The invention relates to a product that can increase the volume of a well of a multiwell plate, preferably a 96-well plate, so that manipulations requiring larger volume or higher dilutions are performed. The adapter (10) consists of a matrix of inter-connected, open bottom wells (12) that have substantially the same well spacing as the plate whose volume the adapter is designed to increase. Wells (12) are inter-connected by a support structure (22).
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MULTIWELL PLATE VOLUME ADAPTER

FIELD OF THE INVENTION

The invention relates to a product for use with multiwell plates used in chemical and biological assays, and more specifically, to a product that increases the volume of individual wells of a multiwell plate without altering the industry standard plate dimensions.

BACKGROUND OF THE INVENTION

Multiwell plates are an important staple in the field of biological and chemical testing. For many years, multiwell laboratory plates have been manufactured in configurations ranging from 1 well to 96 wells, and recently to as many as 1536 wells and beyond. The wells of multiwell plates are typically used as reaction vessels for performing various tests, growing tissue cultures, screening drugs, or performing analytical and diagnostic functions. The dimensions and physical attributes of the plates vary depending on the requirements of a particular assay. A consideration in the design of the plate is that it should function correctly with the end user's equipment.

Equipment using standardized multiwell plates include plate readers, plate washers, robotic plate
handlers, automated pipette stations, plate storage devices, vacuum manifolds and other manipulation devices.

In addition, equipment is available to transmit light through individual wells and to read colorimetric changes or chemiluminescence in individual wells. Some of this equipment is automated to record, analyze and manipulate the data recorded. As a result of this standardization, many dimensions on the plate must fall within an acceptable range. The important parameters include plate width, length, height, well location, well diameter and number of wells, among others. Due to these constraints, the plate parameters may not meet all of the end user's needs, in some instances. For example, a plate that has a standard footprint and height, will have a maximum well volume that is dependent on the number of wells in the plate. The maximum well volume for a particular plate may not be great enough for the end user's particular application. The present invention solves this problem by providing a means for increasing the well volume of a multiwell plate in a way that only temporarily changes the height of the plate.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a removable means for temporarily increasing the volume of wells of a multiwell plate without changing the industry standard dimensions of the multiwell plate. Another object is to provide a volume adapter unit that is capable of being stacked either onto a multiwell plate or onto another volume adapter. A further object is to create an adapter that allows a user to create a well volume for a given application simply as a function of the number of stacked adapters. Yet another object is to provide a means for increasing the well volume of a multiwell plate for which there may not be a commercially available, deep well format, for a particular volume.

The present invention relates to an apparatus for temporarily increasing the volume of wells in a multiwell plate. The invention comprises an adapter plate having a matrix of open ended, substantially bottomless wells. The matrix aligns with the distribution of wells of a multiwell plate such that the adapter plate may either be
stackably fitted onto a base multiwell plate, or onto another substantially identical adapter.

**BRIEF DESCRIPTION OF THE FIGURES**

5

FIG 1 is a plan view of the volume adapter of the present invention.

FIG. 2 is a side view of the volume adapter of the present invention.

10

FIG 3 is a three dimensional view of the volume adapter of the present invention

FIG. 4 is a cross sectional view of two volume adapters of the present invention stacked together and further stacked onto a standard 96-well plate

15

FIG 5 is an enlarged portion of FIG 4 showing successively stacked wells

FIG 6 is a three dimensional view of two volume adapters of the present invention stacked together and further stacked onto a standard 96-well base plate

20

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

FIG. 1 shows a plan view of the volume adapter 10 of the present invention. The invention relates to a product that can increase the volume of a well of a multiwell plate, preferably a 96-well plate, so that manipulations requiring larger volumes or higher dilutions may be performed. The adapter 10 consists of a matrix of interconnected, open bottom wells 12 that have substantially the same well spacing as the plate whose volume, the adapter is designed to increase. Wells 12 are inter-connected by a support structure 22. While the preferred product adapts to a 96-well plate format, varying the adapter to fit a plate with any number of wells is possible. For example, adapters can be manufactured to adapt to plates having anywhere from one
well to 1536 wells, and beyond. The product is preferably injection molded from a thermoplastic material such as polyethylene.

FIG. 2 shows a view of the adapter 10 as seen from the side. The wells 12 have an open top 14 and an open bottom 16. The inner diameter of the top opening 14 is preferably greater than the outer diameter of the bottom opening 16, such that the bottom part of one well from an adapter will fit securely into the top of a corresponding well from another adapter. A seal taper 11 is located on the lower third of the well. The seal taper 11 terminates in a chamfered edge 20 and helps guide the well into sealing contact with a receiving well. The interface between adapters is preferably an interference fit. Further, the outer diameter of the bottom is preferably less than the inner diameter of a well from a corresponding multiwell plate. Likewise, an interference fit preferably results from the well-well engagement between adapter and multiwell plate. The integrity of this seal is important to the design but should not be limited to an interference fit. For example, a locking system may be employed whereby a male piece from a volume adapter locks with a female piece from either another adapter or a multiwell plate thereby. An example of this type of interlocking fit is disclosed in United States Pat. 5,285,253, which is incorporated by reference herein. Further, if a permanent attachment is desired, the adapter could be ultrasonically welded to a multiwell plate and/or other adapters.

FIG 3 shows a three dimensional view of the volume adapter of the present invention. The matrix of bottomless wells 12 are inter-connected by a support structure 22.

FIGS 4-6 show a 96 well base plate 16 with two volume adapter plates 10, 10a fittingly stacked thereon. FIGS 4 and 5 show a cross sectional view. The first adapter plate 10, stacks on the multiwell plate 16. The second adapter plate 10a stacks on the first adapter plate 10. The volume of each well 18 from the multiwell plate 16 has increased approximately threefold, due to the stacked adapter plates 10, 10a. Each expanded well 21 is entirely self contained and liquid tight. Since no filters or partial bottom walls divide the well, a pipette can access the bottom of the well 18 of the multiwell plate 16. The adapter plates are designed so that any number of plates can be stacked to obtain a desired volume. An external chamfer 20 on the bottom of each well
12 of the volume adapter 10 may be incorporated to help align each well 12 of the adapter with each well 18 of the multiwell base plate 16 when they are pressed together. When properly pressed together, an interference fit seal 24 results.

To aid in alignment, the length of the center wells of the volume adapter may be longer than the rest so the center wells engage first. This will help minimize alignment problems associated with accumulated well center to center mismatch. Further, a degree of flexibility will preferably be designed into the plate, through material selection and geometry, to allow the plate to flex so it will fit into plates with non-identical center spacing. Because of the desired flexibility, the adapter will preferably be made of polyethylene. Other materials can be used such as polystyrene or polypropylene.

In order to properly fit an adapter onto a multiwell plate, it is necessary to align the adapter over the multiwell plate in which the assay is to be performed, and press it firmly into the corresponding wells. Additional volume adapter plates can then be pressed into the first until the desired volume is reached. A mechanical press might be necessary to provide enough force to seal each well completely. To disassemble the plates, one can pry them apart by hand or with the use of a special fixture. In this way, the volume of each well can be temporarily increased as required by the application.

It should be noted that adapter plates can be manufactured with wells of varying heights and volumes. For example, a single adapter plate may contain well extensions that increase the well volume several times.

Further, the volume adapter can be attached to a filter plate in the same manner as previously described for attachment to a multiwell plate, such that the wells of the filter plate are extended, and an increased volume of liquid can be pushed through the individual filters.

It should also be understood that a membrane or other porous matrix may be stretched across the bottom openings of the wells of the adapter for the purpose of providing a filter unit or, if several membrane covered adapters are stacked, a layered filtering system.

Further, it should be understood that volume adapters can be manufactured as strips of interconnected bottomless wells that correspond to and fittingly engage cuvette strips or a single row or column of a base multiwell plate. Individual well volume
adapters comprising a single bottomless well can also be manufactured that fittingly
engage a single base well from either a strip of wells, a plate, or a single cuvette

Although the invention has been described in detail for the purpose of
illustration, it is understood that such detail is solely for that purpose and variations can
be made therein by those skilled in the art without departing from the spirit and scope of
the invention which is defined by the following claims.
What is claimed is.

1. A stackable adapter for increasing the volume of a base multiwell plate comprising:
   an adapter plate having a matrix of open ended, substantially bottomless wells,
   said open ended well having an outer diameter at the bottom opening which is smaller
   than the inner diameter at the top opening, said matrix in corresponding alignment with a
   distribution of wells of a base multiwell plate such that said adapter plate may be
   stackably fitted onto a multiwell plate or a substantially identical adapter.

2. The stackable adapter of claim 1 wherein said adapter plate is made of a flexible
   polymer.

3. The stackable adapter of claim 1 wherein said matrix has 96 open ended,
   substantially bottomless wells.

4. The stackable adapter of claim 1 wherein sidewalls of said open ended,
   substantially bottomless wells terminate in a chamfered edge

5. The stackable adapter of claim 1 wherein the volume of each of said open ended,
   substantially bottomless wells is substantially identical to the volume of a well from said
   base multiwell plate.

6. The stackable adapter of claim 1 wherein the volume of each of said open ended,
   substantially bottomless wells is larger than the volume of a well from said base
   multiwell plate.

7. An apparatus in which to perform biological or chemical assays comprising
   a multiwell filter plate having a plurality of filter wells, each of said wells having
   a filter bottom and an open top,
a first volume adapter having at least one open ended, substantially bottomless well,

at least one well of said first volume adapter fitted into a corresponding well of said multiwell filter plate such that the volume of said well from said multiwell filter plate well is increased by said well from said first volume adapter.

8. The apparatus of claim 7 wherein at least one second volume adapter having a at least one open ended, substantially bottomless well is securely fitted into at least one corresponding well from said first volume adapter.

9. The volume adapter of claim 7 wherein said open ended, substantially bottomless wells take the form of a matrix.

10. The volume adapter of claim 7 wherein said open ended, substantially bottomless wells take the form of a strip of wells.

11. An adapter for increasing the volume of a plurality of base wells as used in biological or chemical analysis comprising a plurality of bottomless wells, said wells capable of fittingly engaging said base wells.

12. The adapter of claim 11 wherein said bottomless wells have a tapered bottom portion.

13. An apparatus in which to perform biological or chemical assays comprising:

a multiwell plate having a plurality of wells, each of said wells having a bottom and an open top,

a first volume adapter having at least one open ended, substantially bottomless well,
at least one well of said first volume adapter fitted to a corresponding well of
said multiwell plate such that the volume of said well from said multiwell plate well is
increased by said well from said first volume adapter.

14. The apparatus of claim 13 wherein at least one second volume adapter having at
least one open ended, substantially bottomless well is securely fitted into at least one
corresponding well from said first volume adapter.

15. The volume adapter of claim 13 wherein said open ended, substantially
bottomless wells take the form of a matrix

16. The volume adapter of claim 13 wherein said open ended, substantially
bottomless wells take the form of a strip of wells
### INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) :B01L 3/00  
US CL :422/102

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)

U.S. : 422/99, 101, 102, 104

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

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

**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:
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  *B* earlier document published on or after the international filing date  
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  *N* 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  
  *A* document member of the same patent family

**Date of the actual completion of the international search:**  
10 AUGUST 1998

**Date of mailing of the international search report:**  
23 SEP 1998

**Name and mailing address of the ISA/AJS Commissioner of Patents and Trademarks**  
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Washington, D.C. 20231

**Facsimile No.:** (703) 305-3230

**Authorized officer:** HAROLD Y. PYON

**Telephone No.:** (703) 308-0651

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