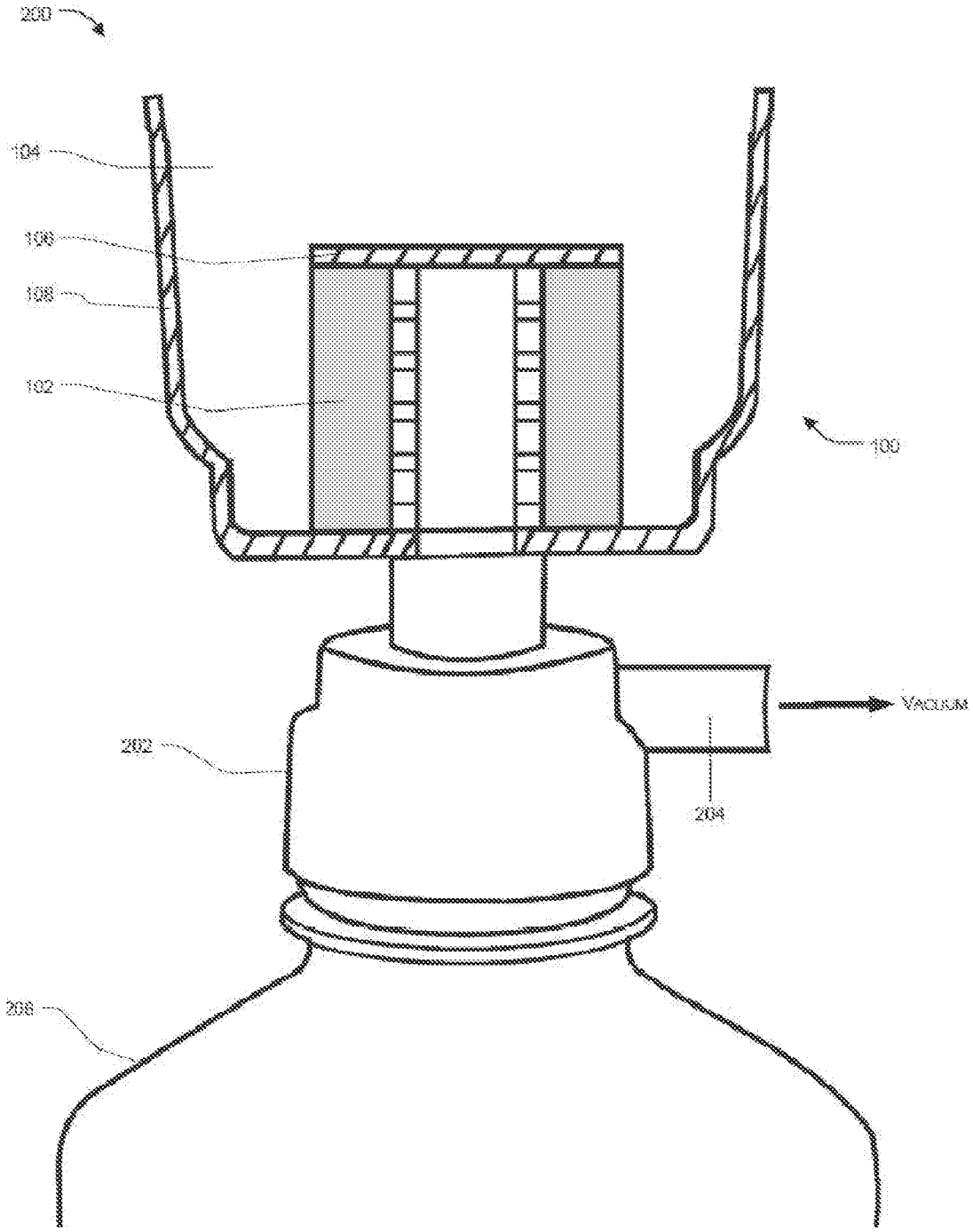

FIG. 2

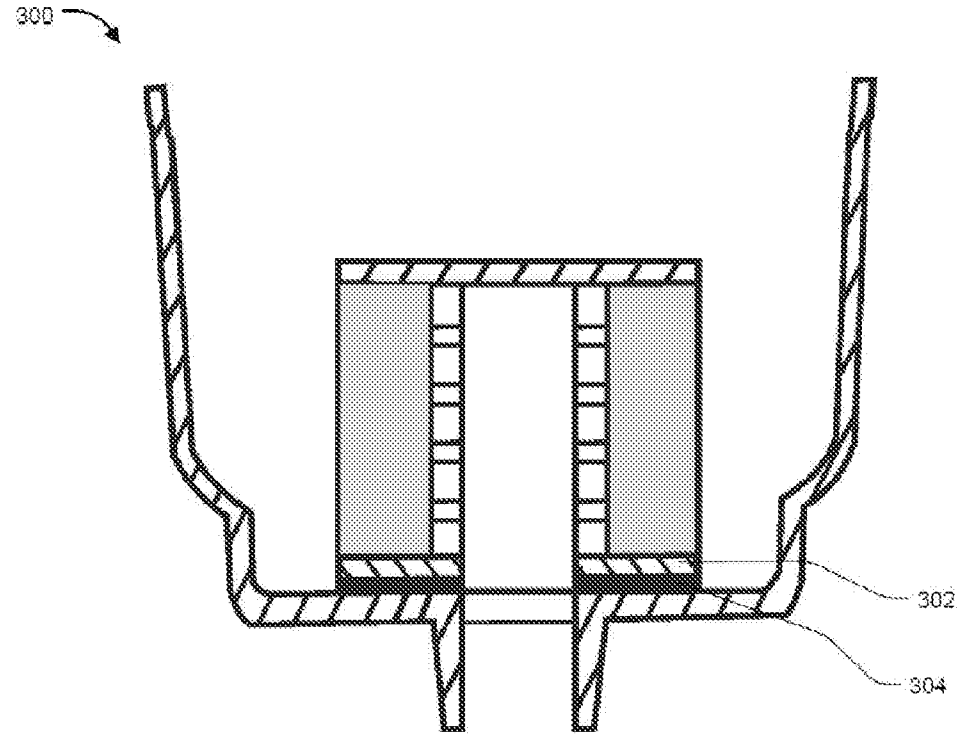

FIG. 3A

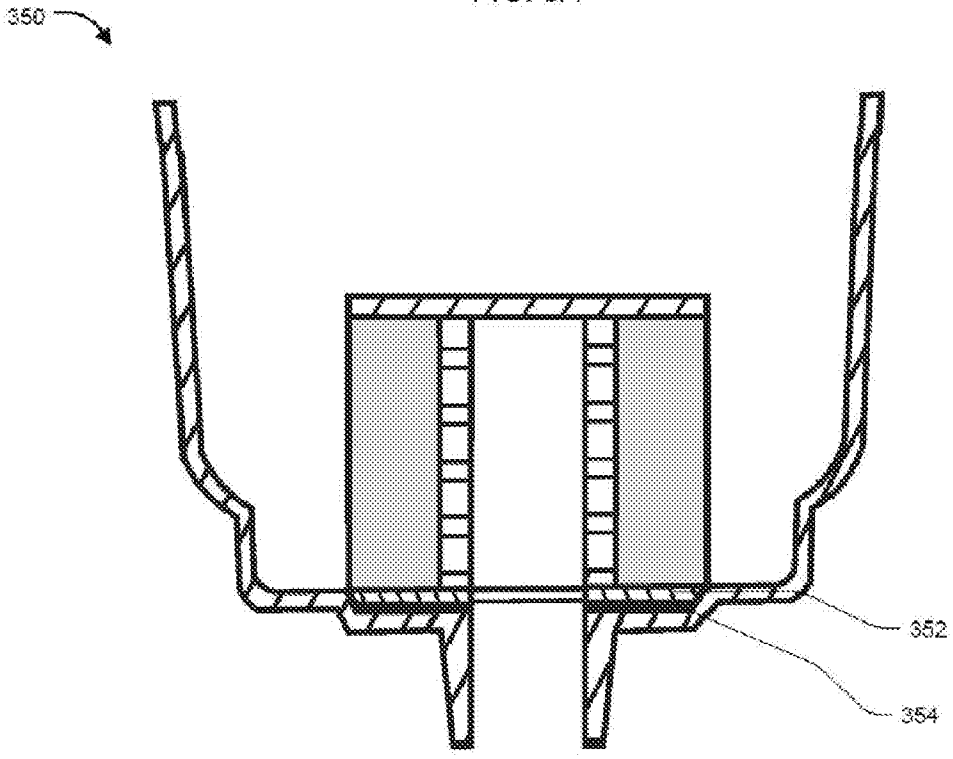

FIG. 3B

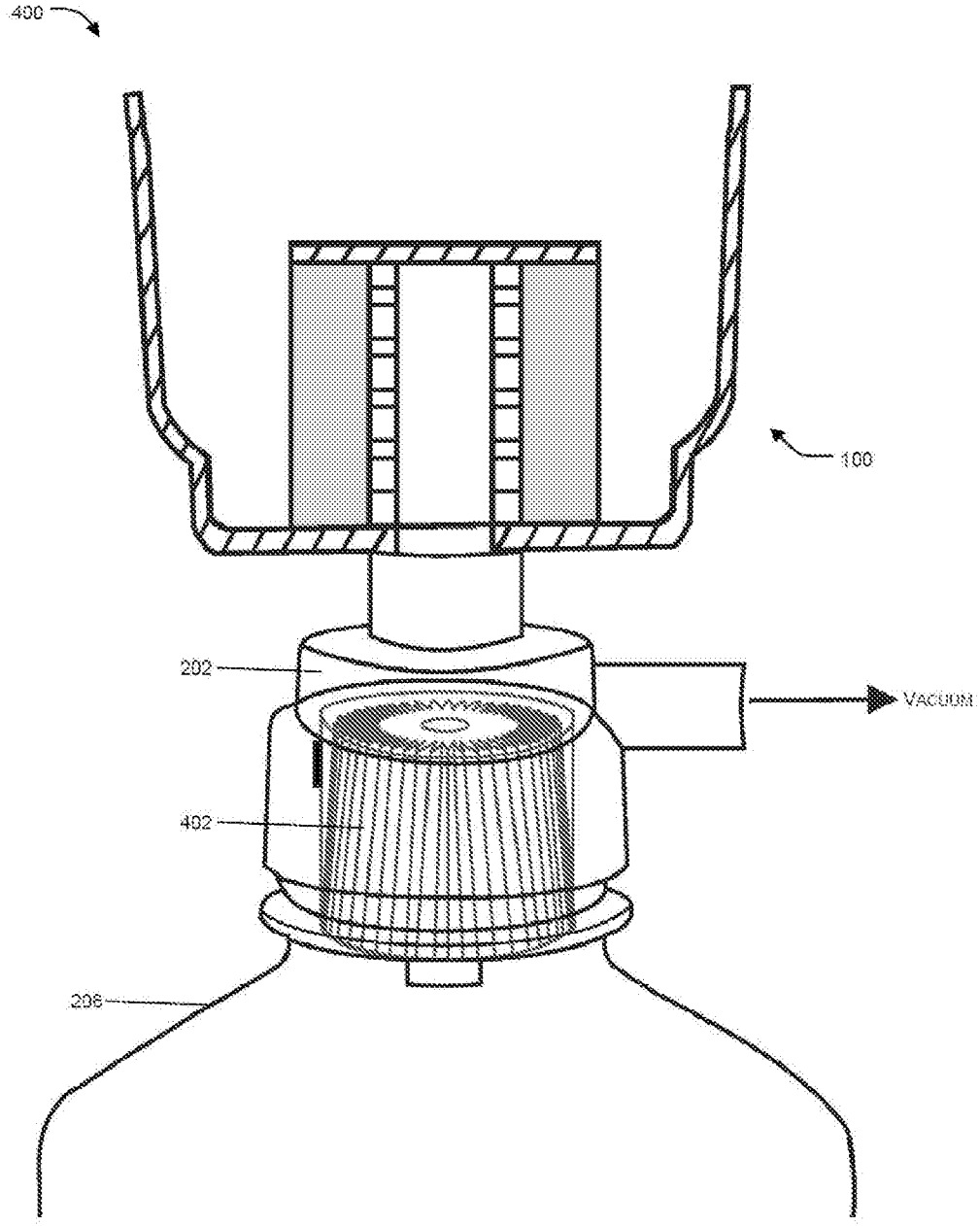

FIG. 4