# United States Patent

**Harp et al.**

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## [54] BIOLOGICAL DOOR SEAL


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[73] Assignee: **The United States of America as represented by the Secretary of the Army**



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[52] **U.S. Cl.** .....**49/483,** 220/46 R

[51] **Int. Cl.** .....**E06b 7/16**

[58] **Field of Search** .....49/483, 485; 312/214, 1; 220/46 R, 46 P



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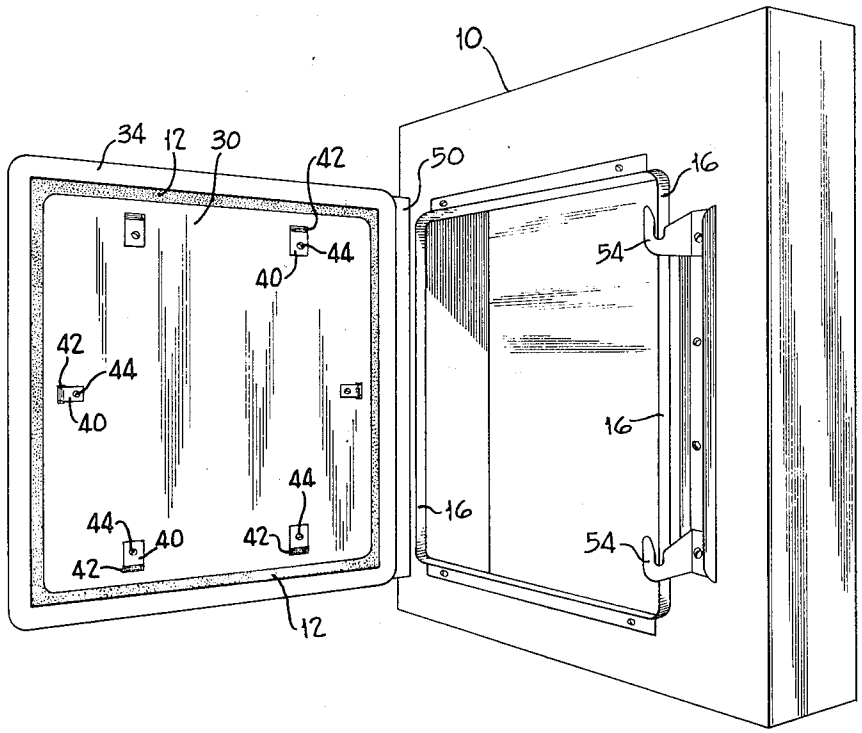
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[57] **ABSTRACT**

A reliable leak-proof biological door seal for use with cabinets containing highly infectious materials therein. The door is provided with a beaded resilient membrane which is stretched over a continuous U-shaped frame section describing the near peripheral portions of each side of the inside of the door which is contacted by mating seating flange integral the cabinet proper for maintaining the cabinet absolutely tight under positive or negative pressures.


**4 Claims, 4 Drawing Figures**



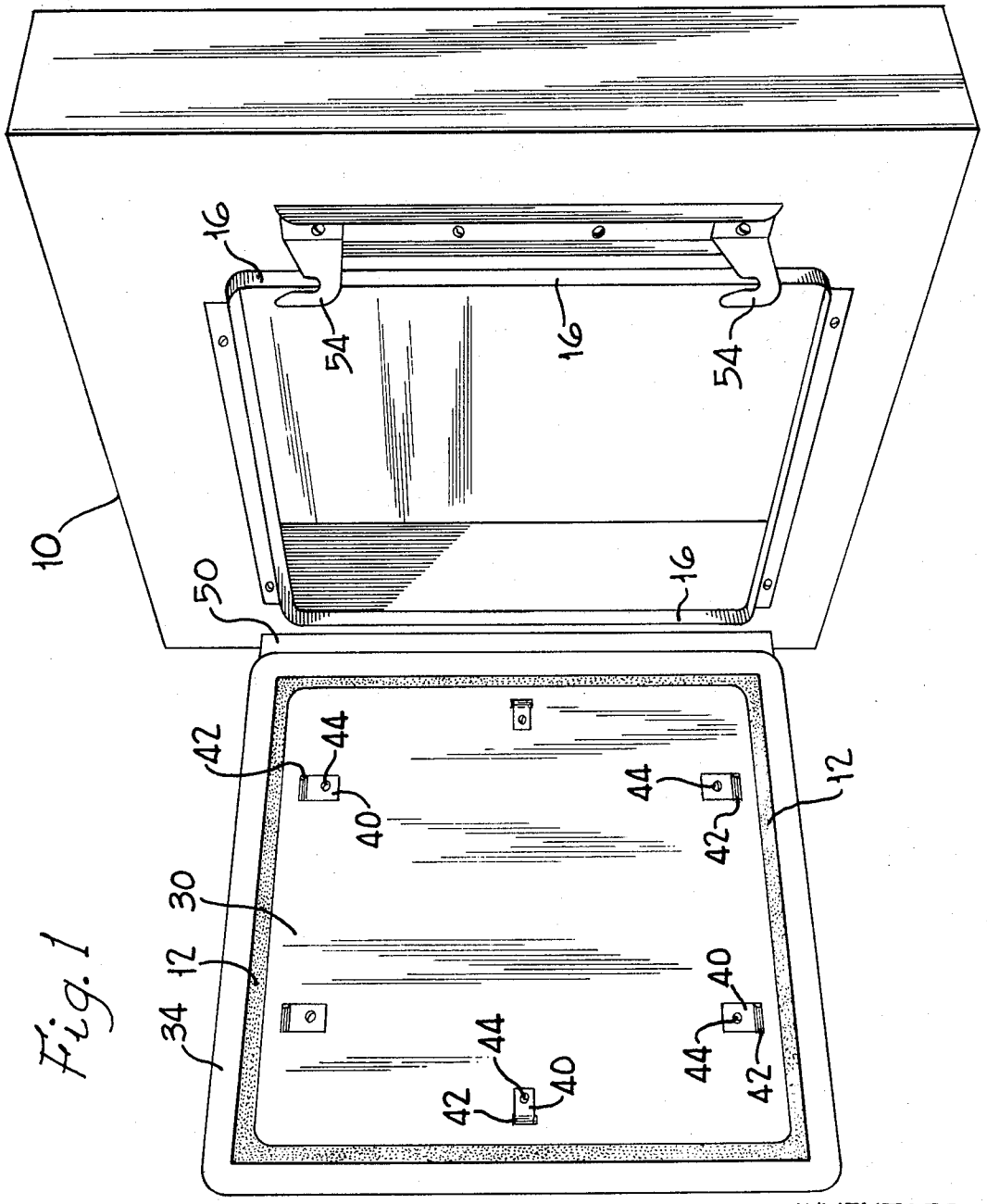



Fig. 1

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Fig. 2

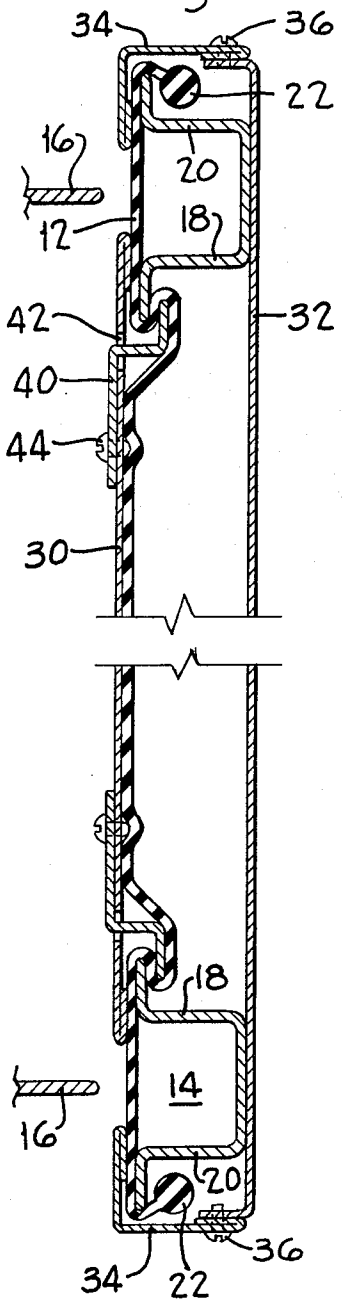
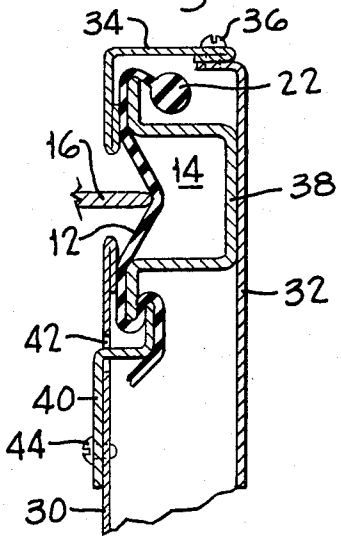



Fig. 3



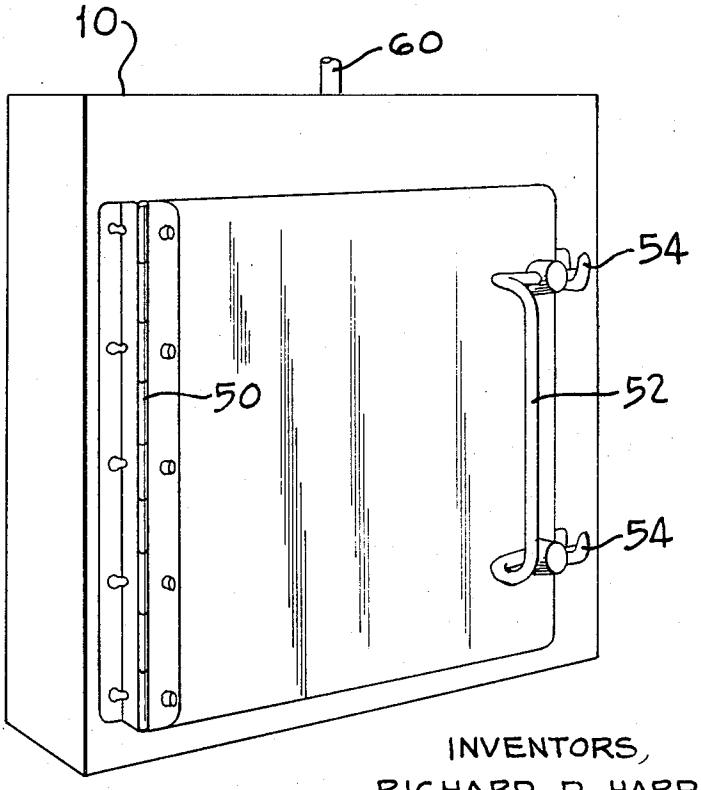




Fig. 4

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# BIOLOGICAL DOOR SEAL

The invention described herein may be manufactured, used, and licensed by or for The U.S. Government for governmental purposes without the payment to us of any royalty thereon.

This invention relates to door seals and more particularly concerns a reliable biological door seal for use with highly infectious materials and the like.

In the area of biological warfare development, continuing experimentation involving highly infectious materials is vital. Any malfunctioning, however slight, of cabinets containing these materials could have devastating ramifications.

Prior door seals involved mechanical seals, among others, which often failed after being placed into service due to gaskets used therein taking on a permanent set. Similarly, pressure tube doors, requiring air pressure to obtain a seal, were unreliable in that a failure of air pressure would cause the door to leak with the probable escape of infectious materials.

The vacuum and pressure tube door is expensive to construct and costly to operate, requiring vacuum and pressure. The static seal used therein is not reliable after being placed into service and fails usually at the juncture of stem and tube. The lightweight sterilizer type door used on passboxes frequently leaked as a result of metal yielding between pressure points on the door tightening device.

Accordingly, it is an object of this invention to provide an improved biological door seal.

Another object of the invention is to provide such a door seal which is lightweight, inexpensive and reliable, and which is dichlorodifluoromethane-tight under a positive or negative cabinet pressure.

The exact nature of this invention as well as other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawings wherein:

FIG. 1 is a perspective view of our improved biological door seal system with the door slightly ajar.

FIG. 2 is a transverse section of our door with handle and hinge assemblies omitted for purposes of clarity.

FIG. 3 is a sectional view of the clamping means of our biological door, the door being illustrated in a closed position; and

FIG. 4 is a perspective view of our door when sealed against a biological cabinet.

Referring now to the drawings, there is shown a test cabinet **10** representative of any of a number of biological cabinets suitable for containing highly infectious materials therein. The door and cabinet must form a dichlorodifluoromethane-tight seal therebetween under positive or negative pressures.

The sealing means is partially effected by the elastic and resilient properties of membrane **12**, suitably of pure gum rubber or neoprene and the like, and which is stretched over a frame member **14** in one plane, as depicted in FIG. 2 of the drawings. The configuration of the frame is such that the sealing seat or flange **16**, attached to cabinet **10**, continuously depresses selected portions of membrane **12**, or substantially those portions visible in FIG. 1, between continuous supports of frame member **14** which comprises an inner support **18** and an outer support **20**. The frame member **14** may thus be considered a hat section or U-shaped section which traverses continuously each of the four sides of the door adjacent its periphery. The purpose of the hat section is to add strength to the door and more importantly, to provide a continuous space between supports **18** and **20** wherein membrane **12** will be permitted to flex. The elastic qualities of the membrane assist in maintaining it in one plane which causes the membrane to be pressed continuously against sealing flange **16** thus obviating any necessity for close tolerance design to effect a most reliable seal. The membrane covers the frame completely as a one-piece molded unit, and utilizes a bead **22** molded around the entire periphery thereof for securely and conveniently attaching to the frame, as shown.



Since the membrane is a one-piece unit, the only probable source of any leakage whatsoever between the door and cabinet might be those portions of the membrane where the sealing flange comes in contact therewith. As aforedescribed, our novel and unique structural combination of a continuous flange member continuously depressing the resilient membrane into the hat section is designed to prevent any leakage or passage of air into or out of the cabinet.

The degree of static seal is a function of the initial stretch given the membrane when assembling it in cooperative relation to the frame. The frame is substantially enclosed with a front protector plate **30**, a rear protector plate **32**, and an outer protective plate **34**, all made from a suitable corrosion resistant material such as steel, for example. The outer plate is attached to the rear plate about each of its four sides by screws **36**, or any other suitable means. For additional rigidity, the hat section of the frame is provided with a member **38** which connects supports **18** and **20** and which will abut or contact rear plate **32**. The front plate is held in position by a plurality of spaced Z-shaped clamping members **40**, one end of which is inserted into a slotted opening **42** in front plate **30** such that the membrane is forced to reverse itself when traveling around inner support member **18** of the hat section.

The clamps do not pass through the membrane and are held in place by round-ended screws **44** or the screws may conveniently engage a nut anchored on the front plate, but in no case will screw **44** penetrate membrane **12**.

In assembling our door, the beaded membrane will be stretched over the frame member **14** to effect a desired degree of static seal, i.e., the tighter the stretch, the greater will be the degree of static seal. Outer plate **34** will then be screwed to back plate **32**, being careful that bead **22** overhangs the outermost portions of support **20**. The clamping members **40** will next be inserted into front plate **30**.

The door will be hinged to the cabinet as at **50** and closure is effected through door handle **52** engaging detents **54** attached to the cabinet.

Extensive testing has proved our system to be leakproof. Testing was accomplished under various cabinet conditions, the most extreme comprising placing dichlorodifluoromethane inside the cabinet and then raising the pressure therein through an inlet-out passageway **60** to 27 inches water gauge. A halogen leak detector indicated no leaks whatsoever, even after 48 hours of pressure.

Another importent feature of our invention resides in the ability of our door to maintain a negative pressure

inside cabinet **10** over extended periods. Again, a negative pressure of 27 inches water gauge was maintained over a 48 hour period with no leakage. In this case, membrane **12** will be forced against sealing flange **16** by the very nature of mating configurated parts. It may be noted herein that a 3-inch water gauge pressure is the maximum United States Government requirement for either positive or negative pressures for biological cabinets of this type.

From the foregoing description, it is apparent that we have provided a reliable, economical and light weight door assembly. An increase of pressure within the cabinet increases the tension of the sealing membrane at the points of contact with the sealing flange due to the design of the sealing flange cooperation with the frame hat section in conjunction with the ability of the central membrane portions to expand toward rear plate **32** due to passage of air through slotted openings **42** and thus increasing the tension. It is interesting to note that there will be slippage of the membrane around that portion of the inner support member **18** and clamp **40** when the central portion of the membrane is caused to expand toward the rear plate. Further increasing the negative pressure within the cabinet obviously increases the tension of the sealing membrane at points of contact with the sealing flange. Still further, our membrane can easily be changed or replaced in the field as needed.

We wish it to be understood that we do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

We claim:

**1**. A positive and negative pressure-tight door seal system for use with a cabinet comprising:

a door having front, rear and outer plates means,

a multi-sided frame having a channel adjacent each of said sides positioned within the plate means, said channel including a pair of substantially parallel extending support members to provide a non-interrupted space between said support members and along the length thereof,

a resilient membrane secured to and stretched over said frame and channel,

a plurality of spaced Z-shaped clamps penetrating said front plate to force said membrane to traverse around an outer portion of an inner member of said support members, said membrane effecting an S-shaped curve thereat,

a sealing flange extending outwardly from said cabinet for continuously mating with said channel such that upon closure of said door, said membrane is flexed into each channel spaces by said flange, and

means for effecting closure and opening of said door to said cabinet.

**2**. The device of claim **1** wherein said membrane is beaded at its extremities for ready attachment between outer protective plate means and inner support means.

**3**. The device of claim **1** wherein said membrane comprises a material selected from the group consisting of pure gum rubber and neoprene.

**4**. The device of claim **1** wherein said door seal system is dichlorodifluoromethane-tight for positive and negative pressures up to and including 27 inches water gauge.

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