US 20050278838A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2005/0278838 A1

Shenosky et al. (43) Pub. Date: Dec. 22, 2005

(54) MODULAR PORT SYSTEM AND REPLACEMENT METHOD THEREOF

(75) Inventors: **Joseph T. Shenosky**, Hellam, PA (US); **Mark F. Kaye**, Falls Church, VA (US); **Valerie J. Yoder**, Ann Arbor, MI (US)

Correspondence Address:
STAAS & HALSEY LLP
SUITE 700
1201 NEW YORK AVENUE, N.W.
WASHINGTON, DC 20005 (US)

(73) Assignee: **Alion Science and Technology**, McLean, VA

(21) Appl. No.: **10/868,197**

(22) Filed: **Jun. 16, 2004**

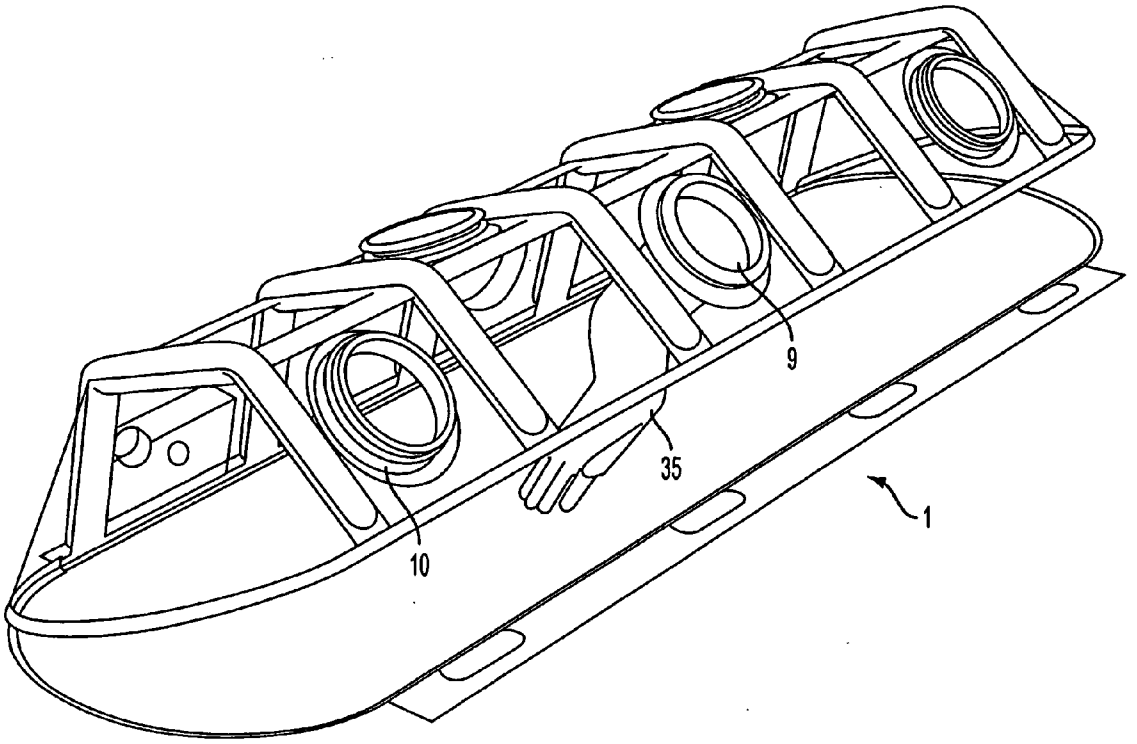
Publication Classification

(51) **Int. Cl.**[7] **A41D 19/00**

(52) **U.S. Cl.** **2/457**; 2/16

(57) **ABSTRACT**

A chemical or biological containment apparatus having a seal to contain contaminants in an inside thereof from passing to an outside, including an outer envelope; a port disposed in the envelope, the port including an outer portion having a circumferential portion extending away from the envelope and a flange extending from the circumferential portion and attached to the envelope, and an inner portion. The inner portion includes a circumferential surface corresponding to the circumferential portion, a plurality of grooves formed in the circumferential surface, and a plurality of O-rings respectively received in the grooves to form the seal with the outer portion.



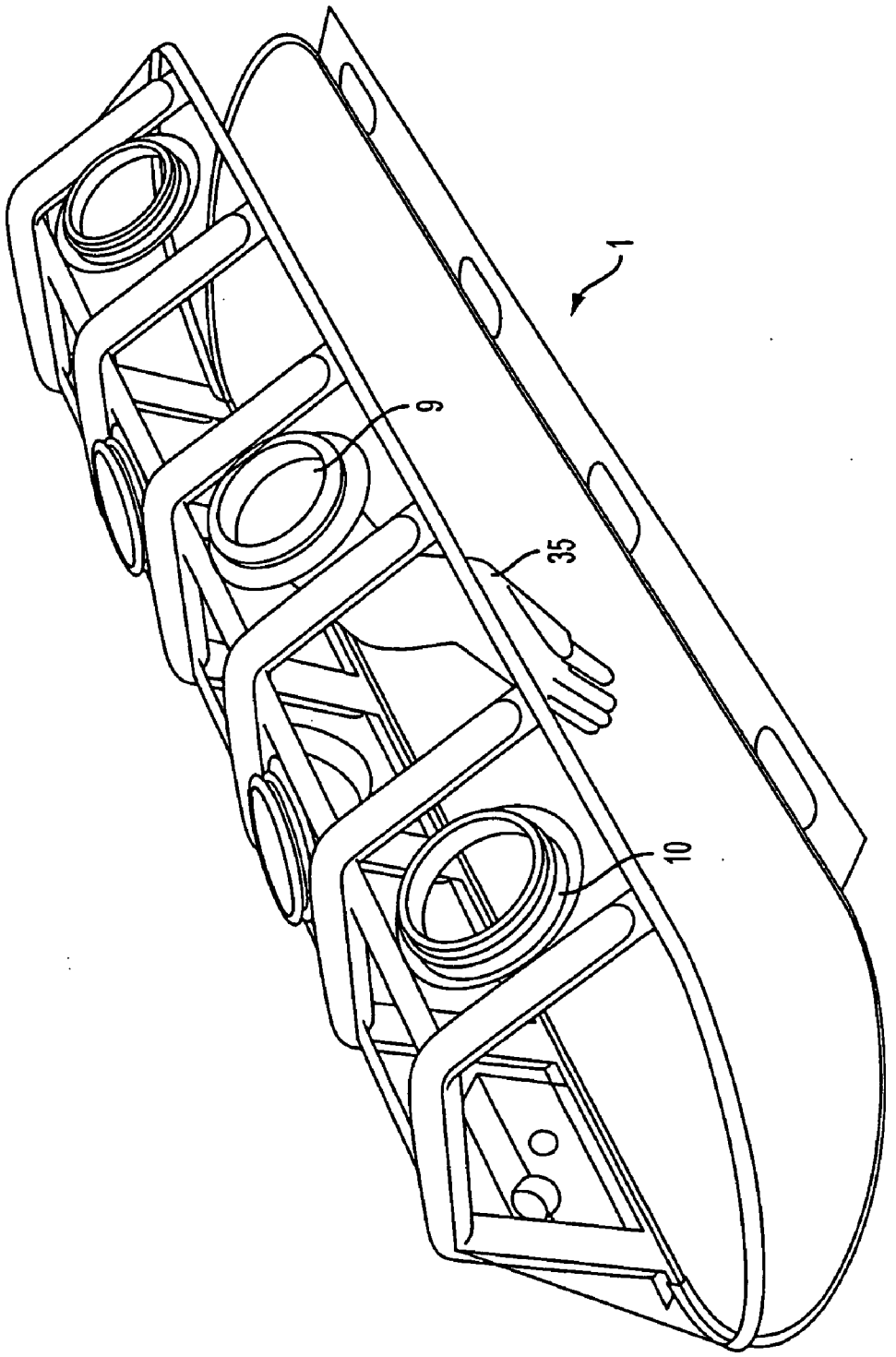


FIG. 1

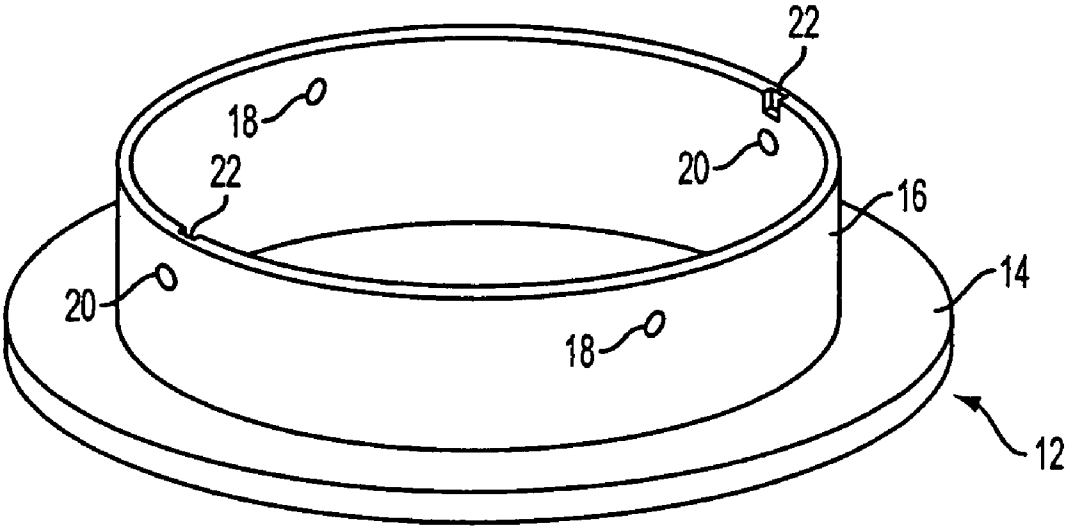


FIG. 2

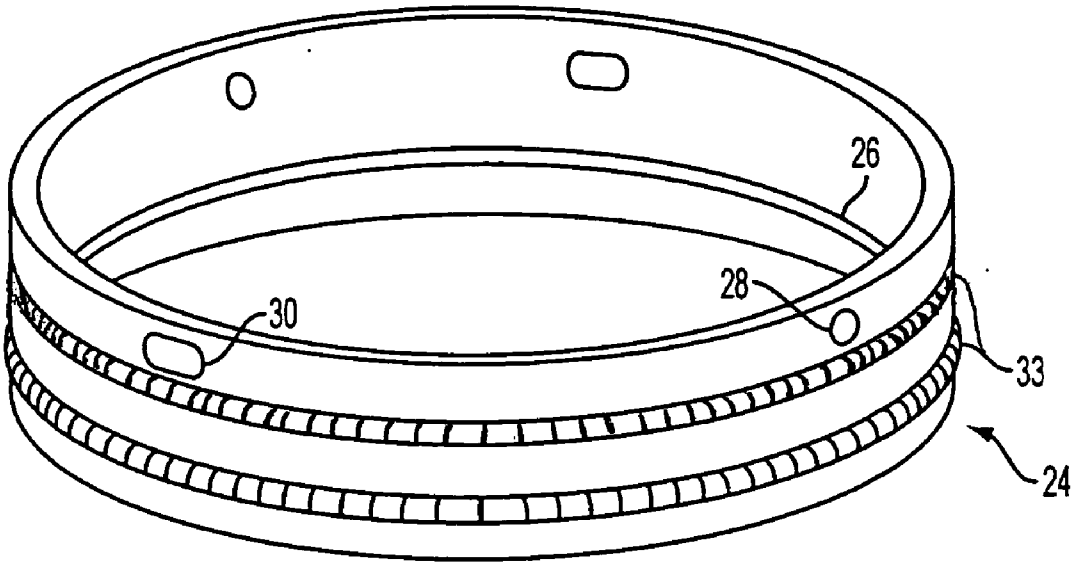


FIG. 3

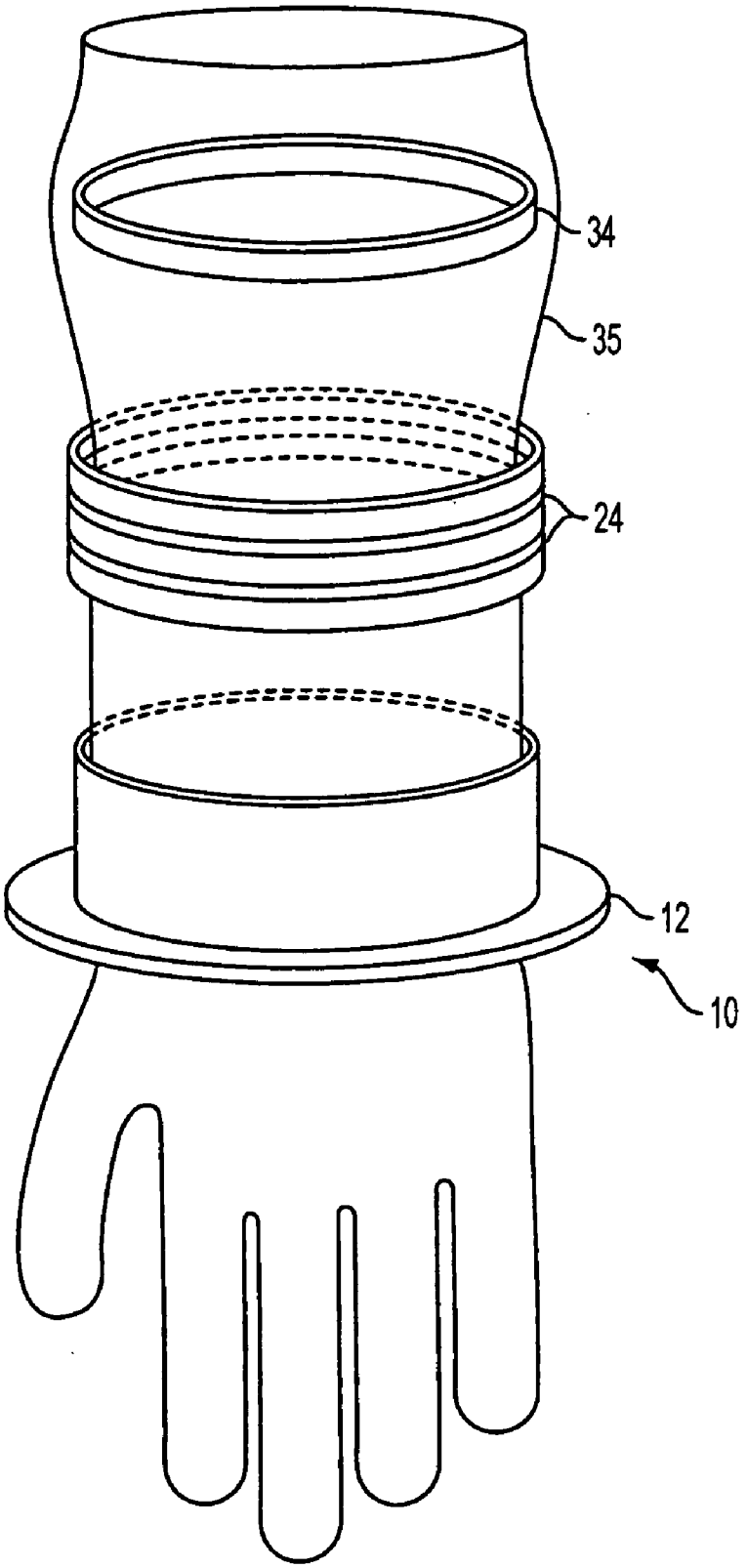


FIG. 4

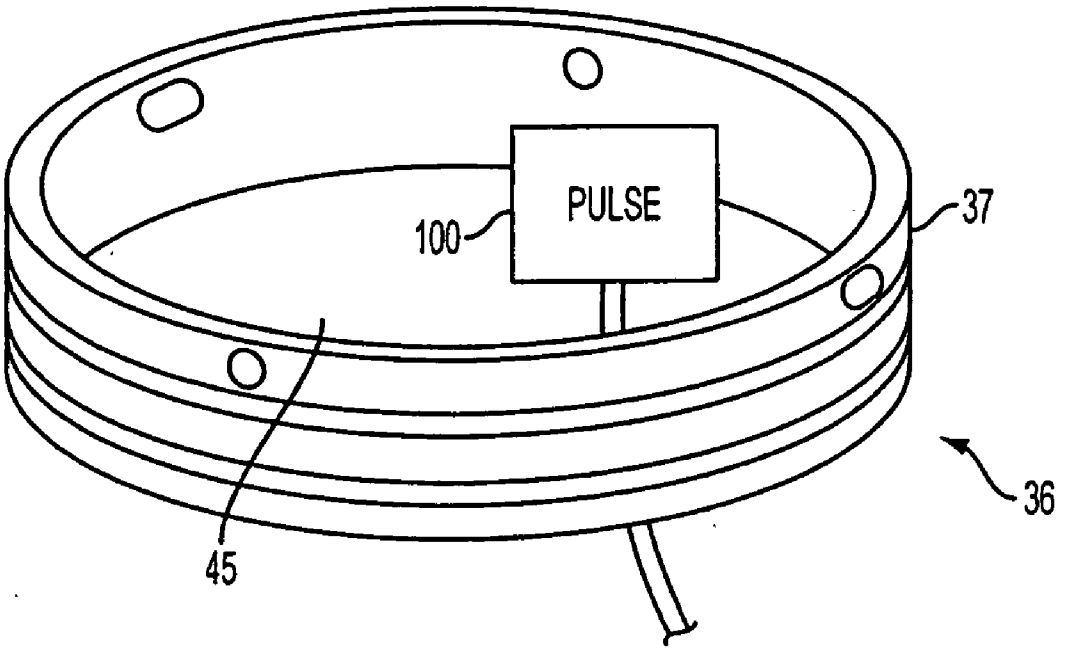


FIG. 5

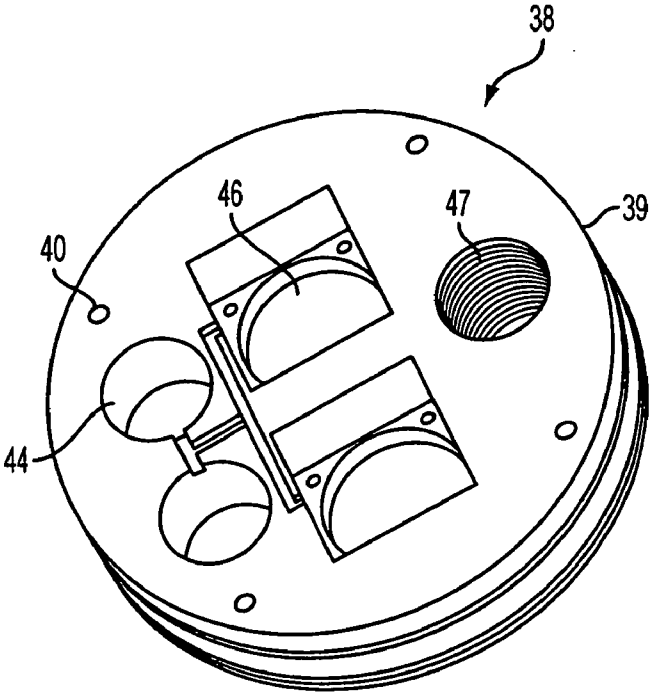


FIG. 6A

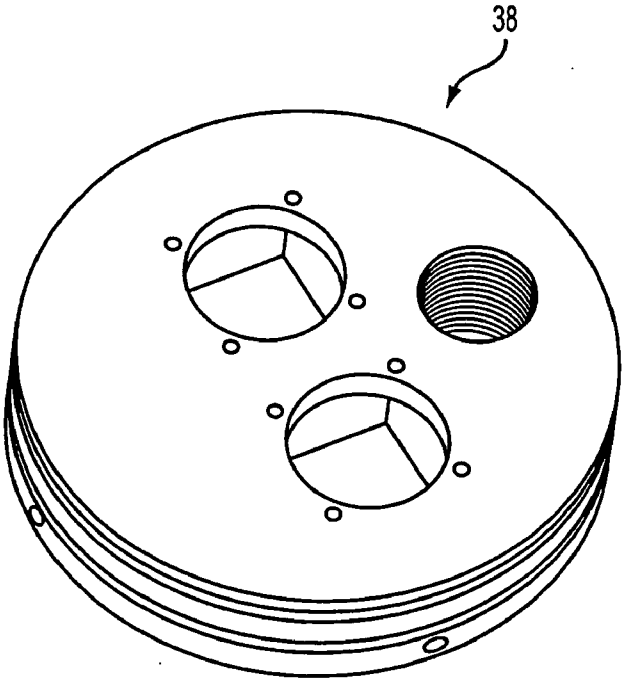


FIG. 6B

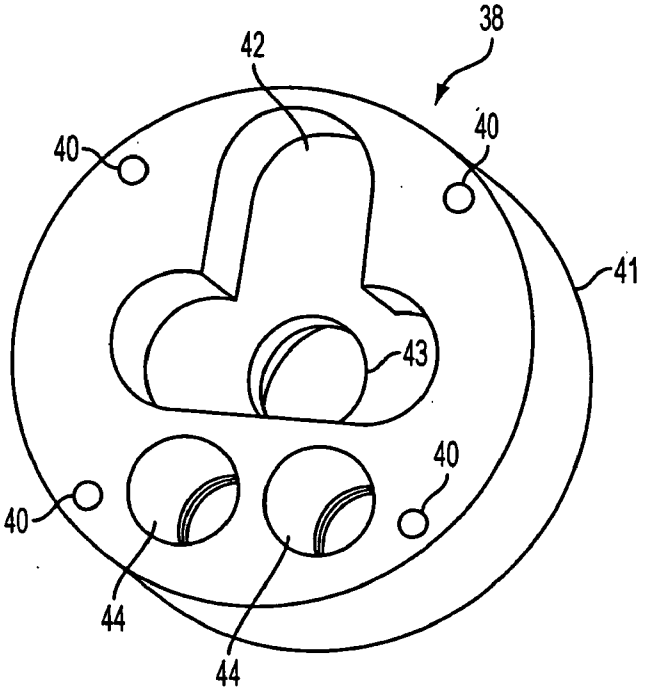


FIG. 7A

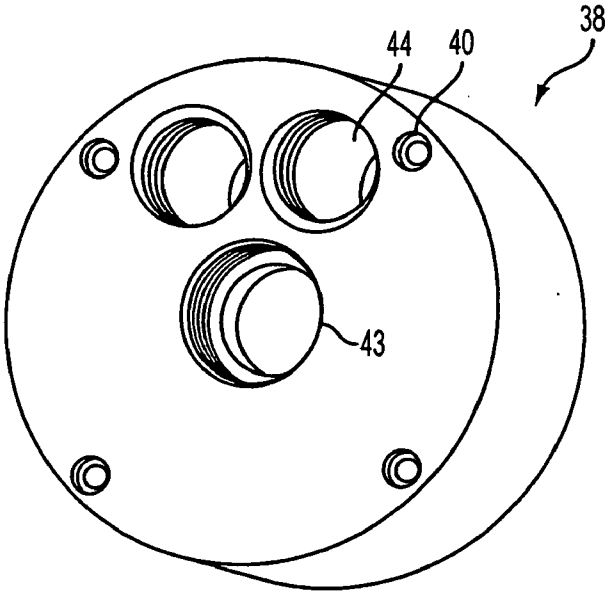


FIG. 7B

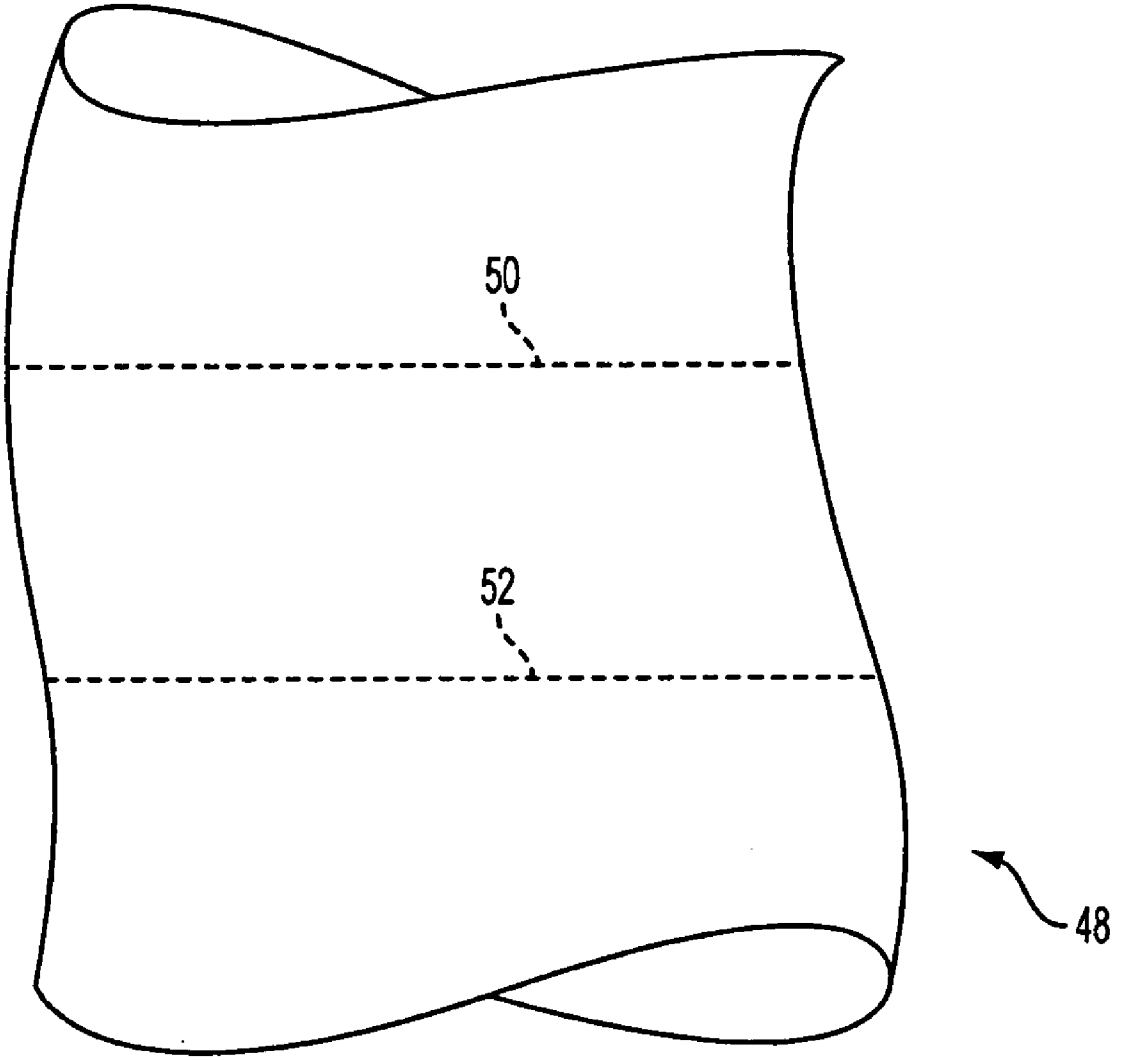


FIG. 8

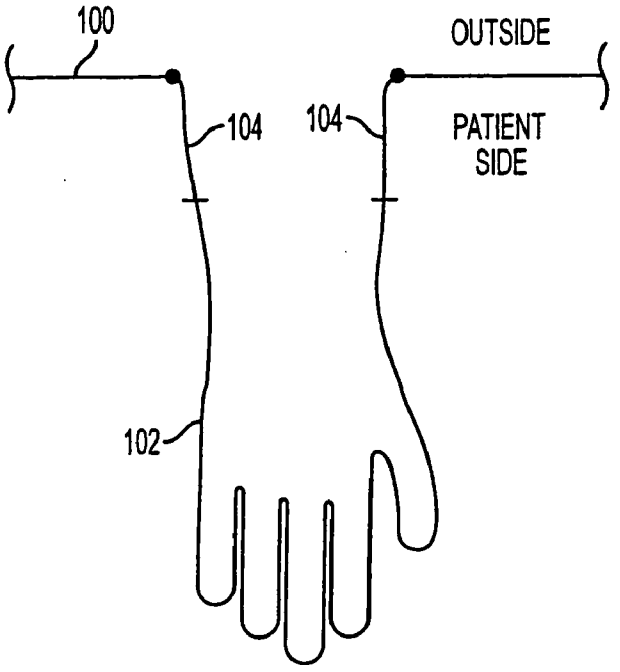


FIG. 9A
(RELATED ART)

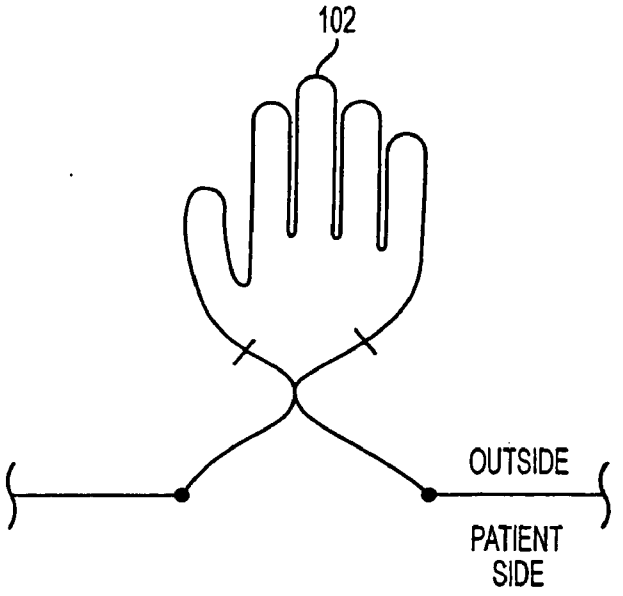


FIG. 9B
(RELATED ART)

MODULAR PORT SYSTEM AND REPLACEMENT METHOD THEREOF

BACKGROUND OF THE INVENTION

[0001] In medical situations, it is sometimes necessary to isolate a patient to prevent medical personnel or the environment at large from being contaminated by the patient. For example, victims of chemical or biological attacks, and certain infectious diseases require isolation. This isolation system may be in the form of a pod, with gloves provided therein to allow access by the medical worker without risk of contamination. However, these gloves may require replacement due to failure or contamination. A related replacement operation is illustrated in **FIGS. 9A and 9B**. During normal operation, a glove **102** is provided in a wall **100** of an isolation device, and is disposed on the inside of the isolation device, where a patient is located. The glove **102** is attached to a flap **104**, which is made of a flexible material. During replacement, the glove **102** is pulled to the outside, and portions of the flaps **104** are pulled together below the glove **102** and tied with a rubber band or other sealing member, so that contaminants within the isolation system do not escape to the outside. The glove **102** is separated from the flap **104**, and a new glove **102** is attached to the flap **104**.

[0002] There are several disadvantages to this operation. First, the glove **102** and the flap **104** may contain contaminants, yet these elements are exposed to the outside during replacement. Thus, workers must be extremely careful to avoid contamination. This may require protective clothing or modified breathing. However, such preventative measures may not be sufficient. Furthermore, the seal formed by tying the flaps **104** may not be sufficient to prevent contaminants from escaping, especially in light of the small size of biological microorganisms and chemical molecules. Also, this operation is cumbersome and time consuming because it requires several steps (tying and untying seals **104**, removing and replacing gloves **102**). In life and death situations, when time is of the essence, patient safety is compromised. Finally, a thick glove is required, degrading the tactile feel sensed by the worker.

SUMMARY OF THE INVENTION

[0003] To possibly address the above concerns and/or different concerns, the inventors propose an apparatus to interface between an inside and an outside of a sealed environment, including an outer port, and an inner port, disposed in the outer port to provide a seal between the inside and the outside. The inner port is replaceable by a replacement inner port while maintaining the seal during a replacement operation.

[0004] To possibly address the above concerns and/or different concerns, the inventors also propose a chemical or biological containment apparatus having a seal to contain contaminants in an inside thereof from passing to an outside. The apparatus includes an outer envelope, a port disposed in the envelope, the port including an outer portion having a circumferential portion extending away from the envelope and a flange extending from the circumferential portion and attached to the envelope, and an inner portion. The inner portion includes a circumferential surface corresponding to the circumferential portion, a plurality of grooves formed in the circumferential surface, and a plurality of O-rings respectively received in the grooves to form the seal with the outer portion.

[0005] To possibly address the above concerns and/or different concerns, the inventors also propose a method including providing a first inner port to create a first seal between an inside and an outside of a biological or chemical containment device, and replacing the first inner port with a second inner port. The replacing includes pressing the first inner port with the second inner port while maintaining the first seal, and creating a second seal with the second inner port while maintaining the first seal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] These and other objects and advantages of the present invention will become more apparent and more readily appreciated from the following description of the preferred embodiments, taken in conjunction with the accompanying drawings of which:

[0007] **FIG. 1** is an isometric perspective view of an isolation device including the port system according to one aspect of the invention.

[0008] **FIG. 2** is a perspective view of an outer port shown in **FIG. 1**.

[0009] **FIG. 3** is a perspective view of an inner port shown in **FIG. 1**.

[0010] **FIG. 4** is an exploded view illustrating the port/glove arrangement of **FIG. 1**.

[0011] **FIG. 5** is a perspective side view of another embodiment of the inner port according to the present invention.

[0012] **FIG. 6A** is a bottom view of a lower half of the inner port according to still another embodiment of the present invention.

[0013] **FIG. 6B** is a top view of the lower half of **FIG. 6A**.

[0014] **FIG. 7A** is a bottom view of an upper half of the inner port according to the embodiment of **FIG. 6A**.

[0015] **FIG. 7B** is a top view of the upper half of **FIG. 7A**.

[0016] **FIG. 8** is a bag which may be used in the isolation device of **FIG. 1**.

[0017] **FIGS. 9A and 9B** illustrate a glove replacement operation according to the related art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

[0019] **FIG. 1** is an isometric perspective view of an isolation system **1** including the port system according to one aspect of the invention. The isolation system **1** includes a plurality of access holes **9** to allow access between an inside and outside thereof. Port systems **10** are in the holes **9** and provide for the insertion of devices such as glove **35**, which allows a medical worker to operate on a patient. In

FIG. 1, the isolation system **1** is shown as having the glove **35** inserted therein. However, as will be discussed below, a bag, motor, or medical evaluation apparatus may also be inserted in the port systems **10**. Furthermore, other devices to allow communication between the inside and outside of the isolation system **1** may be inserted, as well as other devices which allow for the operation of the isolation system **1**. Furthermore, the structure of the isolation system **1** is for illustrative purposes only, and the present embodiments of the port systems **10** may be applied to isolation systems **1** having different designs, or other devices which maintain a sealed environment. For example, although the bottom of the isolation system **1** is shown as being formed of different pieces material, it is certainly possible that a single piece of material could function as both the top and bottom.

[**0020**] A patient is placed within the isolation system **1** in order to prevent the spread of an infectious disease or other hazard. Although the isolation system **1** is shown as being open, the system **1** is closed during actual operation. A positive or a negative pressure may be maintained, depending on the nature of the isolation. The outer port may be made of PVC, polyurethane or similar materials.

[**0021**] **FIG. 2** is a perspective view of an outer port **12** of the port systems **10**. The outer port **12** includes a flange **14** which is in contact with the holes **9**, and a wall **16** extending outward from the holes **9**. Although the holes **9** and outer port **12** are illustrated as having a substantially circular shape, it is noted that different shapes are also possible, provided the integrity of the seal between the inside and outside is maintained. Disposed in the wall **16** are alignment holes **20** which allow for alignment as discussed below. Also in the wall **16** are threaded holes **18** which provide for connection, as discussed below. Slots **22** are also in the wall **16** for alignment, as discussed below.

[**0022**] **FIG. 3** is a perspective view of an inner port **24** of the port systems **10** of **FIG. 1**. The inner port **24** has an external circumference generally corresponding to the inner circumference of the wall **16** of the outer port **12**, to be inserted therein. The inner port **24** includes a retaining stop **26** in the form of a step, which allows the lock unit **34** to rest against and seal the glove **35** between the lock unit **34** and the inner port **24** at all times.

[**0023**] The inner port **24** further includes a plurality of grooves **32**, each of which receives an O-ring **33**. The O-rings **33** contact the inner circumference of the wall **16** and the inner port **24**, forming a seal therebetween. As discussed below with respect to the replacement operation, the O-rings **33** are spaced such that this seal is not broken during a replacement operation. The inner port **24** further includes a slot **30** which aligns with one of the threaded holes **18** to receive a screw, bolt, or other threaded fastening unit passing through the threaded holes **18**. An alignment hole **28** is aligned with one of the alignment holes **20** of the outer port **12**.

[**0024**] **FIG. 4** is an exploded view illustrating the arrangement of the outer port **12**, inner port **24** and the glove **35**. The glove **35** fits between the inner port **24** and a lock unit **34**, illustrated herein as a locking ring. The lock unit **34** rests against the stop **26** and there is a very tight fit creating a seal between the glove **35** and the inside wall of the inner port **24**. Although **FIGS. 1 and 4** illustrate the glove **35** disposed between the lock unit **34** and the inner port **24**, other flexible elements may also be inserted therein, possibly to provide communication between the inside and the outside of the isolation system. Another example of such a flexible element is a bag **48**, as illustrated in **FIG. 8**. The bag **48** includes first and second seals **50**, **52**. The function of the bag **48** will be discussed below.

[**0025**] **FIG. 5** illustrates another embodiment of an inner port **36**, which may be inserted into the outer port **12**. The inner port **36** is in the form of a solid plug. Thus, a solid face **45** spans a circumferential wall **37**. The solid plug **36** may be used to seal any of the holes **9** which are not in use. Alternately, as shown in **FIG. 5**, medical monitoring equipment (i.e., to measure pulse rate or body temperature) may pass through or be mounted on the face. Similarly, other devices which allow for communication between the inside and the outside (i.e., IV, O_2, suction or blood sample lines, or defibrillation lines) may also be mounted on or pass through the inner port **36**.

[**0026**] The solid plug may be modified to include two motors in the bottom wall thereof to pressurize/depressurize the isolation system **1**. As shown in **FIGS. 6A, 6B, 7**A and 7B, a motor and filter port **38** corresponds to the shape of the outer port **12** and includes a similar arrangement of grooves and O-rings on an outside thereof to maintain the seal. The motor and filter port **38** includes an upper half **41** and a lower half **39**. Holes **40** pass through the lower half **39** and the upper half **41** to receive a bolt or other fastening unit. The lower half **39** includes a motor cavity **46**, wherein a fan motor (not shown) or other type of air-driving unit is disposed. Holes **44** receive a battery (not shown) which drives the fan motor. The battery may have a stepped outer circumference, thus a pill bottle or other cup-shaped element may be inserted into the holes **44** so that the overall shape of the holes **44** and cup conform with the battery, thereby preventing the battery from being inserted backwards. A pressure release valve (not shown) fits into a hole **47** to maintain relative pressure between the inside and the outside of the system **1**, for example, in the event of airplane cabin depressurization, or simply to maintain the desired positive or negative pressure under normal circumstances.

[**0027**] As shown in **FIGS. 7A and 7B**, the upper half **41** also includes the holes **40** and **44**, and an airflow cavity **42** to receive air driven by the fan motor. A filter hole **43** is provided with a filter (not shown), which filters the air driven by the fan motor. The filter may be either an intake or an exhaust filter. The filter may be a standard HEPA filter or other biological or chemical filter. As shown more clearly in **FIG. 7B**, the filter hole **43** may be threaded, so that the filter may be screwed therein with a seal on the bottom surface of the filter. The seal may be rubber or a similar material. The top half may also have grooves and O-rings.

[**0028**] A replacement operation according to the embodiments of the present invention will now be described. As an illustrative example, the replacement of the inner port **24**/glove **35** combination will be discussed. However, the replacement of the other embodiments is similar. The operation begins with the state illustrated in **FIG. 1**, in which the glove **35** is already inserted into the isolation system **1**, with a seal already existing. It may become necessary to replace the glove **35** with another glove **35**, for example, if the old glove **35** becomes worn. In such a case, a replacement module is provided, which includes the inner port **24**, the

lock unit **34** and the replacement glove **35** all assembled in one unit. The replacement inner port **24** is simply pressed against the inner port **24** that is already in place until the original inner port **24** drops inside of the isolation system **1**. The spacing of the O-rings **33** is such that at some point during the replacement operation, O-rings **33** of both inner ports **24** are providing seals. Thus, when the seal created by the original inner port **24** is lost, the replacement seal has already been established. Thus, the glove **35** can be replaced without compromising the seal, or exposing the original glove **35** to the outside environment. Thus, any contaminants on the original glove **35** are not exposed to the outside. Finally, a thinner glove may be used, thereby improving the tactile feel.

[**0029**] With respect to the bag **48**, a similar pressing operation takes place. After the bag **48** is in place, an object (not shown) may be passed to the inside of the system **1** therethrough. The seal **52** is opened from the outside, and the object is placed between the seals **50** and **52**. Then, the seal **52** is re-sealed, and the seal **50** is opened from the inside (with the glove **35**) to introduce the object to the inside.

[**0030**] The invention has been described in detail with particular reference to preferred embodiments thereof and examples, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

[**0031**] For example, similar continuous seal replacement methods may be employed in connection with glove boxes in nuclear, chemical or biological laboratories, portable laboratories for chemical analysis, incubators, or when working behind protective glass for explosives or lasers.

What is claimed is:

1. An apparatus to interface between an inside and an outside of a sealed environment, comprising:

an outer port; and

an inner port, disposed in the outer port to provide a seal between the inside and the outside,

the inner port being replaceable by a replacement inner port while maintaining the seal during a replacement operation.

2. The apparatus of claim 1, wherein the inner port comprises first and second seal members disposed on an outside thereof to contact the outer port and thereby form the seal.

3. The apparatus of claim 2, wherein the replacement inner port comprises first and second seal members disposed on an outside thereof to contact the outer port and thereby maintain the seal.

4. The apparatus of claim 3, wherein at least one of the first and second seal members of the inner port and the replacement inner port contact the outer port at all times during the replacement operation.

5. The apparatus of claim 2, wherein the first and second seal members of the inner port are O-rings.

6. The apparatus of claim 3, wherein the first and second seal members of the replacement inner port are O-rings.

7. The apparatus of claim 1, wherein the apparatus is a chemical or biological containment device, and the outer port comprises:

a circumferential surface to receive the inner port and the replacement inner port; and

a flange portion extending radially from the circumferential surface to attach the outer port to the containment device.

8. The apparatus of claim 1, wherein the inner port comprises:

a circumferential outer surface;

a plurality of grooves formed in the outer surface; and

a plurality of O-rings respectively formed in the plurality of grooves to contact the outer port and thereby form the seal.

9. The apparatus of claim 1, wherein the inner port and the outer port each comprise a plurality of holes, the apparatus further comprising a plurality of fastening units to respectively pass through the holes of the outer and inner ports to fasten the outer and inner ports together.

10. The apparatus of claim 1, wherein the apparatus is a chemical or biological containment envelope.

11. The apparatus of claim 3, wherein one of the seal members of the inner port and one of the seal members of the replacement inner port simultaneously contact the outer port during the replacement operation.

12. The apparatus of claim 1, further comprising:

a lock unit disposed within the inner port; and

a bag disposed between the lock unit and the inner port.

13. The apparatus of claim 1, further comprising:

a lock unit disposed within the inner port; and

a glove disposed between the lock unit and the inner port.

14. The apparatus of claim 8, wherein the inner port further comprises a face spanning across the outer surface.

15. The apparatus of claim 14, wherein the face is a solid face.

16. The apparatus of claim 14, further comprising medical monitoring equipment disposed on the face.

17. The apparatus of claim 15, further comprising a fluid communication unit passing through the face, to allow fluid communication between the outside and a patient disposed within the inside.

18. The apparatus of claim 8, further comprising a motor to pressurize/depressurize the sealed environment.

19. A chemical or biological containment apparatus having a seal to contain contaminants in an inside thereof from passing to an outside, comprising:

an outer envelope;

a port disposed in the envelope, the port comprising:

an outer portion having a circumferential portion extending away from the envelope and a flange extending from the circumferential portion and attached to the envelope, and

an inner portion comprising a circumferential surface corresponding to the circumferential portion, a plurality of grooves formed in the circumferential surface, and a plurality of O-rings respectively received in the grooves to form the seal with the outer portion.

20. The apparatus of claim 19, further comprising a plurality of the ports.

21. The apparatus of claim 20, wherein at least one of the ports further comprises a glove between the sealed inner portion.

22. The apparatus of claim 20, wherein at least one of the ports further comprises a bag between the sealed inner portion.

23. The apparatus of claim 20, wherein the inner portion of at least one of the ports further comprises a face spanning the circumferential surface.

24. The apparatus of claim 20, wherein the inner portion further comprises a motor to pressurize/depressurize the envelope.

25. A method comprising:

providing a first inner port to create a first seal between an inside and an outside of a biological or chemical containment device; and

replacing the first inner port with a second inner port, comprising:

pressing the first inner port with the second inner port while maintaining the first seal, and

creating a second seal with the second inner port while maintaining the first seal.

26. The method of claim 25, further comprising:

providing an outer port to receive the first and second inner ports; and

pressing the first inner port with the second inner port after the creating of the second seal until the first inner port is ejected from the outer port to the inside of the device.

* * * * *