

Filed May 2, 1967

FLUOROCARBON LINED GLOVEBOX

4 Sheets-Sheet 1

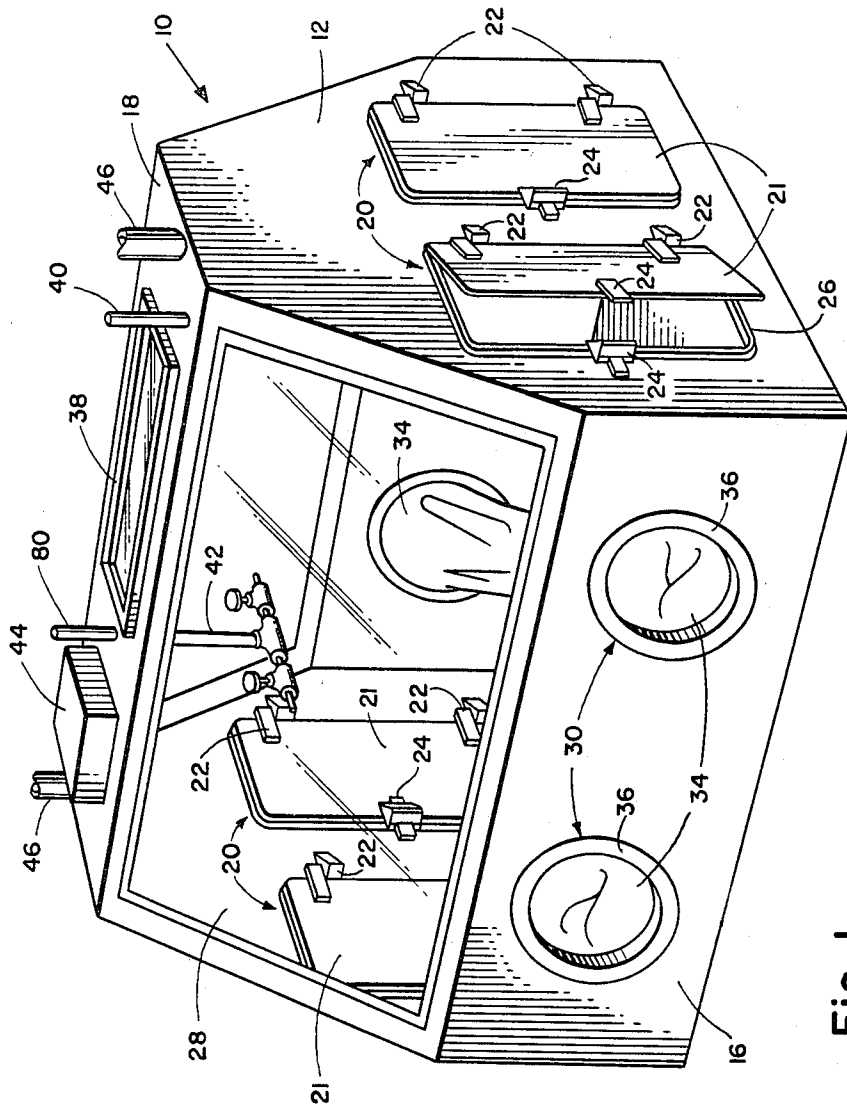


Fig. 1

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3,410,619

FLUOROCARBON LINED GLOVEBOX

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4 Sheets-Sheet 2

Fig. 2

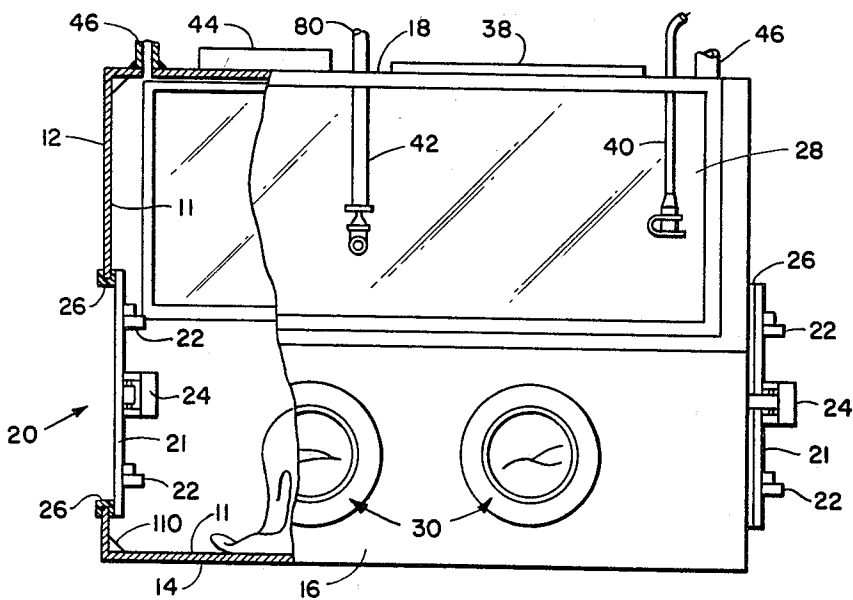
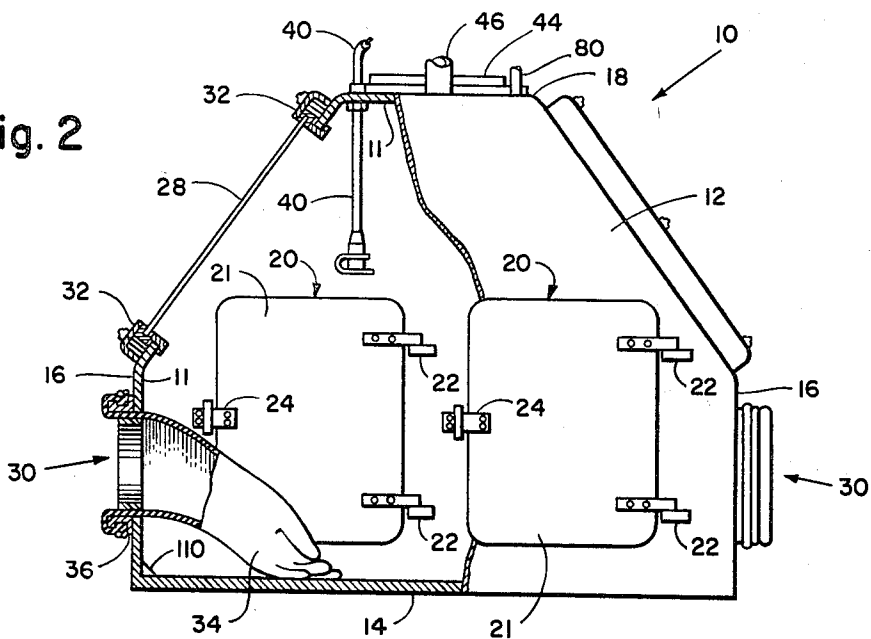


Fig. 3

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FLUOROCARBON LINED GLOVEBOX

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4 Sheets-Sheet 3

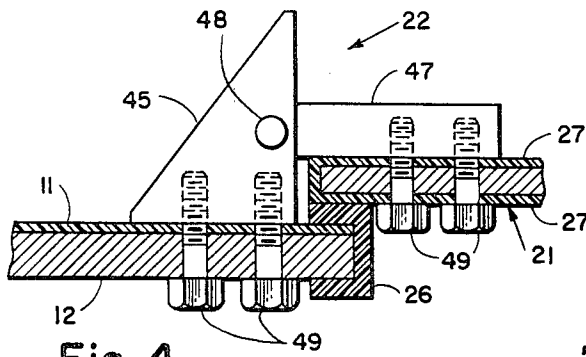


Fig. 4

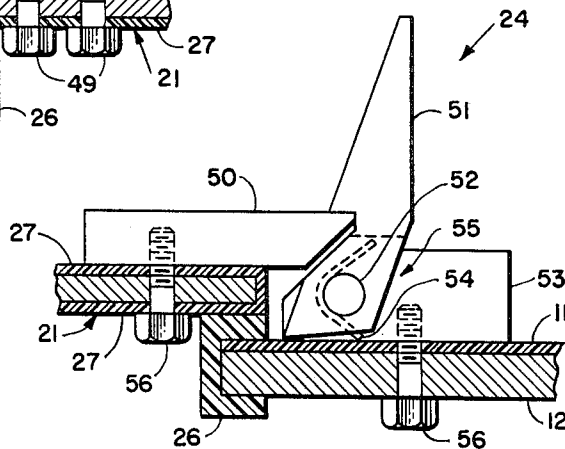


Fig. 5

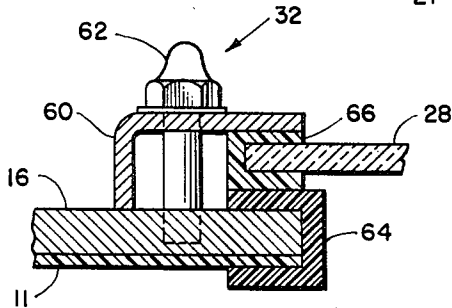


Fig. 6

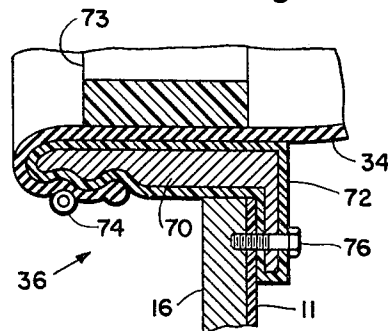


Fig. 7

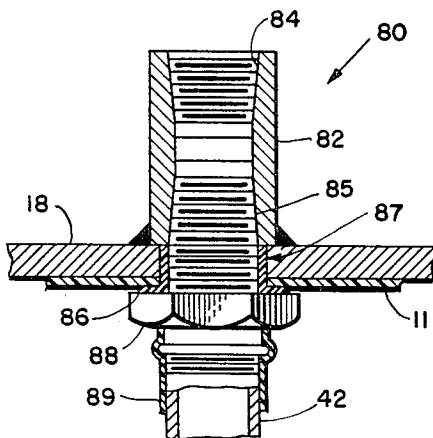


Fig. 8

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4 Sheets-Sheet 4

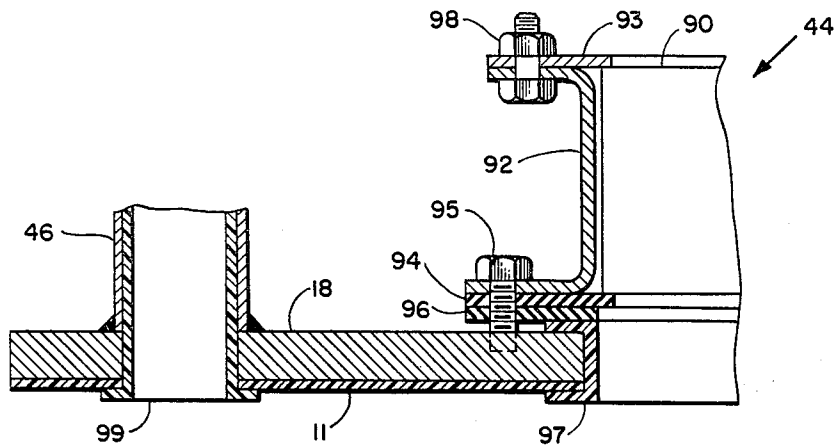


Fig. 9

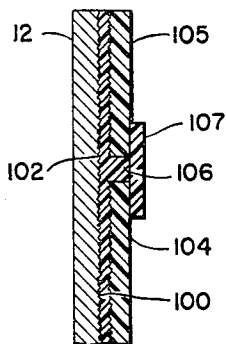


Fig. 10

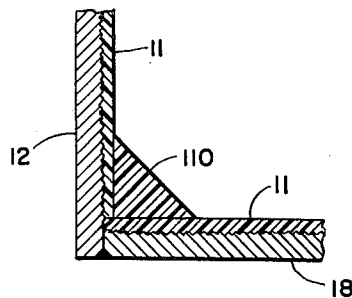


Fig. 11

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FLUOROCARBON-LINED GLOVEBOX

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2 Claims. (Cl. 312-1)

ABSTRACT OF THE DISCLOSURE

A glovebox having various glove ports, access ports, service ports, windows and doors, for handling and treating hazardous materials contained within the glovebox with linings or coatings at all interior surfaces of an easily cleanable, corrosion and fire resistant fluorocarbon material, and with various fittings and structural parts of a corrosion resistant fluorocarbon material.

Background of invention

Gloveboxes or dry boxes are widely used for handling and treating materials, particularly hazardous materials, in a controlled or contained environment. Conventional gloveboxes are fabricated from various materials depending upon the particular application of the glovebox. Materials widely used for fabricating gloveboxes include aluminum, carbon steel, stainless steel, steel painted with acid resistant paints, chrome plating, "Plexiglas" and plywood. A glovebox is generally provided with a plurality of glove ports having flexible, impervious gloves fitted thereto for reaching into the enclosure and working upon or with the confined materials. Further, a glovebox is also generally provided with a plurality of windows, access ports and service ports, the latter providing access to the interior of the enclosure for various production or laboratory services such as electricity, air, vacuum, water, inert gas, etc. A glovebox thus protects personnel working with the enclosed material while placing at their disposal all the necessary tools and materials as well as protects the materials themselves from possible contamination.

It has become an increasing problem in the analysis and treating of ultra-pure materials, such as electrolytically produced plutonium, having impurities less than about 25 parts per million to provide an enclosure essentially corrosion-free over extended periods of time so as not to add impurities to the materials while they are being analyzed and treated. Such materials are commonly treated during analysis with highly corrosive agents such as various acids including hydrochloric, nitric, sulfuric, hydrochloric-nitric, hydrochloric-sulfuric and nitric-sulfuric acids, bases and organics such as chlorinated hydrocarbons, ketones, alcohols, etc. Prior gloveboxes used for such an application are commonly fabricated from stainless steel painted with an acid-resistant paint. These gloveboxes must be cleaned prior to the analysis and treating of each new ultra-pure sample and the entire glovebox must be stripped and re-painted about every 90 days. Cleaning of prior gloveboxes has been particularly troublesome due to corroded and pitted interior surfaces of the box, especially when radioactive material has been treated or handled in the enclosure. Even with these precautions, corrosion from stainless steel which bleeds through the paint contaminates the material samples with chromium, nickel, and iron to such an extent that it is becoming increasingly impractical to determine the concentration of these elements. Such procedures are expensive and time consuming and do not produce satisfactory results.

2

The materials used in the glove ports, service ports and access ports as well as the material sealing such ports and the mechanical fasteners and hinges associated therewith have also been a source of contaminating material in prior gloveboxes. Further, the acid resistant paint or the glovebox itself has been subject to corrosion or destruction from burning materials resulting from the material sample treatment. Also, when radioactive materials have been used in a glovebox, it has been very difficult and time consuming to thoroughly clean and decontaminate the glovebox since the glovebox materials and the apparatus disposed therein have generally pervious surfaces and become even more so after usage from corrosion.

Summary of invention

In view of the limitations of the prior art as noted above, it is an object of this invention to provide a glovebox container having a corrosion-free interior surface in a controllable environment for handling and treating highly toxic, ultra-pure materials with corrosive agents.

It is a further object of this invention to provide a glovebox container which can be used efficiently for quantitative and qualitative analysis of materials having impurities in the parts per million and parts per billion range.

It is a further object of this invention to provide a glovebox container which can be easily cleaned, can be highly illuminated and is resistant to fire and heat.

Various other objects and advantages will appear from the following description of one embodiment of the invention, and the most novel features will be particularly pointed out hereinafter in connection with the appended claims.

This invention comprises a corrosion-free glovebox for handling of ultra-pure materials such as plutonium and uranium which are treated with highly corrosive materials including acids, bases and organics including the combination of a plurality of rigid metal panels forming walls of the glovebox; said panels having inwardly disposed surfaces roughened as by sandblasting; light colored layers of at least one material taken from the group consisting of polytertrafluoroethylene, polytetrafluoroethylene-propylene, polytrifluorochlorethylene and polymonochlorotrifluoroethylene having outwardly disposed roughened surfaces disposed toward the inwardly disposed roughened surfaces of the metal panels and securely bonded thereto throughout said roughened surfaces; at least some of said layers of material having merging edge portions, and an additional thickness of said material extending between and interconnecting said merging edge portions.

Description of drawings

The present invention is disclosed in the accompanying drawings wherein:

FIG. 1 is a perspective view of a glovebox incorporating this invention;

FIG. 2 is a front elevation view, partially cutaway, of the glovebox shown in FIG. 1;

FIG. 3 is a side elevation view, partially cutaway, of the glovebox shown in FIG. 1;

FIG. 4 is a detailed partially cutaway view of a hinge used with an entry port means;

FIG. 5 is a detailed partially cutaway view of a latch used with an entry port means;

FIG. 6 is a detailed partially cutaway view of a window mounting means;

FIG. 7 is a detailed partially cutaway view of a glove ring mounting means used with a glove port means;

FIG. 8 is a detailed partially cutaway view of a service port means;

FIG. 9 is a detailed partially cutaway view of a por-

tion of an air intake filter means and an air exhaust port;

FIG. 10 is a detailed cutaway view of a portion of the glovebox lining and a lining butt joint, and also showing in somewhat exaggerated manner roughened mating surfaces of glovebox base material and lining material; and

FIG. 11 is a detailed cutaway view of a liner corner butt joint and also indicating in exaggerated manner roughened base and liner materials.

Detailed description

In FIGS. 1, 2 and 3, a glovebox 10 is shown which has been constructed in accordance with this invention. Glovebox 10 is conventionally a generally rectangular shaped enclosure having an inner lining or coating 11 (shown in detail in FIGS. 4-11) on each of the end panels or bulkheads 12, floor or bottom portion 14, front and rear panels or portions 16 and top panel 18. Both of the bulkheads 12 and the front and rear panels 16 are shown for purposes of illustration as pairs of generally identical structures. Depending on the particular application of the glovebox and the accessibility necessitated thereby, the bulkheads, front and rear panels and top portion can be modified accordingly within the scope and principle of this invention.

Each bulkhead 12 in this embodiment, has a pair of similar entry ports 20 having doors 21 disposed thereon. The doors 21 are attached and sealed to bulkhead 12 by hinges 22, latches 24 and sealing means 26. Hinges 22, latches 24 and sealing means 26 are shown in greater detail in FIGS. 4 and 5 respectively. The doors 21 have a lining or coating 27 disposed on all surfaces of the doors as shown in FIG. 4.

Floor or bottom portion 14 is shown for purpose of illustration as a flat, rigid sheet or plate attached to bulkheads 12 and front and rear panels 16. Floor 14 may have recessed portions (not shown), laboratory tools and equipment mounted thereon (not shown), stand or table means attached thereto for supporting the glovebox (not shown) at a convenient working height, etc. in a manner well known in the art depending on the particular use of the glovebox.

Front and rear panels 16 in this embodiment, have transparent viewing sections or windows 28 and glove ports 30 disposed and mounted thereon. The front and rear panels are shown having a slanted portion where windows 28 are mounted which enables personnel to view all areas of the interior of glovebox 10. The panels can be any shape or form within the principles and scope of this invention. Windows 28 are attached and sealed to panels 16 by mounting means 32 as shown in greater detail in FIG. 6. Gloves 34 are suitably attached and mounted to glove ports 30 by ring retaining or mounting means 36. Gloves 34 can be any flexible and impervious gloves made of a rubber or rubber-like material such as is described in U.S. Patent No. 3,237,821 to R. E. Hayne et al. for Glove Changing Apparatus and Method, filed Mar. 25, 1964 and used in conventional gloveboxes. Glove mounting means 36 are shown in greater detail in FIG. 7.

Top panel 18 has a plurality of service port means passing through portion 18 into the glovebox. The service port means include a window 38, electric power cable means 40, laboratory service piping means 42, air intake filter means 44 and air exhaust conduits 46. Window 38 is attached and sealed to the glovebox in the same manner as windows 28 (as shown in FIG. 6). A light source (not shown) is conventionally positioned adjacent window 38 to provide light to the interior of the glovebox. Laboratory service piping means 42 is mounted and sealed to the service port means 80 as shown in greater detail in FIG. 8. Electric power cable means 40 or any other similar service may be mounted and sealed in a service port as shown in FIG. 8. Filter means 44 filters any incoming air to the glovebox in a conventional manner. The mounting and sealing of the filter means is shown in greater detail in

FIG. 9. Air exhaust conduits 46 remove air or fumes from the glovebox and conveys this air through conventional filters (not shown) to the exhaust ducting in a manner well known in the art and is mounted and sealed to the glovebox as shown in detail in FIG. 9. The types of filters associated with both the intake and exhaust systems depend on the operations being performed in the glovebox and the material used therewith and may be either chemical, electrostatic, glass, paper, etc. or any combination thereof. In some operations it may be desirable to eliminate the air intake system. The numbers and kinds of services described above are not intended to be a complete or limiting illustration of the services which can be provided within the teachings of this invention but are representative of the types of services used in some operations. Laboratory services include inert gas, dry air, fuel gas, distilled water, vacuum, etc. Whatever services are used, they are mounted in the service port in the same manner as shown in FIG. 8.

The basic glovebox shell or frame, including the bulkheads, floor, front panel, rear panel and top, are preferably made of a generally high strength, rigid material such as a metal, which may be a relatively low grade carbon steel or stainless steel. The windows 28 and 38 may be made from any high strength, transparent, chemically inert material, such as safety glass. The doors 21 may be of a generally high strength rigid material such as aluminum or steel. The coatings 11 and 27 of the invention can be chemically inert and impervious materials preferably having a smooth, easily cleaned, light colored, fire resistant surface such as polytetrafluoroethylene or polytetrafluoroethylene-propylene (e.g. materials generally available as "Teflon") or polytrifluorochloroethylene or polymonochlorotrifluoroethylene (e.g. materials generally available as "Kel-F").

In FIG. 4, the improved hinge 22 is shown on which the doors 21 may turn or swing to provide access to the interior of glovebox 10 through bulkheads 12. Hinge 22 comprises a member 45 affixed to bulkhead 12 and second member 47 affixed to door 21 and rotatably coating with member 45 around hinge pin 48. Members 45 and 47 are affixed or fastened to bulkhead 12 and door 21 respectively by bolt-type fastening means 49 threadedly engaged with said members. Members 45 and 47 and hinge pin 48 are of chemically inert, generally rigid and impervious material having a smooth easily cleaned, fire resistant surface such as "Kel-F." Bolts 49 are of a high strength material such as steel or "Kel-F." In some applications, gloveboxes are attached to each other using a common bulkhead so that both sides of the bulkhead and door are in a glovebox. In these instances, bolts 49 are preferably made of solid "Kel-F" or for greater strength with a steel or metal shaft and a "Kel-F" coated or solid head.

In FIG. 5, the improved latch 24 is shown which fastens and seals doors 21 to bulkheads 12. Latch 24 comprises a member 50 affixed to door 21 and a hook or catch 51 rotatably attached around pin 52 to a second member 53, affixed to bulkhead 12. Catch 51 is rotatably biased against member 50 by spring or biasing means 54 in slot 55 to effect closure of door 21 and sealing of door 21 to bulkhead 12 through sealing means 26. Members 50 and 53 are affixed or fastened to door 21 and bulkhead 12 respectively by bolt-type fastening means 56 threadedly engaged with said members. Members 50 and 53 and pin 52 may be chemically inert, generally rigid and impervious material having a smooth, easily cleaned, fire resistant surface such as Kel-F. Bolts 56 may be made of the same material as bolts 49 in FIG. 4. Sealing means 26 may be a U-shaped channel of a chemically inert, compressible material such as polychloroprene ("neoprene") or butadiene or silicone rubbers.

In FIG. 6, the improved window mounting means 32 is shown which mounts and seals window 28 to front and rear panels 16 and top panel 18 of glovebox 10.

Mounting means 32 comprises a channel or clamp 60 attached to panel 16 by a plurality of fastening means or bolts 62 which are threadedly engaged with panel 16. Panel 16 has a U-shaped lining or channel 64 cemented or bonded over the exposed end of the panel. Window 28 has a U-shaped gasket 66 cemented or bonded over the end of the window. Clamp 60, lining 64 and gasket 66 extended around the entire periphery of window 28 so that when bolts 62 are tightened, a seal is effected between window 28 and panel 16. Channel 64 is made of a chemically inert and impervious material having a smooth, easily cleaned, fire resistant surface such as "Teflon" or "Kel-F" while gasket 66 may be a compressible, chemically inert material such as "neoprene" or butadiene or silicone rubbers. In some applications it may be desirable to provide access to the glovebox through window 28. Suitable hinge means (not shown) can be attached to clamp 60 and panel 16 along one side of window 28 in a manner well known in the art.

In FIG. 7 the improved ring retaining means 36 is shown which mounts and seals gloves 34 to front panel 16 in the glove ports. Ring retaining means 36 comprises a tubular ring 70 having a coating 72 and conventional glove bands 73 and retaining bands 74 engaging the gloves and beads or notches in ring 70 in a manner well known in the art to provide a seal with ring 70. Ring 70 is affixed and sealed to panel 16 by a plurality of bolt-type fastening means 76 which are threadedly engaged with panel 16. Coating 72 is of chemically inert and impervious material having an easily cleaned, fire resistant surface such as "Teflon" or preferably "Kel-F." Bolts 76 may be a high strength, chemically inert material having an easily cleaned, fire resistant surface as "Kel-F" or bolts 76 may be made with a steel or metal shaft and a solid or coated "Kel-F" head.

In FIG. 8, a service port means 80 for laboratory service piping means 42 is shown which mounts and seals the piping means to top panel 18 of glovebox 10. The service port means 80 include a metal coupling or gland 82, having internal threaded portions 84 and 85, which is attached or welded to top portion 18. An L-shaped lining or channel 86 is bonded or cemented to the exposed surface of top portion 18 in opening 87. Piping means 42 is threadedly engaged with threaded portion 85 of gland 82 through opening 87. Retaining member or nut 88 is threadedly engaged with piping means 42 so as to effect a seal between the piping means and the top portion 18. A tubular lining 89 is fitted around piping means 42 and over the end of nut 88 extending the full length of the exposed piping means. Channel 86 and lining 89 may be chemically inert and impervious materials having a smooth easily cleaned, fire resistant surface as "Teflon" or "Kel-F" though lining 89 is preferably a "Teflon" tube which is capable of being heat shrunk into place. Nut 88 may be a rigid, chemically inert and impervious material having a smooth easily cleaned, fire resistant surface such as "Kel-F." Service port means 80 may be constructed in accordance with this invention and used for any conventional service required in glovebox 10 such as the electric power cable means 40 in the same manner as illustrated for piping means 42 in FIG. 8. In some applications, power cable means 40 may be pressure fitted through gland 82.

In FIG. 9, service port means, including a portion of air intake filter means 44 and air exhaust conduit 46, are shown which are mounted and sealed to top panel 18 of glovebox 10. Air intake filter means 44 comprises a filter element 90 held in place by a flanged member or channel 92, a clamp strip or bar 92 and a gasket 94. Flanged channel 92 is sealingly mounted on top portion 18 by a plurality of bolts 95 threadedly engaged with portion 18 through gasket 96 and lining or channel 97. Clamp bar 93 is fastened to flanged channel 92 by a plurality of bolts 98. Filter element 90 may be any conventional type of filter depending on the degree and type

of filtration required. Gaskets 94 and 96 may be any compressible, generally chemically inert gasket material such as "neoprene" or butadiene or silicone rubbers. Channel 97 may be a chemically inert and impervious material having an easily cleaned, fire resistant surface such as "Teflon" or "Kel-F."

Air exhaust conduit 46 is attached or welded to top panel 18 and covered internally with a generally tubular lining 99 which extends from the inner surface of lining 11 to a suitable filtering and exhaust element (not shown). Lining 99 may be a chemically inert and impervious material having an easily cleaned, fire resistant surface such as "Teflon" or "Kel-F."

Since many glovebox applications require either pressures below or in excess of atmospheric pressure, it is generally desirable to fabricate and seal the basic glovebox shell, complete with the service port means, entry ports means, glove port means and the window means and test the seal before applying the coating 11 to the glovebox. Thus, the bulkheads, front and rear panels and the top and bottom panels are formed, attached or welded to each other in a conventional manner and the resulting seal checked, with the various service port means blanked off, by suitable measuring means. After this check has been completed, the coating 11 can be applied and the complete glovebox assembled.

As noted above, all exposed metal surfaces within glovebox 10 are coated or lined with either "Teflon" or "Kel-F" and all exposed bolts or bolt heads, hinges and latches are fabricated from either "Kel-F," or coated with "Kel-F." A metal surface can be coated with either "Teflon" or "Kel-F" by spraying the surface with a dispersion of the lining material, preferably with multiple coats to a depth of about 13-17 mils. Since "Teflon" is relatively soft and may be damaged by sharp objects, it is desirable when using "Teflon" as the lining to bond or cement a "Teflon" sheet or panel having a thickness from about 0.06 to about 0.1 inch to the glovebox surface rather than spraying the surface with a "Teflon" dispersion so as to obtain a lining which is sufficiently thick to maintain its integrity during extended use whereas thinner films might be sufficient for other uses. In order to facilitate bonding of a "Teflon" sheet or material to a metal glovebox, such as carbon steel, it is desirable to roughen the steel and "Teflon" surfaces by suitable means such as by sandblasting or etching with a suitable material such as alcoholic-sodium. The steel surface may be washed with a detergent and rinsed with alcohol before applying the coating thereto to provide a better bonding surface.

FIG. 10 illustrates a typical butt joint or merging between two layers or coatings of "Teflon" along a portion of the glovebox inner surface, in this instance illustrated as the bulkhead 12. After the inner surface 100 of bulkhead 12 has been roughened or sand blasted and the mating surface of the "Teflon" liner roughened by etching (shown with exaggerated roughened surface for purposes of illustration), a suitable two-part epoxy type resin adhesive or cement, compatible with fluorocarbon materials, is applied to surface 100 forming a cement layer 102 and the "Teflon" layers 104 and 105 positioned thereon. The gap or joint 106 (shown with exaggerated spacing for purposes of illustration) between edge portions of layers 104 and 105 is then filled with the cement and a "Teflon" strip or tape 106 bonded thereto, or in the case of a sprayed coating 11, an additional thickness of material sprayed over any merging edge portions of the coating.

When the layers or coatings 11 of "Teflon" abut or merge at a joint between members of glovebox 10 such as where bulkhead 12 is attached or welded to top panel 18 as shown in FIG. 11, a generally triangular shaped sealing strip 110 or an additional thickness of material can be bonded or cemented in the joint, or in the case of a sprayed coating 11, an additional thickness of material sprayed over the merging edge portions at the point.

It will be apparent to those skilled in the art that this invention is not limited to the particular configuration of the glovebox illustrated in the drawings and that this invention can be incorporated in any conventional glovebox design. For instance, in some glovebox applications, rear panel 16 and the bulkheads 12 are modified to provide a raised hood above the glovebox as an effluent channel for large amounts of fumes generated in the glovebox. The hood is generally separated from the glovebox working area by a baffle arrangement. In accordance with this invention, the hood and baffle would have a lining similar to coating 11.

A glovebox constructed in accordance with this invention has been used to analyze plutonium metal samples having impurities of about 25 parts per million. The analysis included the dissolution, reduction and titration of the sample which exposed the glovebox interior to copious amounts of highly corrosive materials and fumes including hydrochloric acid fumes without any noticeable corrosion of the glovebox or contamination of the sample. The glovebox members were made from 1/8 inch stainless steel while the doors were made from 1/4 inch stainless steel. The glovebox can be made from carbon steel having from .15% to .35% carbon. The glovebox has been repeatedly cleaned after use with radioactive, non-radioactive and corrosive materials without any residue or contamination of the glovebox and without any adverse effect to the coating 11 or the equipment in the glovebox. Materials which have been used to treat plutonium and uranium in the glovebox are nitric, sulfuric, hydrochloric, hydrofluoric and formic acids and sodium hydroxide, fluorine, nitrogen dioxide and nitrous oxide. The cleaning required less time than prior gloveboxes and obviated the need for applying an acid resistant coat of paint and the attendant labor. Since the coating 11 was white and did not corrode, the glovebox illumination was enhanced.

Coating 11 has been subjected to burning plutonium metal chips which were dropped directly onto the coating. The fire extinguished quickly on contact with the coating leaving a residue containing plutonium metal, plutonium oxide and plutonium fluoride, probably by replacing the air above the burning plutonium with degradation products of the coating which do not support combustion or enter into a chemical reaction. The coating showed a yellowish spot which was easily removed with a damp cloth.

It will be understood that various changes in the details, materials and arrangements of the parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principles and scope of the invention as expressed in the appended claims.

What is claimed is:

1. A corrosion-free glovebox with provision for services, gloves and windows for handling therein materials such as plutonium and uranium with impurities less than about 25 parts per million which are treated therein with highly corrosive materials including acids, bases and or-

ganics comprising the combination of a plurality of rigid metal panels forming walls of the glovebox; said panels having inwardly disposed surfaces roughened as by sand-blasting; a light colored layer about 0.06 inch to 0.1 inch thick of at least one material taken from the group consisting of polytetrafluoroethylene, polytetrafluoroethylene-propylene, polytrifluorochloroethylene and polymonochlorotrifluoroethylene having outwardly disposed roughened surfaces disposed toward the inwardly disposed roughened surfaces of the metal panels and securely bonded thereto by an epoxy resin throughout said roughened surfaces; at least a portion of said layer of material having merging edge portions, and an additional thickness of said material extending between and overlapping each of said merging edge portions; at least some of said rigid panels having access openings with edge surfaces forming glove ports, entry ports, service ports and windows; channel shaped members of at least one material taken from the group consisting of polytetrafluoroethylene, polytetrafluoroethylene-propylene, polytrifluorochloroethylene and polymonochlorotrifluoroethylene bonded into position encompassing said edge surfaces and overlapping said layer of material; rigid metal doors for covering said entry ports and a light colored layer of at least one material taken from the group consisting of polytetrafluoroethylene, polytetrafluoroethylene-propylene, polytrifluorochloroethylene and polymonochlorotrifluoroethylene covering and bonded to all inwardly disposed surfaces of said doors, and hinge and latch means for affixing said doors to said panels, each of said hinge and latch means being composed of at least one material taken from the group consisting of polytrifluorochloroethylene and polymonochlorotrifluoroethylene; and fastening means for sealing and connecting gloves and services to said glove ports and said service ports and to said panels, said fastening means being composed of at least one material taken from the group consisting of polytrifluorochloroethylene and polymonochlorotrifluoroethylene.

2. The glovebox of claim 1 wherein said fastening means includes bolt-type fasteners having exposed heads made of a material taken from the group consisting of polytrifluorochloroethylene and polymonochlorotrifluoroethylene for mounting said hinge and latch means and gloves and services to said glove ports and service ports and to said panels.

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