CONTAINER AND CONTAINER ENGAGING MEMBER SUITABLE FOR VACUUM ASSISTED FILTRATION

This application claims priority of U.S. Patent Application Serial No. 14/641,843 filed March 9, 2015 and U.S. Provisional Application Serial No. 61/968,532 filed March 21, 2014, the disclosures of which are incorporated herein by reference.

BACKGROUND

The embodiments disclosed herein generally relate a container and a container engaging member, and in certain embodiments, relate to vacuum filter devices and particularly to such devices for filtering liquids from one container through a membrane and depositing the filtrate directly into another container.

Numerous laboratory devices have been developed to carry out filtration, in order to concentrate, separate and/or purify laboratory samples. Researchers routinely need to concentrate their sample prior to other investigative research. Devices for filtering biological solutions generally involve three primary components, i.e. a membrane filter interposed between two vessels, a feed container located upstream of the membrane for holding the sample solution to be filtered and a filtrate container located

downstream of the membrane filter for collecting the filtered sample solution. Typically a vacuum is drawn downstream of the membrane to increase the rate of filtration by creating a pressure differential across the filter.

Several device designs have been made for filtering a feed liquid into a filtrate container. These are typically used to clarify and sterilize biological solutions, such as fetal calf serum, tissue culture media and the like. In certain conventional devices, the user transfers the feed liquid from a storage vessel to the filter device. Vacuum filtration systems such as the STERICUP® system commercially available from EMD Millipore is ideally suited for sterile filtration of cell culture media, buffers and reagents. This device can handle a maximum unfiltered volume of 1 liter based on the size of the feeding funnel. Large volumes can be processed continuously, as determined by the volume of the feed and filtrate storage vessels.

The arrangement of the components for vacuum filtration can take various forms; however, especially in laboratory settings, ease of use, reduced storage requirements and minimal disposable hardware are important concerns as is avoiding spillage of the biological solution. In certain other applications, preserving the sterility of the solution

being filtered is also important.

Various single use, disposable, sterile filtration devices including a funnel and lid attached to a filtration collar, with an attached container, are commercially available. Most of these devices can process volumes ranging from 150 ml to 1000 ml, and offer a filtration top that includes a funnel and lid attached to a filtration collar assembly that one can assemble onto a pre-existing bottle or container. The assembly comes bagged with packaged bottle caps, and are sterilized such as by gamma sterilization. Conventional devices require 1-2 turns to disengage the bottle or container from the filter after filtration is complete. Since the bottle or container is filled with media , this manipulation can lead to possible dripping, spilling, etc., as well as contamination of the sample. This is especially true when operating in a laminar flow cell culture hood, where the sash is open 10-18” and manipulation is especially difficult.

SUMMARY

The problems of the prior art have been overcome by the embodiments disclosed herein, which provide a device particularly useful for large volume filtration of sample,

although the applications are not limited to filtration. In certain embodiments, the device provides rapid high-quality separations or purifications of samples in a convenient and reliable manner, which simplifies the engagement and disengagement of the various device components. In certain embodiments, assurance is provided that the device is closed, and feedback is provided to the user that the container engaging member is completely engaged. In certain embodiments, the device includes a container and a container engaging member. In certain embodiments, the container engaging member includes a collar, and may include a sample holder or reservoir or funnel and a filtration element such as a membrane. In the assembled condition, the sample holder or reservoir is upstream of the filtration element, the container is downstream of the filtration element, and the sample holder or reservoir is attached to the container. In certain embodiments, the container is filtrate bottle. Upon subjecting the sample in the sample holder to a driving force such as vacuum, the sample flows from the reservoir, through the filtration element, and into the container. In certain embodiments, the container engaging member includes a container cap. In certain embodiments, the container engagement member is engageable and disengageable from the

bottle or container in a quick attach, quick release manner, such as with only a 90 degree, ¼ turn. Since only a 90 degree ¼ turn is required to engage or disengage the components, the user’s hands/fingers do not have to leave the device to engage or disengage the components. In certain embodiments, a tactile indication that the engagement is complete is provided. In certain embodiments, an audible indication that the engagement is complete is provided. In certain embodiments, the container engagement member is a container cap that is similarly engageable and disengageable from the container, with similar audible and tactile indications.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a container in accordance with certain embodiments;

FIG. 2 is an enlarged perspective view of the neck portion of the container of FIG. 1 in accordance with certain embodiments;

FIG. 3A is a perspective bottom view of a container engaging member in accordance with certain embodiments;

FIG. 3B is a perspective view of a neck portion of a container in accordance with certain embodiments;

FIG. 3C is a cross-sectional view of tabs on the outer surface of the neck of a container in accordance with certain embodiments;

FIG. 4 is a perspective bottom view of a container engaging member with a portion shown in detail, in accordance with certain embodiments;

FIG. 5 is a perspective view of a container with a portion shown in detail, in accordance with certain embodiments;

FIG. 5A is a partial enlarged perspective view of a container engaged with a container engaging member in accordance with certain embodiments;

FIG. 5B is a perspective view of an engaging member shown engaged with and sealed to a container in accordance with certain embodiments;

FIG. 6 is a perspective bottom view of a container engaging member in accordance with certain embodiments;

FIG. 7 is an enlarged perspective bottom view of a container engaging member in accordance with certain embodiments;

FIG. 7A is a perspective view of another engaging member engaged with and sealed to a container in accordance with

certain embodiments;

FIG. 8 is a partial enlarged perspective bottom view of a container engaging member in accordance with certain embodiments;

FIG. 9 is a partial enlarged perspective view of a container engaged with a container engaging member in accordance with certain embodiments; and

FIGS. 10A, 10B and 10C are views illustrating a snap lock feature in accordance with certain embodiments.

DETAILED DESCRIPTION

Turning first to FIG. 1, in accordance with certain embodiments there is shown a container or housing 10 having an open top 11 as shown. In the embodiment shown, the container 10 is a generally cylindrical one-piece housing that can hold relatively large volumes of sample, such as about 500 milliliters, although the volume capacity is not particularly limited. In certain embodiments, the container 10 is made of a plastic such as polystyrene, polycarbonate, a member of the PET family (e.g., PETG, PETE), and a polyolefin, particularly polypropylene, but may also be made from any other suitable material not deleterious to the

operation (keeping in mind cost and vacuum strength).

FIG. 2 shows the details of certain embodiments of the neck 13 of the container 10. In certain embodiments, the neck 13 is generally cylindrical and extends from the body 12 of the container 10. The neck 13 is open at 11, allowing access to the interior of the container 10. The outer surface of the neck 13 includes a plurality of spaced tabs 14, individually labeled as tabs 14a, 14b, 14c, 14d (four shown) that extend radially outwardly from the outer surface of the neck 13. In certain embodiments, there are six spaced tabs, positioned in three stacked pairs, each stacked pair being spaced from another stacked pair. In certain embodiments, the spacing between stacked pairs of tabs is determined to achieve a balance between moldability and function (stability and avoidance of cross-threading). Each stacked pair includes an upper tab (e.g., 14a) and a lower tab (e.g., 14b), the lower tab parallel to, aligned with, and positioned just below the upper tab. In certain embodiments, each of the tabs extends radially outwardly from the neck 13 to the same extent, and are similarly shaped. In certain embodiments, the opposite ends of each tap taper inwardly towards each other. In certain embodiments, the tabs in two stacked pairs of tabs are shorter in length than the tabs in

the third stacked pair, to ensure orientation is in one direction and that the container and engaging member line up. In certain embodiments, the tabs of the two stacked pairs that are shorter in length than the tabs of the third are of equal length. As seen in FIG. 3C, in certain embodiments each tab includes a downwardly sloping ramp portion 24 that transitions to a vertical portion 25, and has a flat bottom portion 26. The tabs are discontinuous with respect to each other. In certain embodiments, each stacked pair is positioned a different distance below the open end of the neck 13. In other words, were each of the lower tabs connected, the resulting hypothetical annular ring would be angled with respect to the open end of the neck 13. Similarly, were each of the upper tabs connected, the resulting hypothetical annular ring would be angled with respect to the open end of the neck 13. In certain embodiments, the angle of the two hypothetical rings with respect to the open end of the neck 13 would be the same.

The pitch of the tabs 14 is configured so that the tabs are capable of engaging and disengaging with a suitable engaging member with a 90 degree ¼ turn, and are also capable of engaging with a conventional engaging member (e.g., a standard buttress thread with a pitch of 0.1667 inches) with

a full 360 degree or more turn. Pitch is defined as the z-axis (depth) of movement corresponding to a full, 360° turn. The thread start (starting with the depth of the first thread) and thread lead (angle where the first thread starts) are configured to ensure that the stop is engaged after the click is engaged and after the engaging member seal 48 is fully engaged. More specifically, in certain embodiments as shown in FIG. 5B, a seal 48 such as a foam gasket is positioned to be compressed by the collar 40 as it is rotated relative to the body 12 onto the container, contacting the flat surface of the free end of the neck 13. Similarly, as shown in FIG. 7A, in certain embodiments cap 60 includes a seal 48’ is comprised of a protruding ring feature that engages with the inside wall of the bottle neck 13 to form a seal when compressed.

The neck 13 also includes a circumferential flange 30 extending radially outwardly. In certain embodiments, the flange extends radially outwardly a distance further than the tabs 14. In certain embodiments, the flange 30 is spaced from the bottom of the neck 13; that is, it is positioned just above the region where the neck 13 transitions to the body 12 of the container 10. In certain embodiments, the flange 30 includes two spaced tabs 31a, 31b, preferably spaced 180°

from each other. Each tab includes a radially extending top portion 32 that extends upwardly from the flange 30 and radially outwardly from the neck 13 coextensively with the flange 30 extends. Each tab also includes a radially extending bottom portion 33 that extends radially outwardly from the edge of the flange 30 and terminates in a free end 34. In cooperation with certain elements on the collar 40 as discussed below, the tabs 31a, 31b serve to create a snap fit engagement between the collar 40 and the container 10, or a cap 60 and the container 10.

Turning now to FIGS. 3A and 4, collar 40 is shown. In certain embodiments, collar 40 is configured to engage the neck 13 of container 10. In certain embodiments, the collar 40 is generally cylindrical, and includes a top portion 39 (FIG. 5A) that has a plurality of spaced radial ribs 44 or the like that support a filter element such as glass fibers or a membrane (not shown) (e.g., DURAPORE® 0.45µm membrane). In certain embodiments, the collar 40 also supports a sample reservoir (not shown) that is in fluid communication with the container 10 via the membrane through a plurality of apertures in the collar 40. The collar can be placed in communication with a driving force such as vacuum via inlet pipe 38.

Within collar 40 there is an inner cylindrical member 41 extending axially from the underside of the top portion of the collar 40. In certain embodiments, the cylindrical member 41 is centrally located in the collar 40 and is a neck engaging member. In certain embodiments, the inner wall 42 of the cylindrical member 41 includes a plurality of spaced threads or helical sweeps 45, extending radially inwardly from the inner wall 42 and configured to receive respective tabs 14 on the neck 13 of the container 10. In certain embodiments, the threads 45 are discontinuous with respect to each other. In certain embodiments, there are nine spaced threads 45, positioned in three axially stacked groups, each stacked group being equally spaced from another stacked group. Each stacked group includes a first thread (e.g., thread 45a), a second intermediate thread (e.g., thread 45b), and a third thread (e.g., thread 45c), the second and third threads being parallel to, aligned with, and positioned just below (when the collar 40 is in the upright position) the first thread 45a. In certain embodiments, the cylindrical member 41 also includes one full thread 45’ that spans the entire inner circumference of the cylindrical member 41 near the bottom thereof. In certain embodiments, each of the threads 45 extends radially outwardly from the wall 42 to the

same extent, and the threads are similarly shaped. In certain embodiments, two stacked groups of threads are shorter in length than the threads of the third stacked group, to ensure orientation is in one direction and that the container and engaging member line up. In certain embodiments, the threads of the two stacked groups that are shorter in length than the threads of the third are of equal length. In certain embodiments, the opposite ends of each thread taper inwardly towards each other. In certain embodiments, each thread 45 includes an upwardly sloping ramp portion 46 that transitions to a vertical portion 47. The upwardly sloping ramp portion of a thread contacts the downwardly sloping ramp portion 24 of a corresponding tab 14 when the collar 40 is engaged on the neck 13.

The enlarged detail of FIG. 4 illustrates the snap engagement feature 50 of certain embodiments. The snap engagement feature 50 cooperates with the tabs 31a, 31b to create a snap fit engagement between the collar 40 and the container 10. In certain embodiments, the snap engagement feature 50 is formed on the free end 49 of the cylindrical member 41, and includes a raised snap bead 51, a notch 52, and a raised stop member 53. In certain embodiments, there

are two such snap engagement features 50, spaced apart 180°, each capable of cooperating with a respective one of the tabs 31a, 31b of the container 10. As the collar 40 is rotated with respect to the container 10, the tab 31a travels along the free end 49 of the collar 40 until it is raised axially by raised snap bead 51. Further relative rotation in the same direction causes the tab 31a to ride over the snap bead 51 (creating feedback to the user) and drop into notch 52. Still further relative rotation causes the tab 31a to abut against side wall 54 of raised stop member 53, creating a backstop. The abutment of the tab 31a against the side wall 54 causes an audible “click” sound feedback to the user, warning the user to cease the rotation, thereby preventing over-torquing. The tab will remain in the notch 52 until sufficient force is exerted so that the tab 31a can overcome the height of the snap bead 51. In certain embodiments, such sufficient force is defined as force that can easily and comfortably overcome the height of the snap bead by the 5th percentile adult female to the 95th percentile adult male as verified through usability studies. The tab 31a thus sits in the region of notch 52 when the collar 40 is in the closed position on the container 10, and the raised snap bead 51 is raised a sufficient amount to hinder premature or unwanted

loosening of the tab 31a from the region of the notch 52. Tab 31b cooperates with the other snap engagement feature in a similar way.

In certain embodiments, the cylindrical member 41 includes one or more (two shown) rotational limiting members such as tabs 55a, 55b that extend axially from the cylindrical member 41 as shown in FIGS. 3A and 4. The rotational limiting members 55a, 55b are positioned in the thread relief region 57 of the cylindrical member 41. The rotational limiting members 55a, 55b interact with the bottom portion 33 of tabs 31a, 31b on the container 10 and stop the relative rotation of the collar 40 and container 10 when disengaging the collar 40 from the container 10. This provides feedback to the user when the tabs 14a, 14b, 14c and 14d on the neck 13 are located in the thread relief region 57 of the cylindrical member 41, are no longer engaged with the threads 45a, 45b and 45c, and thus the collar 40 can be raised axially away from the container 10 and removed therefrom. Were this feature absent, the threads 45 could re-engage with the tabs 14 if the relative rotation of the collar 40 and container 10 exceeds 90°. In certain embodiments, the rotational limiting member(s) 55 also serve to assist in the proper positioning of the container engaging

member with respect to the container to engage the components. For example, as these components are brought together, the rotational limiting member(s) can be positioned in a region between the spaced, discontinuous tabs 14 of said neck (such a region being called out by marking 9 (FIG. 5) formed on the container body). The container is then moved axially with respect to the container engaging member, followed by rotating the container with respect to the neck engaging member 90° to engage the tabs of the container with the threads of the neck engaging member.

In certain embodiments, there are three spaced thread relief regions 57 and three spaced groups of threads 45. This allows the container 10 to drop in up to the single full thread 45’ on the bottom of the collar 40. Relative rotation of the container 10 and collar 40 will further engage all of the threads.

In certain embodiments, it is advantageous to have a cap for the container 10. Users often store media in the container 10 for weeks at a time, and access the container 10 regularly to feed cells. Accordingly, the cap/container interface is often the primary interface of the device, and should be ergonomically designed. Turning now to FIG. 6, a cap 60 is shown. In certain embodiments, the cap 60 includes

a generally cylindrical body 62 and annular bell shaped bottom region 63 that angles out radially from the body 62. In certain embodiments, the cap 60 includes a plurality of spaced fins 61 that extend radially outwardly from the body 62 and associated radiuses that in conjunction with annular ring 64, allow ergonometric gripping of the cap for assembling and disassembling of the cap 60 on the neck 13 of the container 10 with one hand, e.g., a single thumb, especially while wearing gloves. For example, the user's fingers conveniently fit in the regions between the fins 61, facilitating the relative rotation of the cap 60 with respect to the container 10. The fins 61 also allow the cap 60 to rest on its side to reduce the chance of contamination.

In certain embodiments, the interior of the body 62 of cap 60 includes a single continuous helical thread 66. The thread 66 allows for free-spin operation; applying a slight rotation force to the cap 60 relative to the container 10 is sufficient to rotate the cap 60 relative to the container 10 enough to disengage the cap 60 from the container 10.

In certain embodiments, the cap 60 includes a snap engagement feature 50'. The snap engagement feature 50' cooperates with the tabs 31a, 31b of the container 10 to

create a snap fit engagement between the cap 60 and the container 10. In certain embodiments, the snap engagement feature 50′ is formed on the surface of the cylindrical body 62 where it transitions to the bell shaped bottom region 63, and includes a raised snap bead 51′, a notch 52′, and a raised stop member 53′. In certain embodiments, there are two such snap engagement features 50′, spaced apart 180°, each capable of cooperating with a respective one of the tabs 31a, 31b of the container 10. As the cap 60 is rotated with respect to the container 10, the tab 31a approaches the snap fit engagement feature 50′ until it is raised axially by raised snap bead 51′. Further relative rotation in the same direction causes the tab 31a to drop into notch 52′. Still further relative rotation causes the tab 31a to about against side wall 54′ of raised stop member 53′, creating a backstop. The abutment of the tab 31a against the side wall 54′ causes an audible “click” sound as well as tactile feedback to the user, warning the user to cease the rotation, thereby preventing over-torquing. The tab 31a sits in the region of notch 52′ when the cap 60 is in the closed position on the container 10, and the raised snap bead 51′ is raised a sufficient amount to hinder premature or unwanted loosening of the tab 31a from the region of the notch 52′. Tab 31b

cooperates with the other snap engagement feature in a similar way.

FIGS. 8-10 illustrate another embodiment of the cap engagement with a container 10. In accordance with this embodiment, a snap lock feature is provided that flexes radially outwardly when it engages the lock features in the container 10. As shown in FIG. 8, a cantilever snap lock member 51″ is positioned radially outwardly from raised stop member 53″, and offset therefrom circumferentially (e.g., offset by the thickness of the tab 31a). In certain embodiments, the cantilever snap lock member 51″ is formed in a recess 510 in the bell shaped bottom region 63 of the cap 60, and protrudes axially therefrom. The edges of the snap lock member 51″ are chamfered as can be seen in FIG. 8, and the snap lock member 51″ is capable of flexing radially outwardly when its radially inward surface engages the radially outward surface of tab 31a on the container 10, as shown in FIG. 9. In certain embodiments, there are two such snap lock members, spaced apart 180°, each capable of cooperating with a respective one of the tabs 31a, 31b of the container 10.

As the cap 60 is rotated relative to the container 10, the tab 31a (and more specifically, the radially extending

bottom portion 33 of the tab 31a) rides over the chamfered edge forcing the snap lock member 51″ radially outward. As shown in FIG. 10A, initial contact between the tab 31a and the snap lock member 51″ is made (e.g., at about 11°). FIG. 10B shows that continued relative rotation of the cap 60 and container 10 causes the snap lock member 51″ to deflect radially outward. FIG. 10C shows that upon further relative rotation, the tab 31a no longer contacts the snap lock member 51″, and the latter returns to its original position. In the position shown in FIG. 10C, the tab 31a (and more specifically, the radially extending top portion 32 of tab 31a) abuts against side wall 54″ of raised stop member 53″, creating a backstop. This abutment of the tab 31a and raised stop member 53″ causes an audible “click” sound as well as tactile feedback to the user, warning the user to cease the rotation, thereby preventing over-torquing.

What is claimed is:

1. An assembly comprising a container, a container engaging member and a seal member, said container having a container body and an open neck, said open neck comprising a plurality of spaced, discontinuous open neck tabs extending radially from said neck; said container engaging member comprising a body having a neck engaging member, said neck engaging member comprising a plurality of spaced, discontinuous threads configured to engage with said spaced, discontinuous open neck tabs upon relative rotation of said neck and said neck engaging member, wherein

said container further comprises a circumferential flange extending radially outwardly from said neck, said flange comprising a plurality of spaced flange tabs, and wherein

said neck engaging member comprises an axially extending cylindrical portion having an axially raised snap bead, a notch, and an axially raised stop member at the bottom surface of the cylindrical portion that cooperate with said flange tabs to create a snap fit engagement between said neck and said neck engaging member, and wherein

said seal member is positioned to engage said neck and compress upon relative rotation of said neck and said neck engaging member.

2. The assembly of claim 1, wherein said open neck tabs are positioned in a plurality of stacked pairs, each stacked pair being equally spaced from another stacked pair.

3. The assembly of claim 2, wherein each said stacked pair comprises an open neck upper tab and an open neck lower tab, said open neck lower tab being parallel to, aligned with, and positioned just below said open neck upper tab.

4. The assembly of claim 2, wherein each open neck tab comprises a downwardly sloping ramp portion that transitions to a vertical portion.

5. The assembly of claim 1, wherein said container engaging member comprises a cap for closing said container.

6. The assembly of claim 1, wherein each said flange tab comprises a radially extending top portion that extends upwardly from said circumferential flange and radially outwardly from said neck, and a radially extending bottom portion that extends radially outwardly from said circumferential flange and terminates in a free end.

7. The assembly of claim 1, wherein said neck engaging member comprises at least one rotational limiting member that extends axially from said neck engaging member and abuts against said flange tabs on said circumferential flange to prevent relative rotation in one direction of said neck engaging member and

container.

8. The assembly of claim 1, wherein said neck engaging member comprises a cantilever snap lock member and a raised stop member, said cantilever snap lock member being positioned radially outwardly from said raised stop member.

9. The assembly of claim 1, wherein said seal member comprises a foam gasket.

10. The assembly of claim 1, wherein said seal member comprises an annular ring extending from said container engaging member.