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(54) **METHOD AND APPARATUS FOR
PROVIDING A MODULAR SHIELDED
ENCLOSURE**

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(52) **U.S. Cl.** **52/79.1; 52/267**

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(57) **ABSTRACT**

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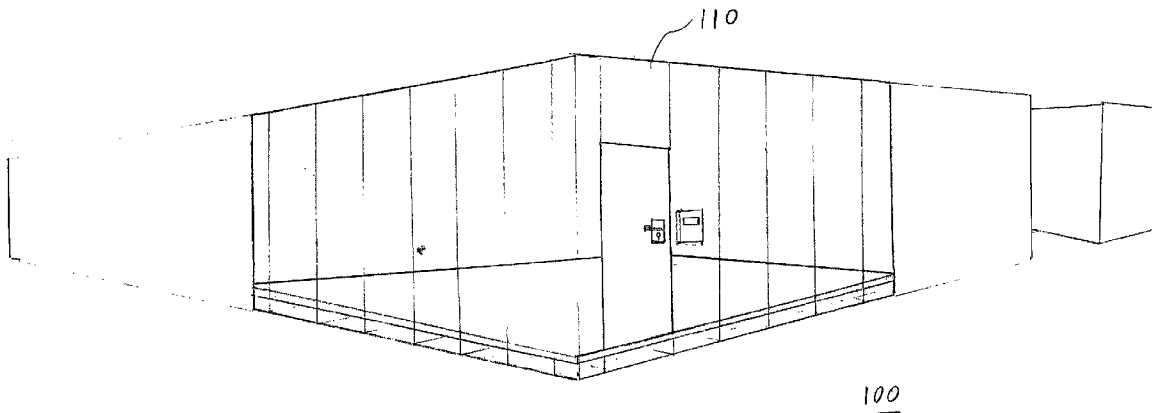
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(22) **Filed: Jun. 5, 2002**

Related U.S. Application Data

(60) **Provisional application No. 60/295,953, filed on Jun.
5, 2001.**

A modular, shielded enclosure engineered to provide structural security for information technology (IT), data, and telecom equipment is provided. The enclosure is composed of individual periphery shields locked together to create an airtight, thermal resistant, fire resistant, waterproof, hermetically sealed facility. In addition, a series of penetration management devices (PMD) and a control panel can be deployed. The enclosures are infinitely configurable independent structures, and may be expanded, reduced, or relocated with ease to give end-users the flexibility needed to manage the ever-changing, highly specialized IT facility.



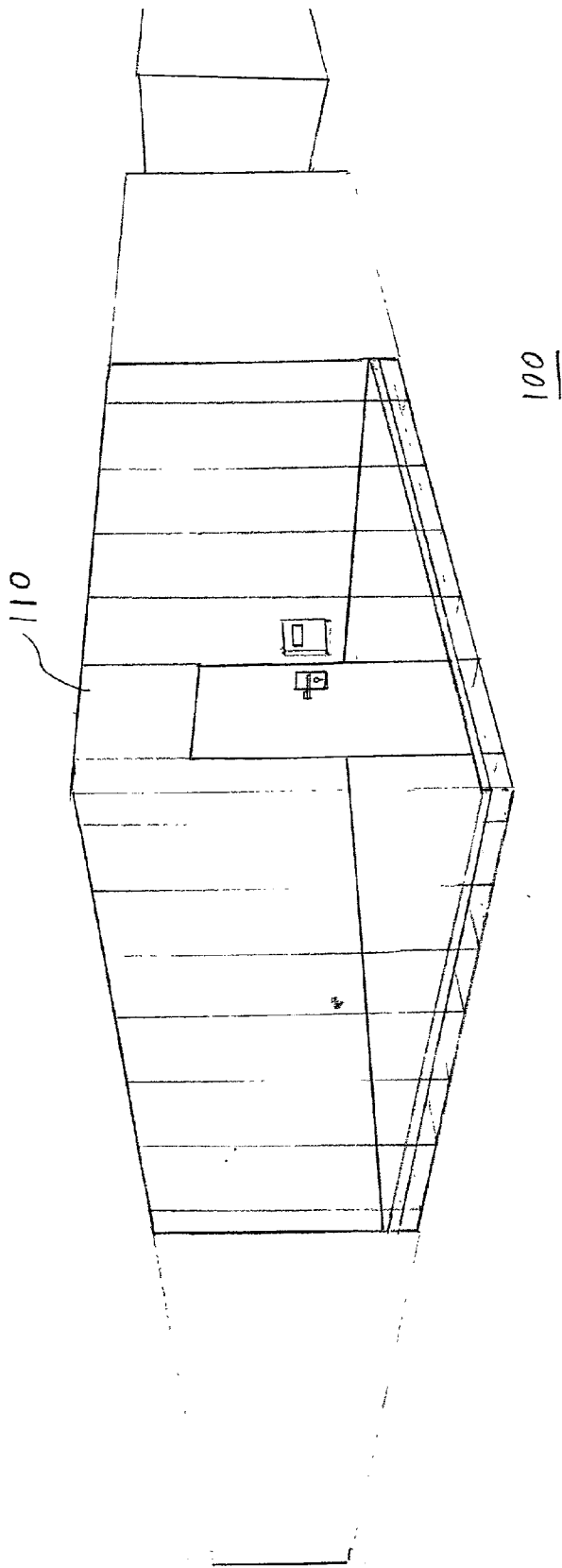


FIG. 1

110

Fig. 2

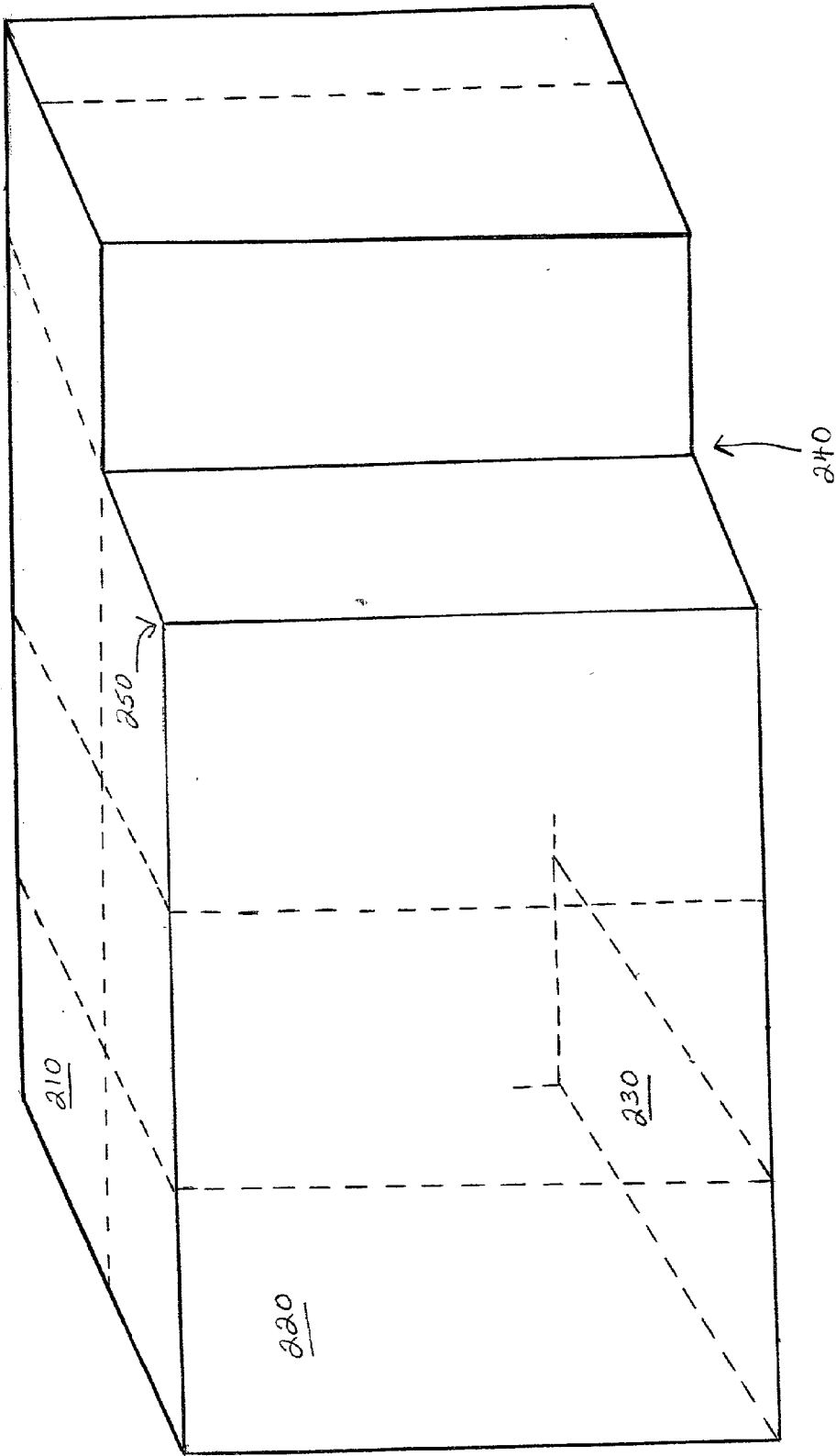
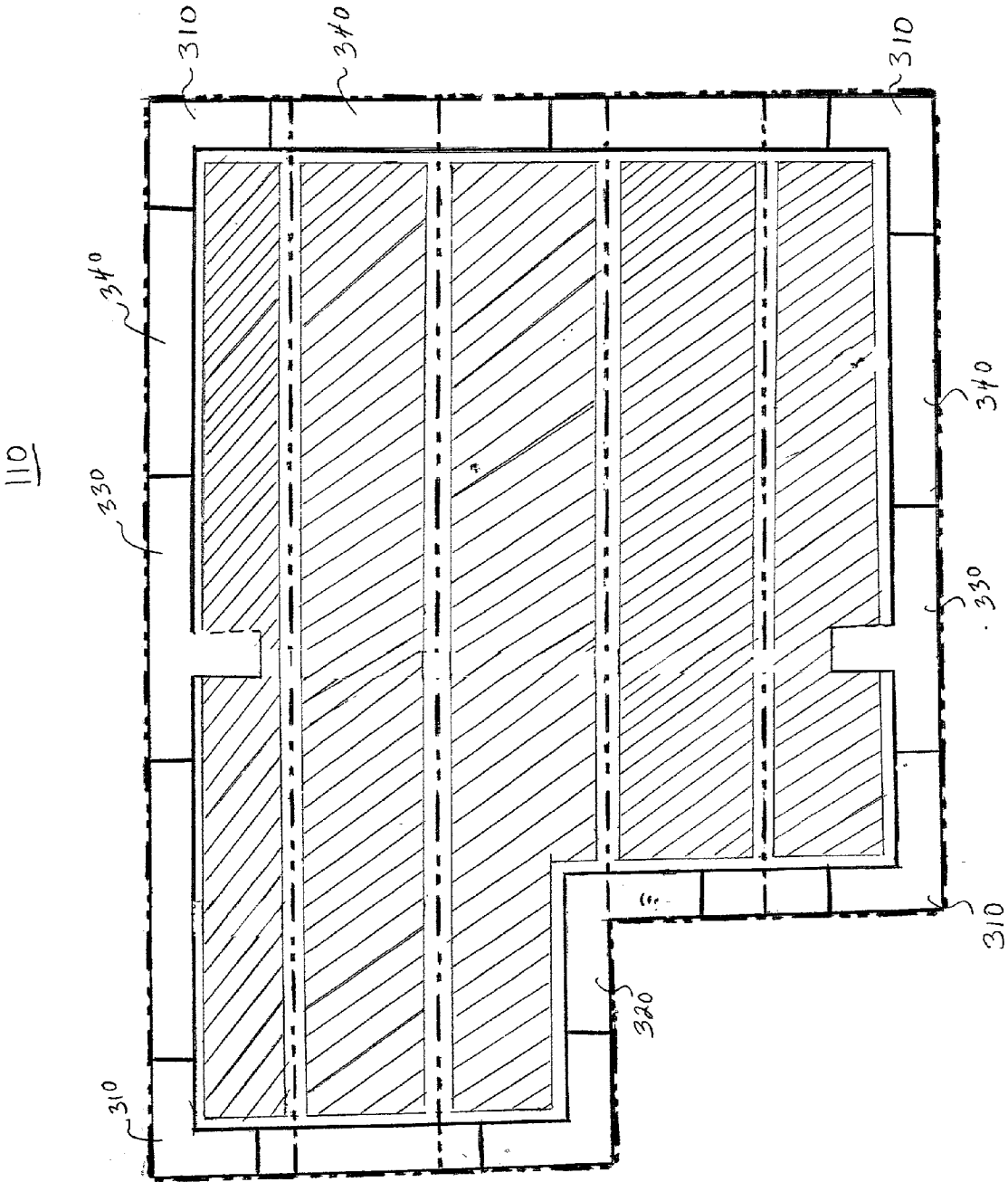
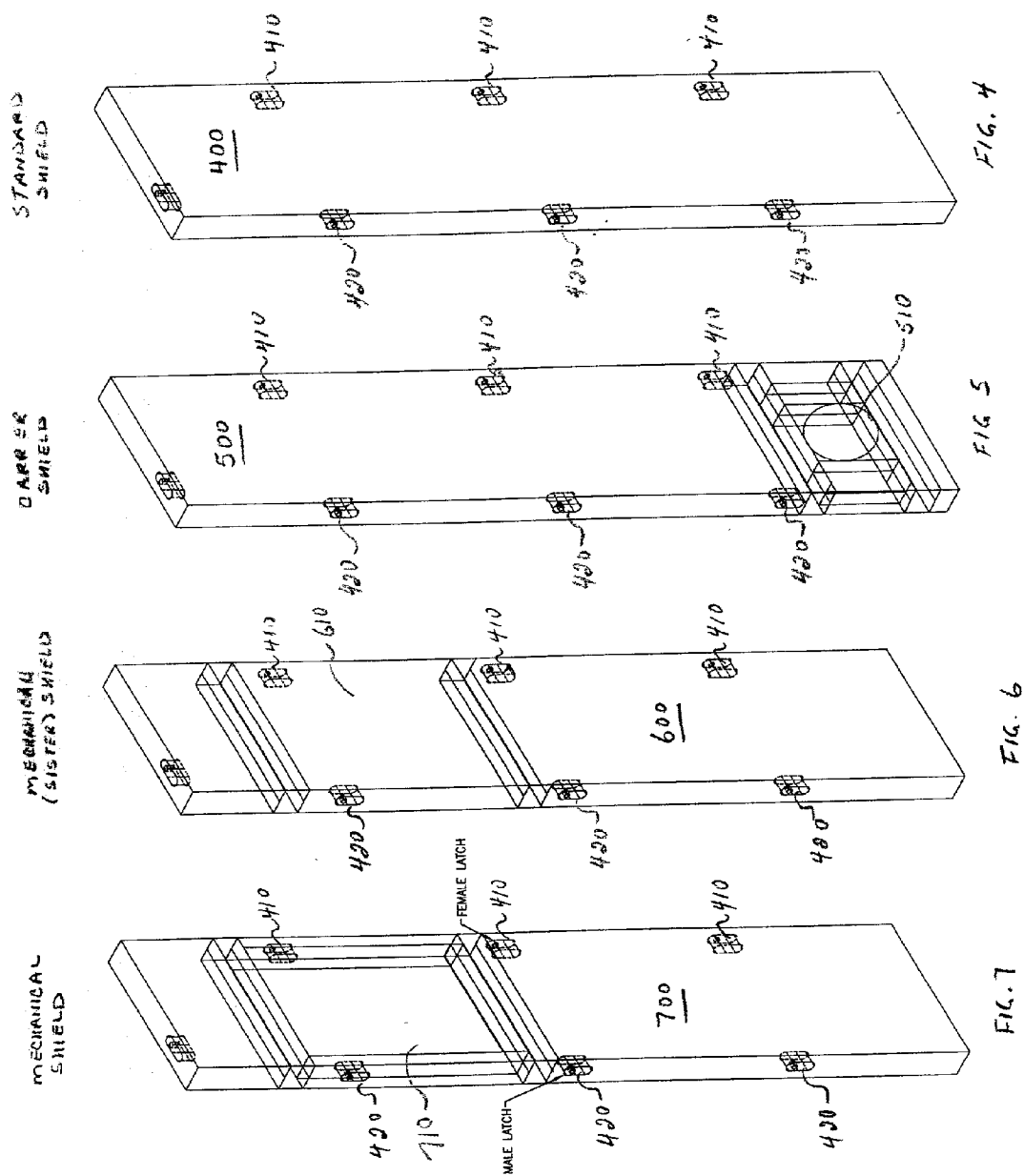
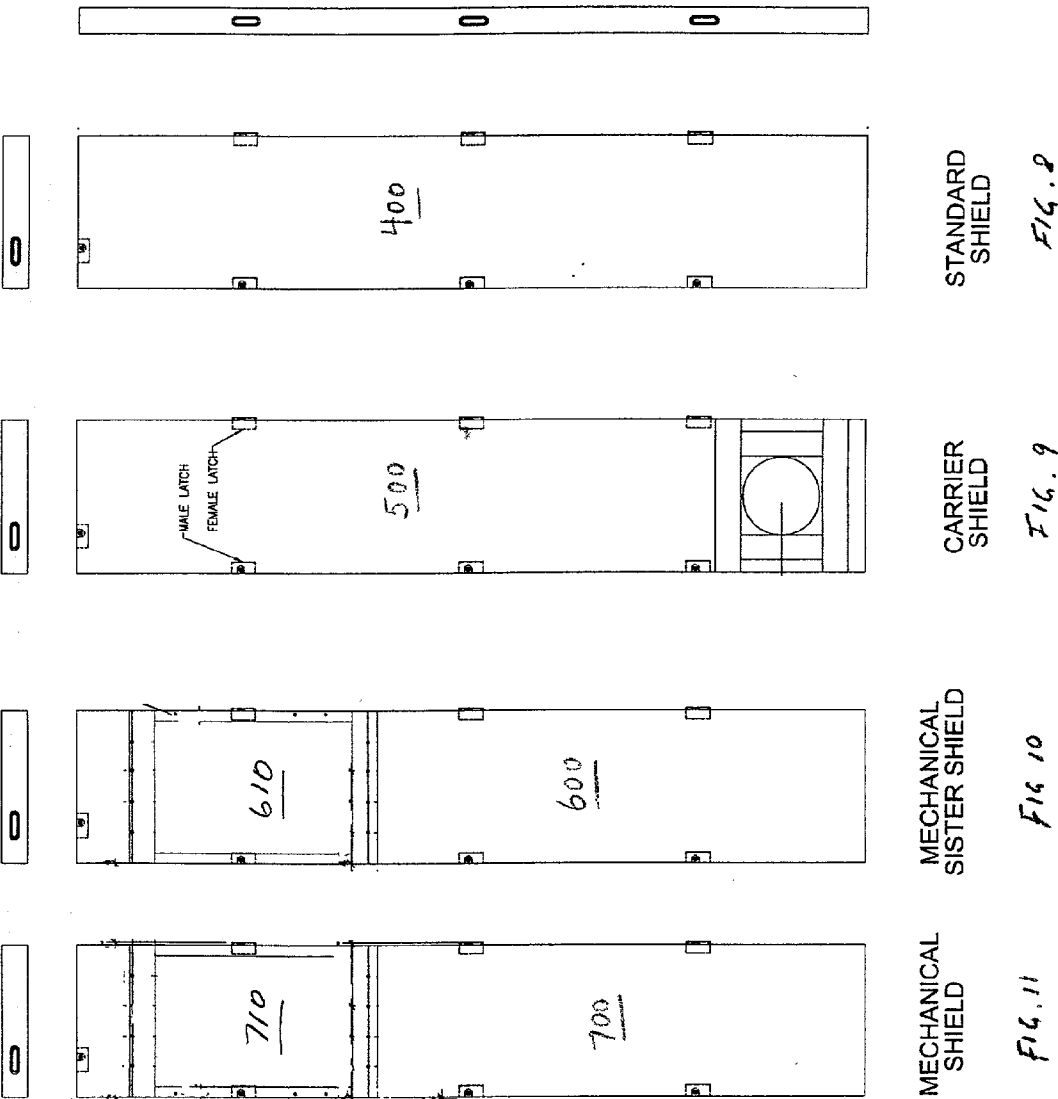
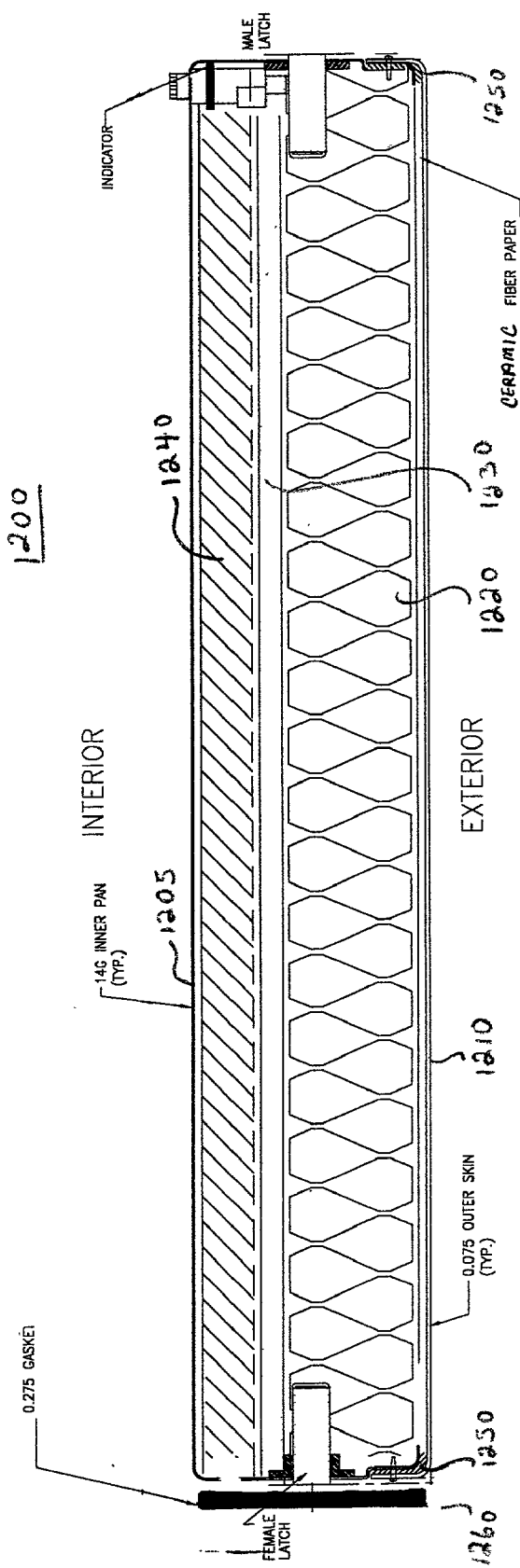


Fig. 3









VERTICAL SHIELD CONNECTION

Fig 12

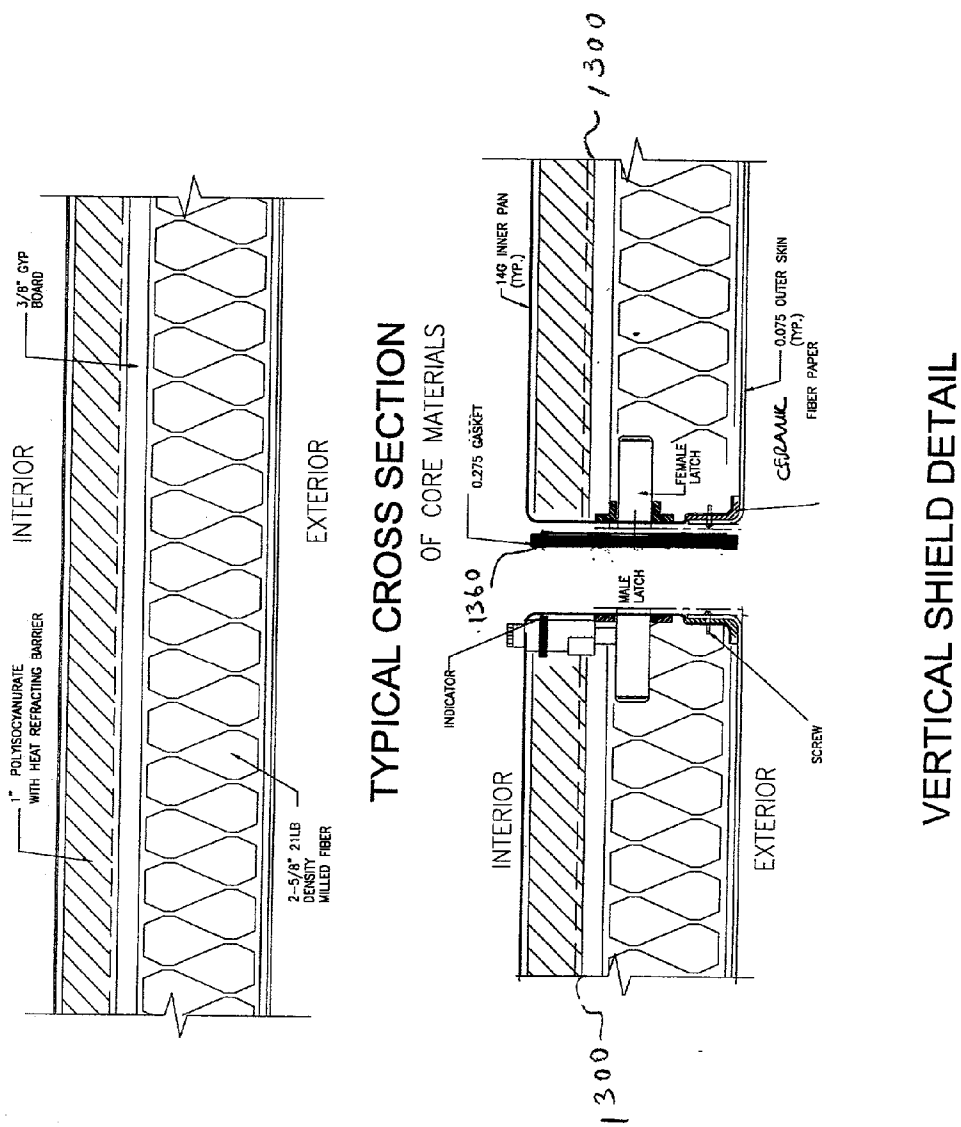
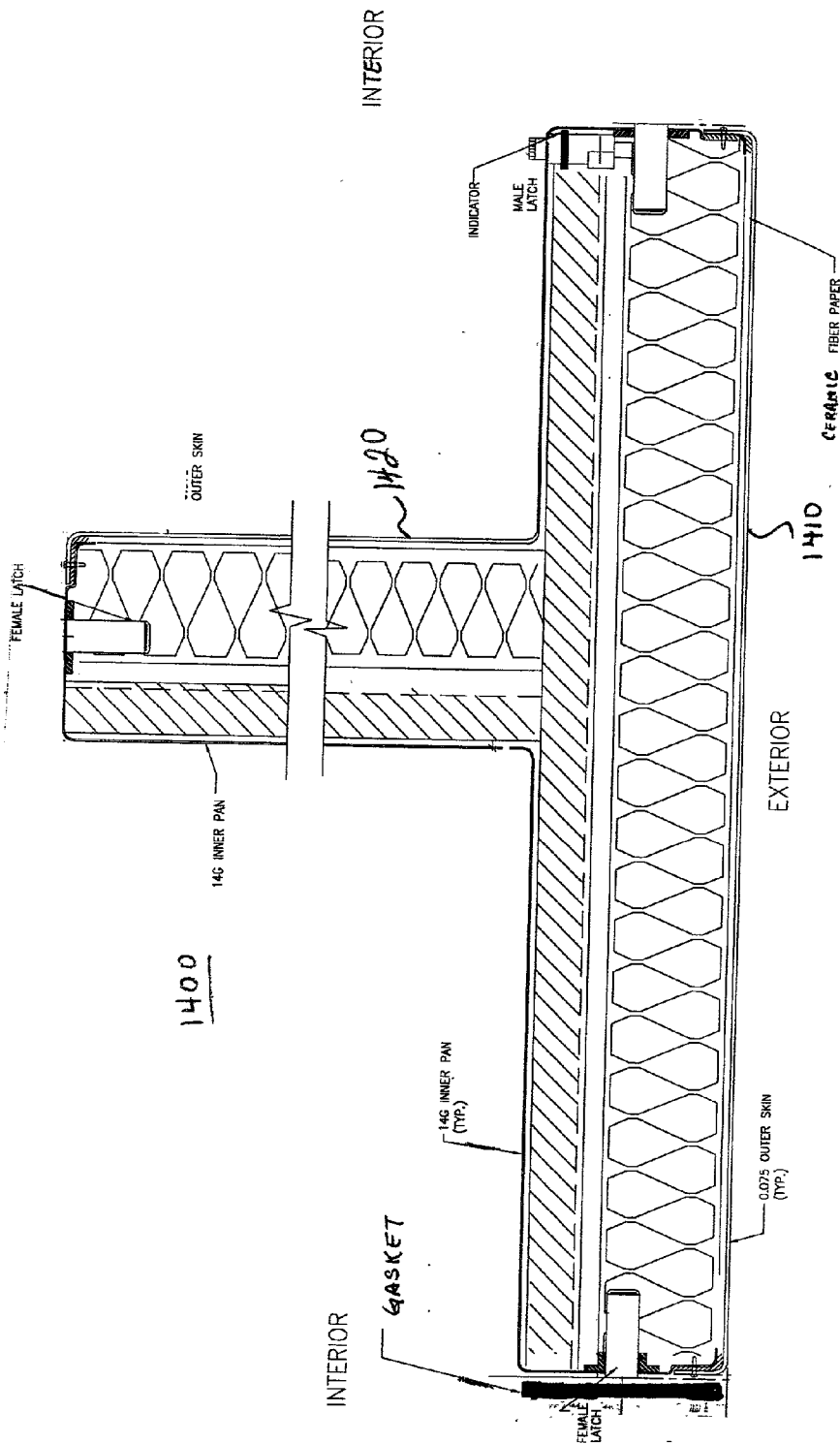
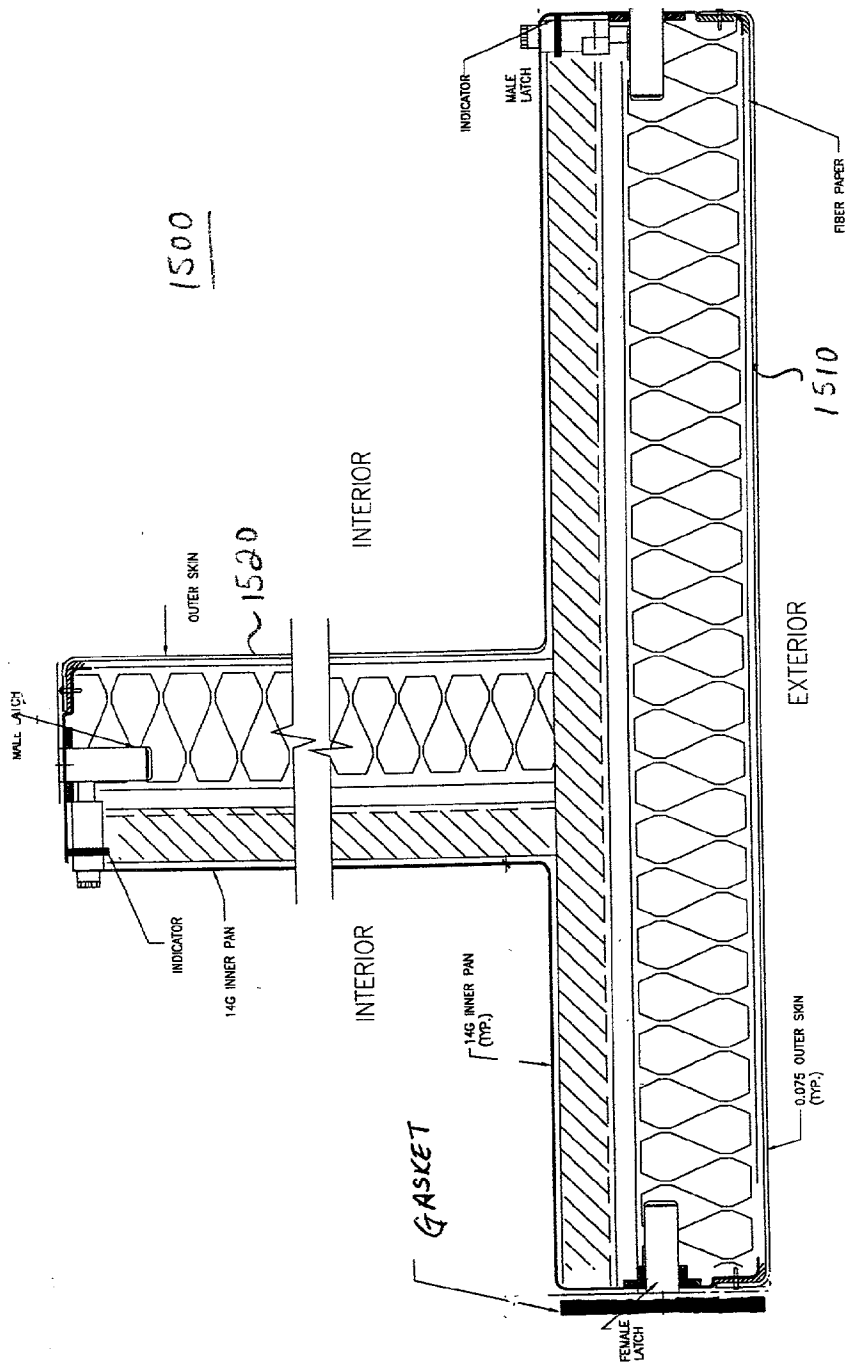


FIG. 13



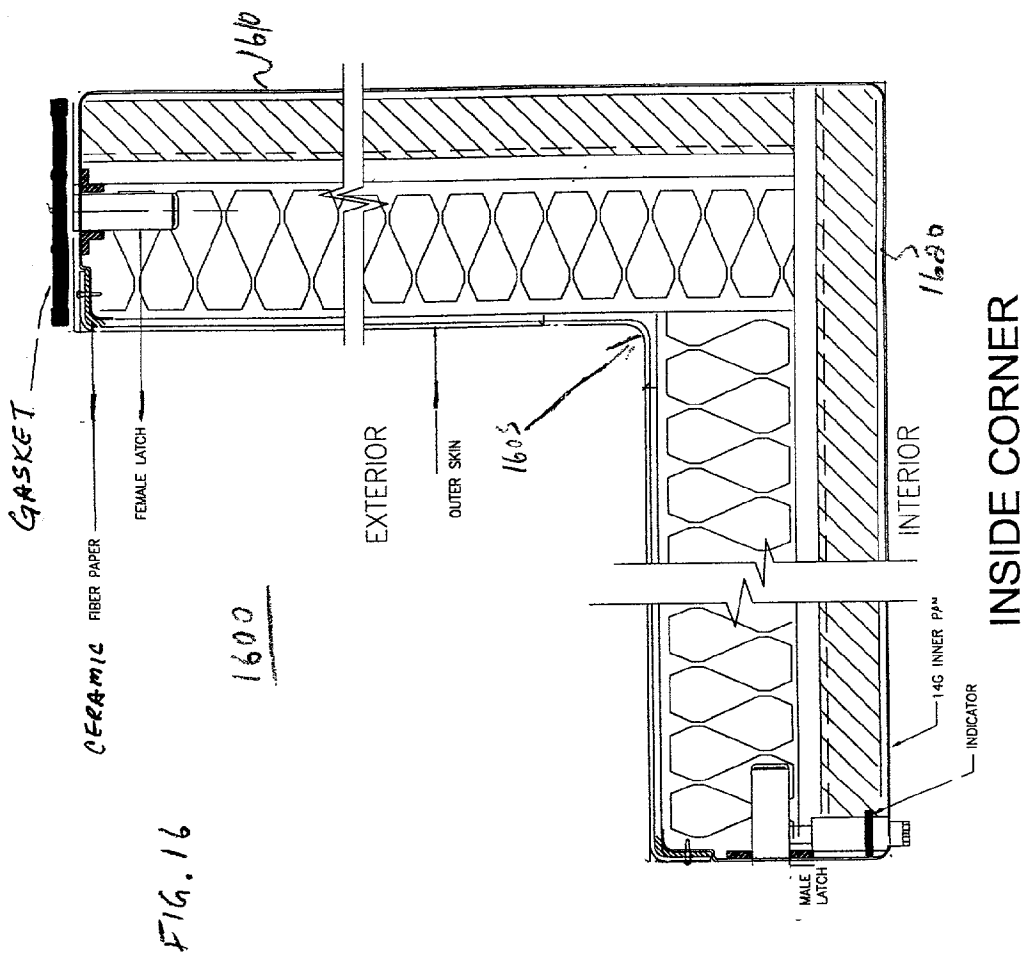
"T" SHIELDS (L)

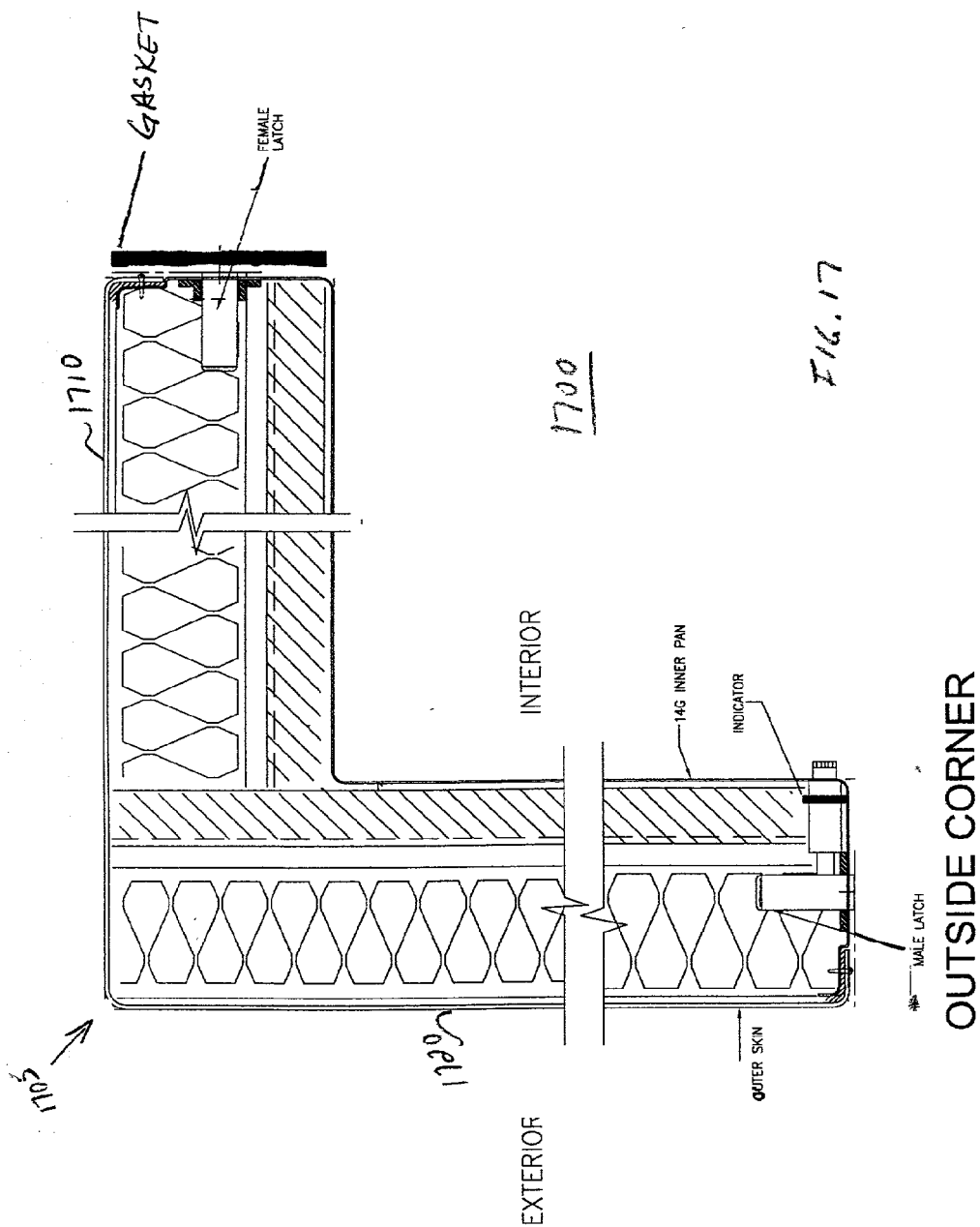
Fig. 14

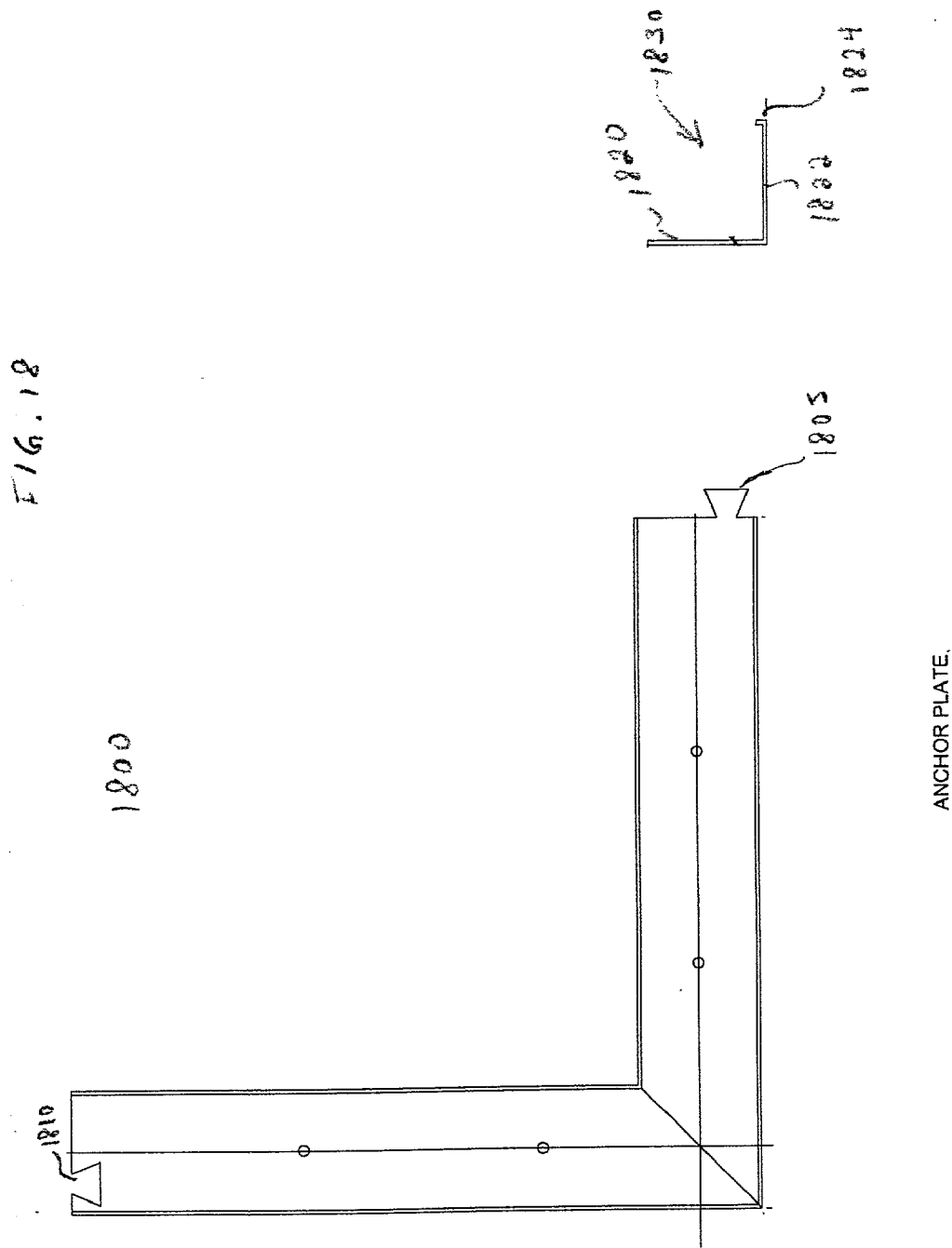


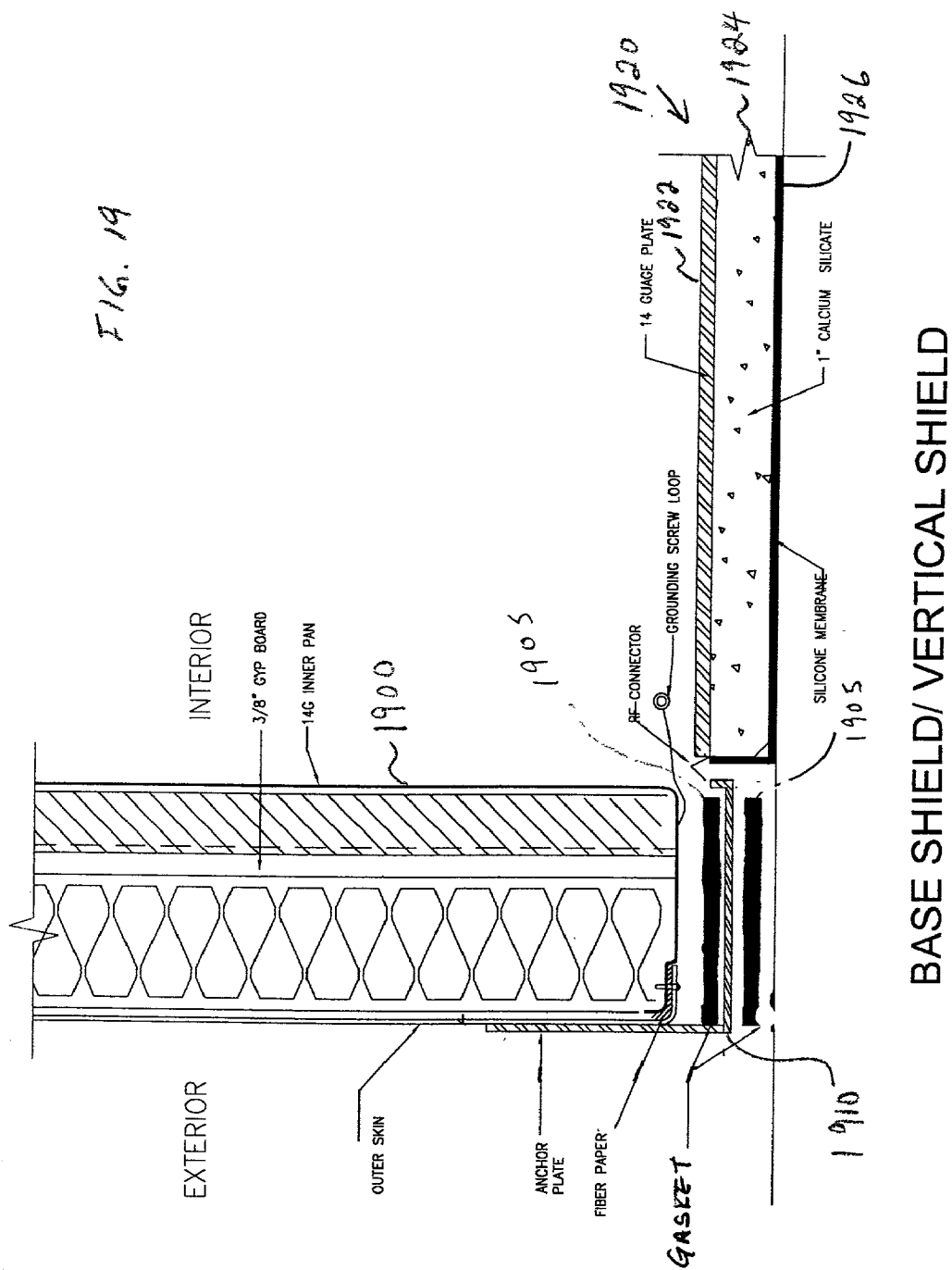
"T" SHIELD(R)

FIG. 15









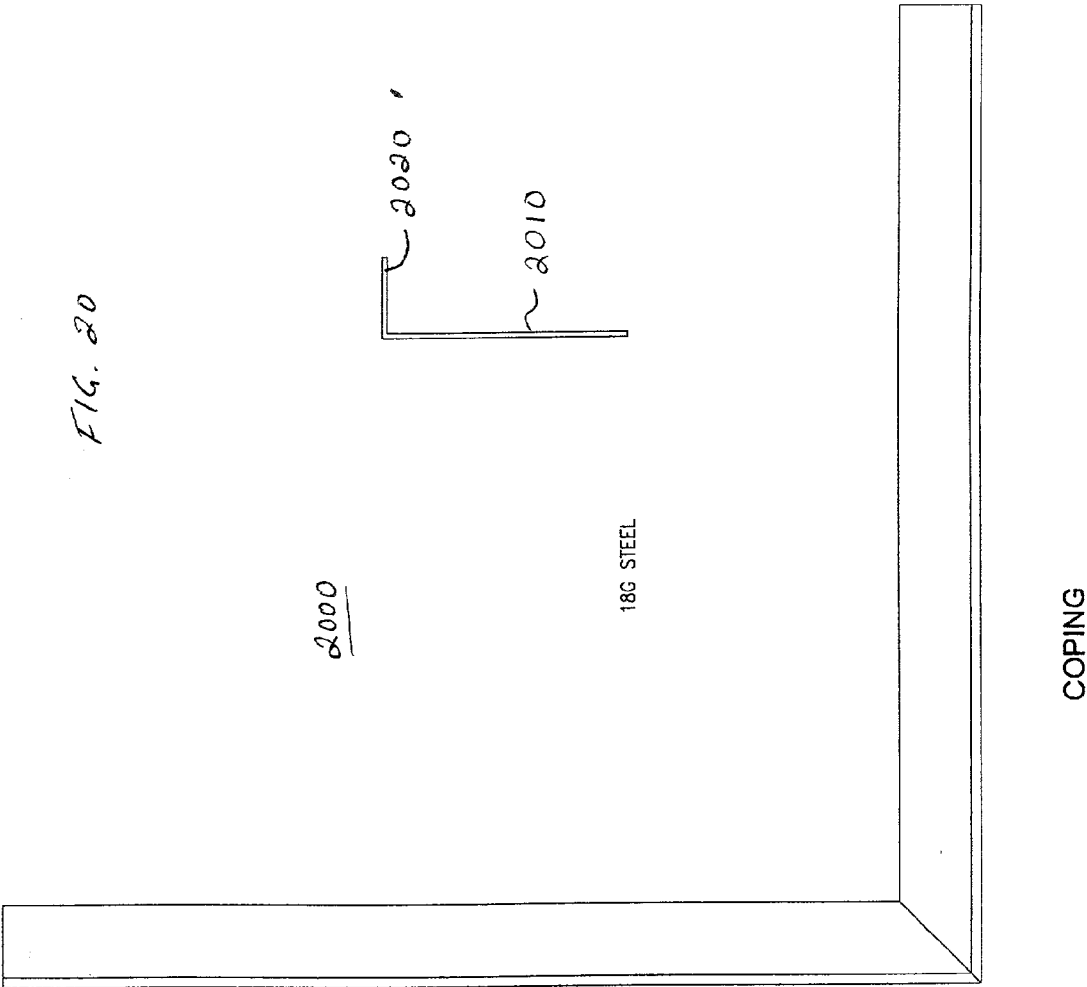
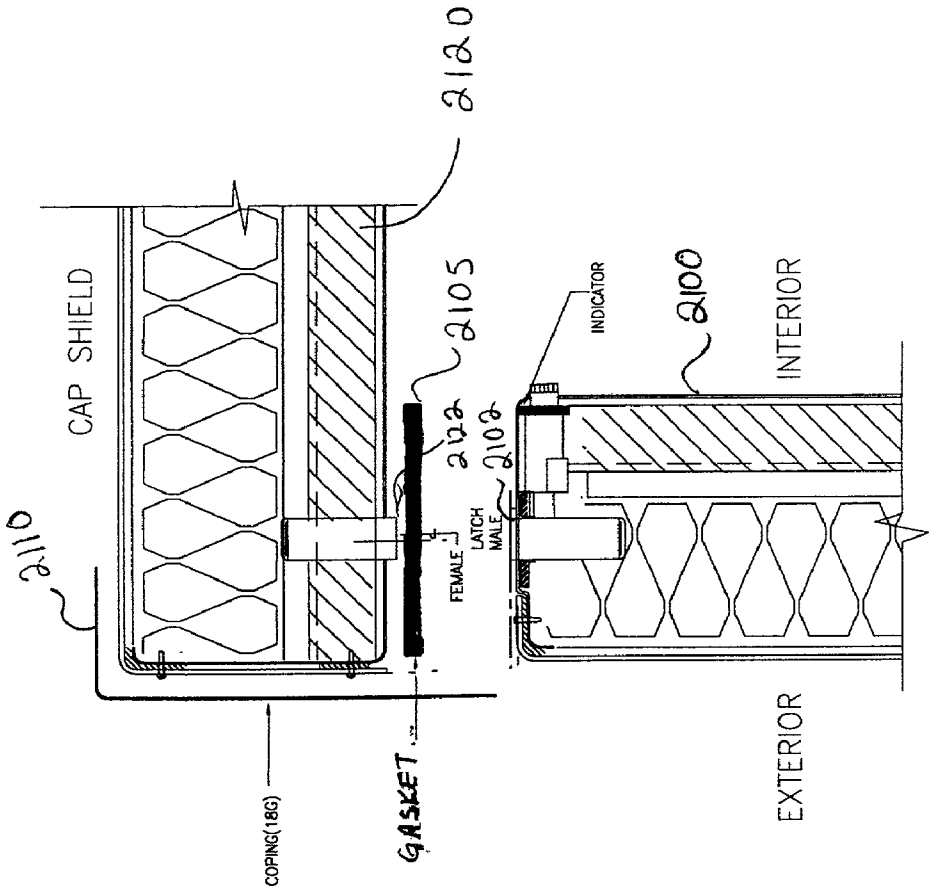


FIG. 81



CAP SHIELD/ VERTICAL SHIELD

2200

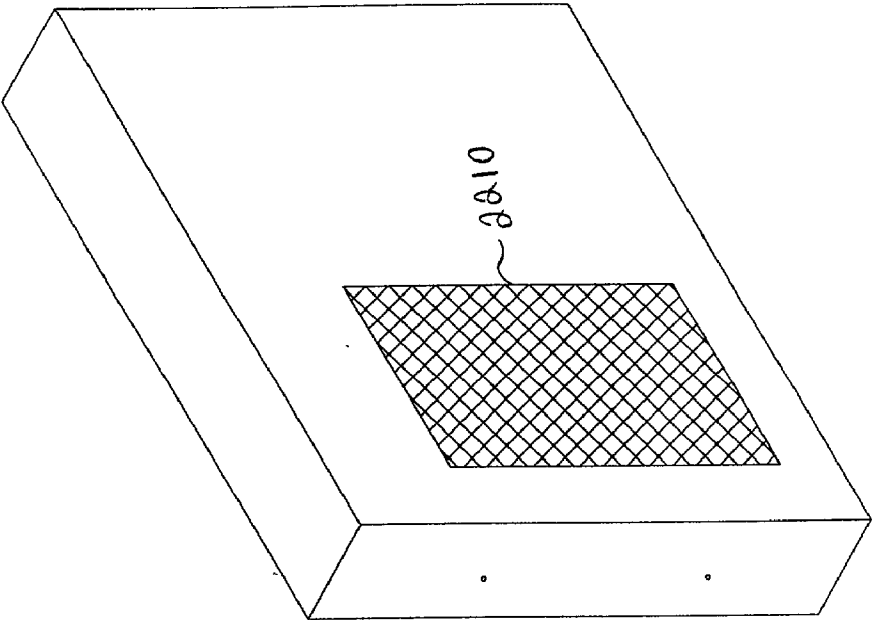
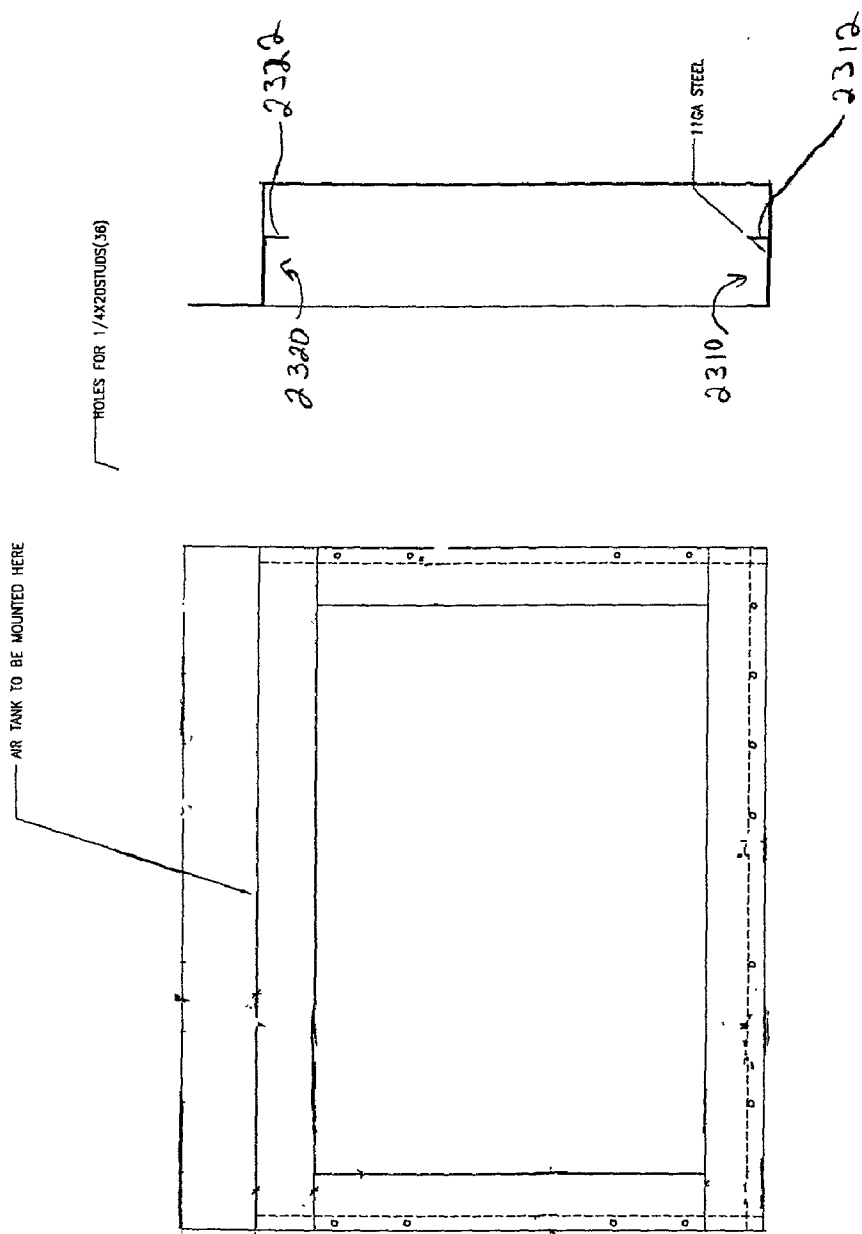


FIG. 22

DAMPER HOUSING

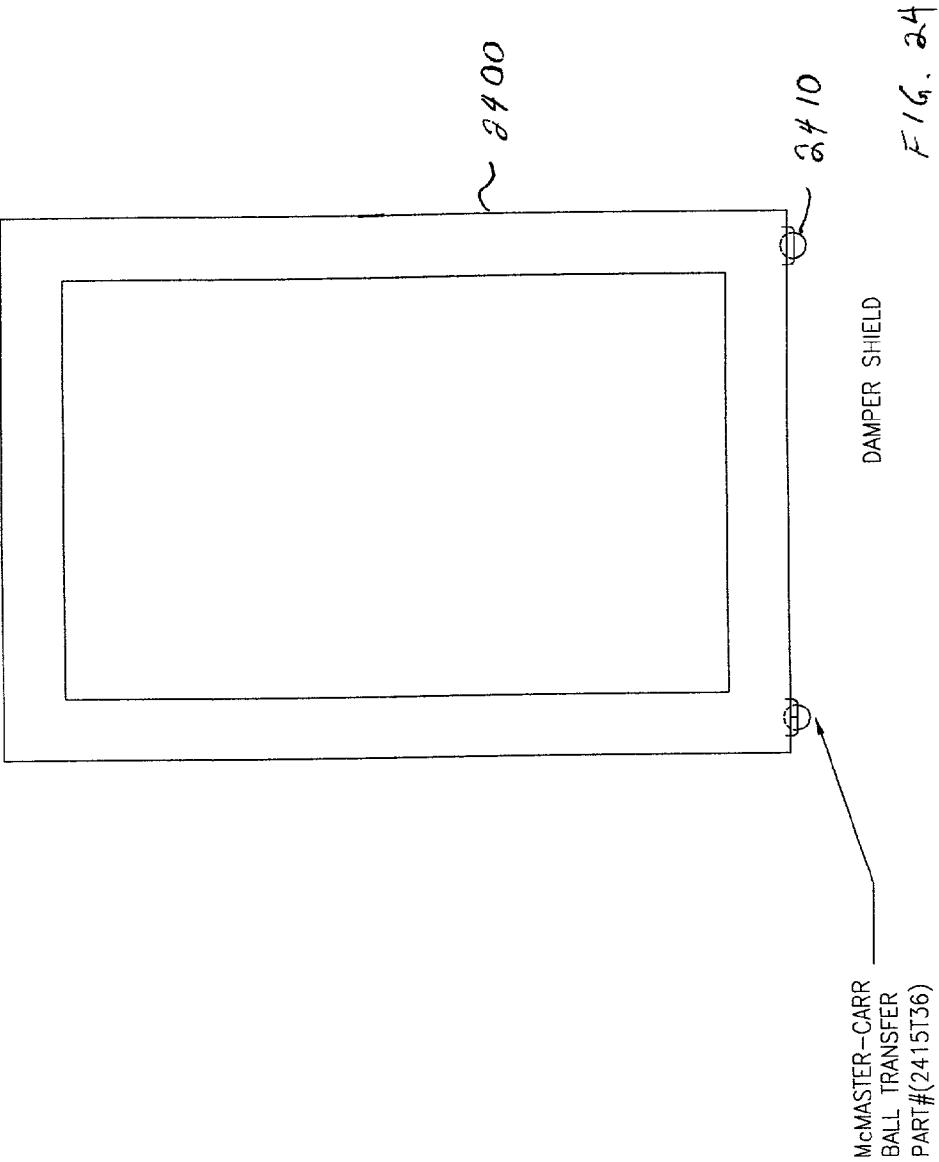


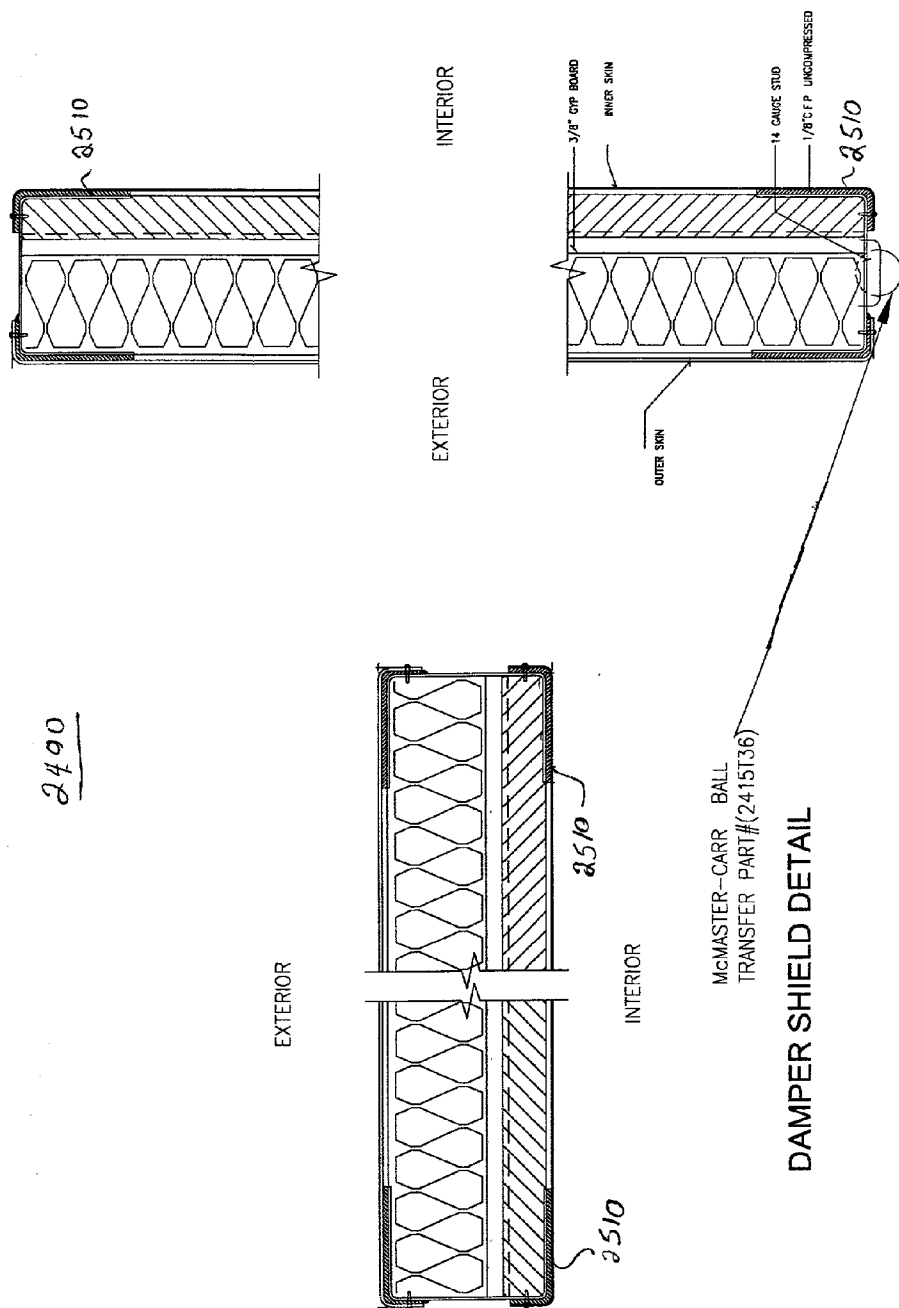
2200

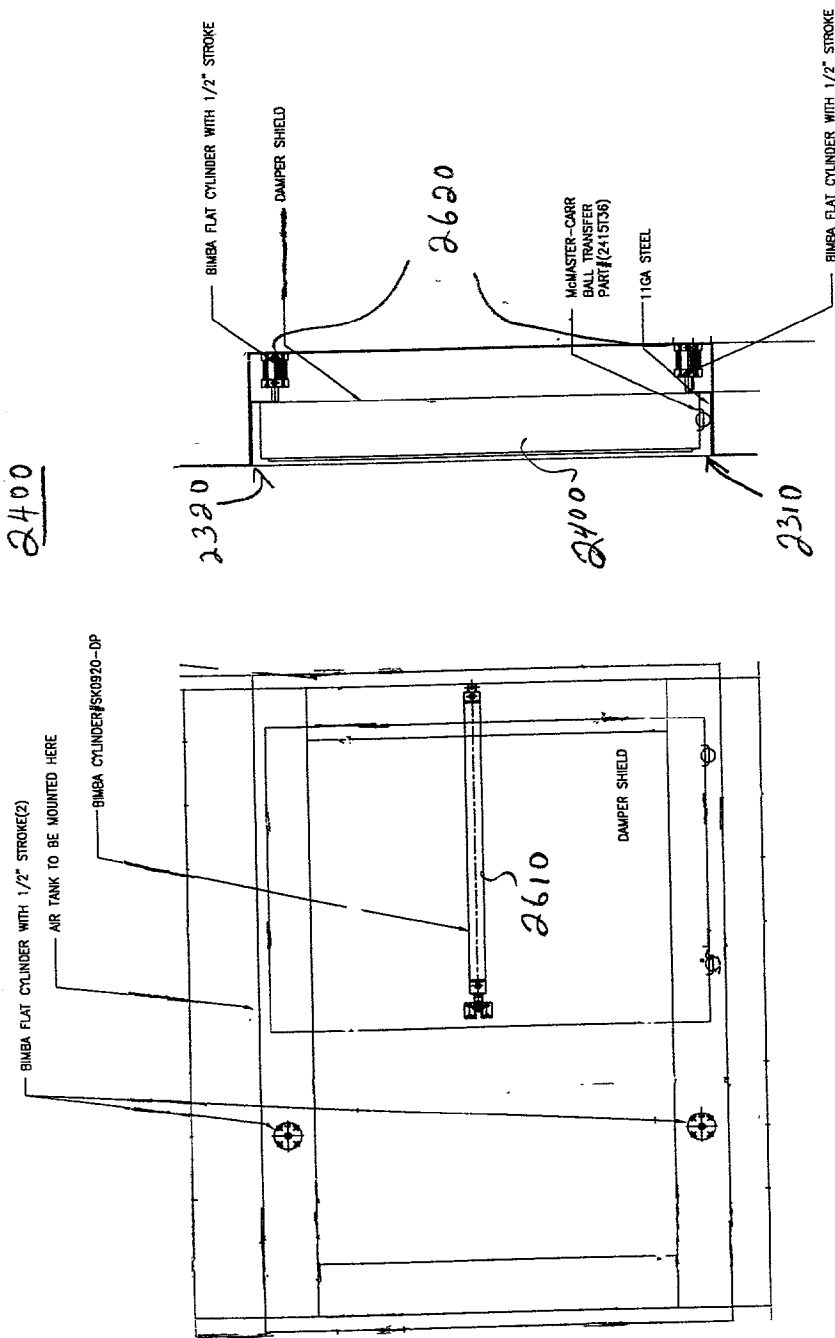
110 GAUGE STEEL DAMPER HOUSING

DAMPER HOUSING

FIG. 23

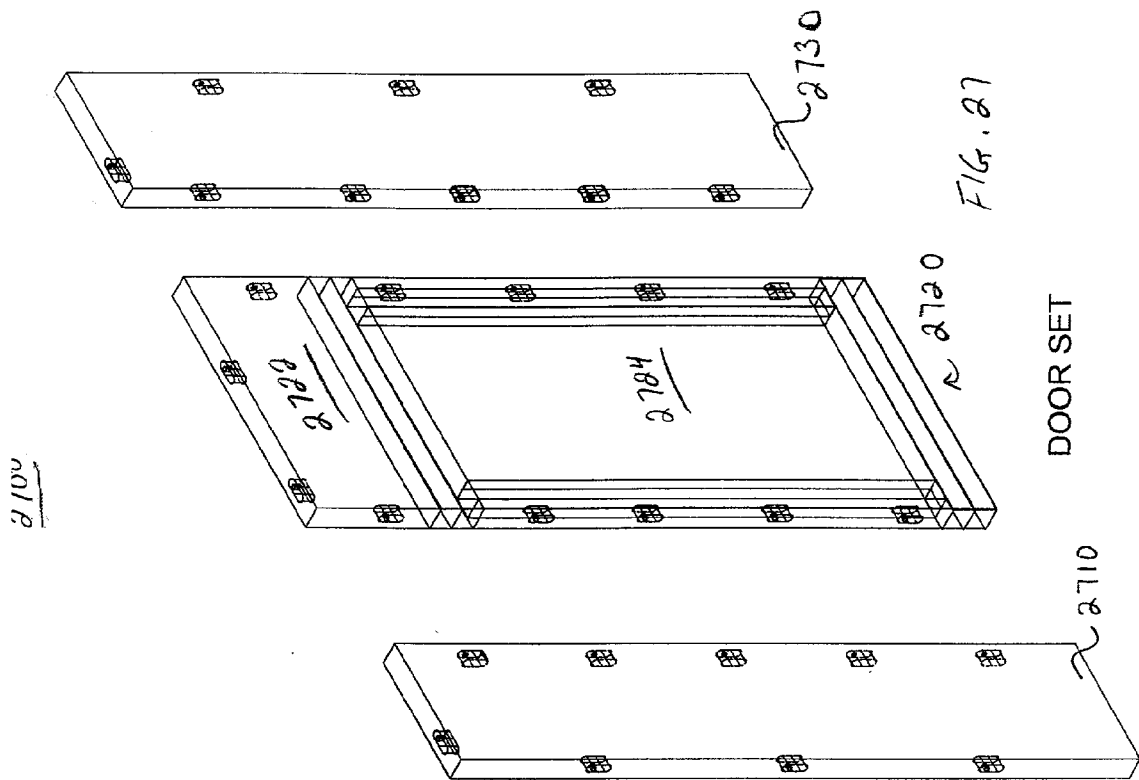






DAMPER ASSEMBLY

Fig. 26



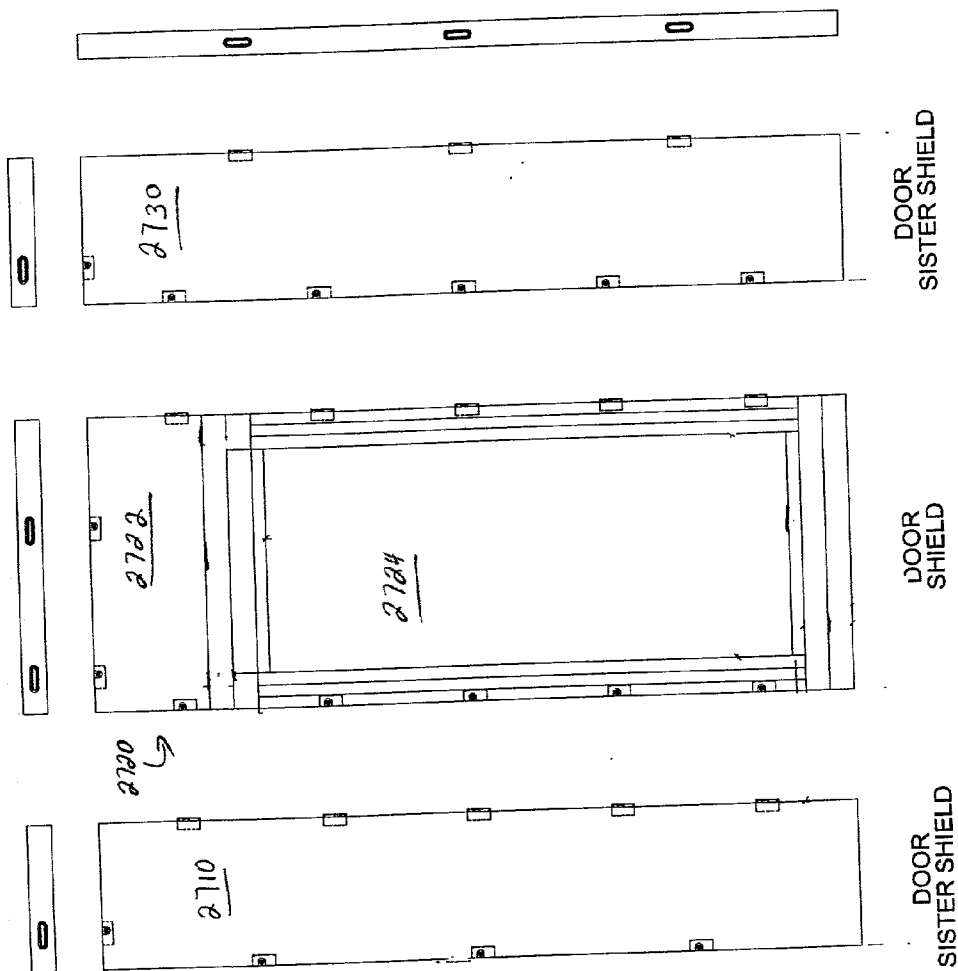


FIG. 88

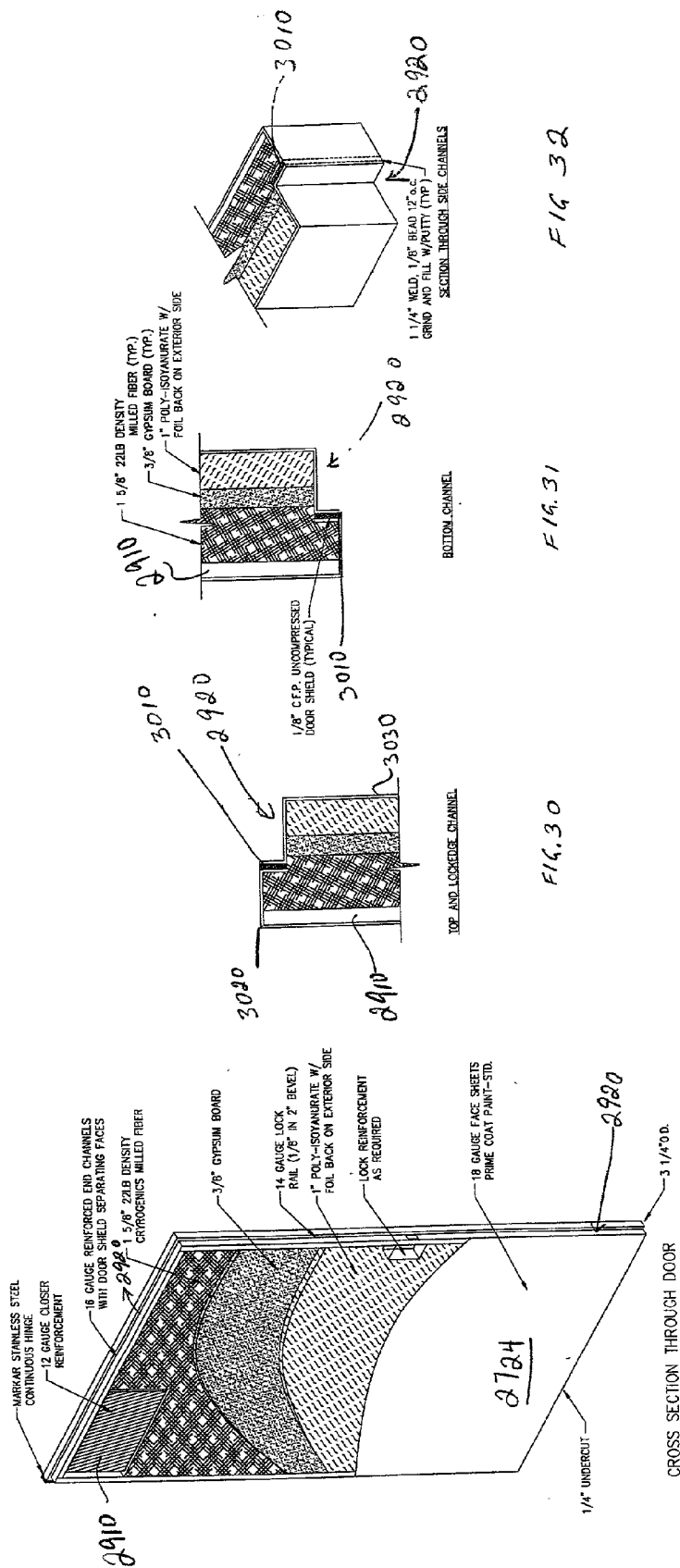
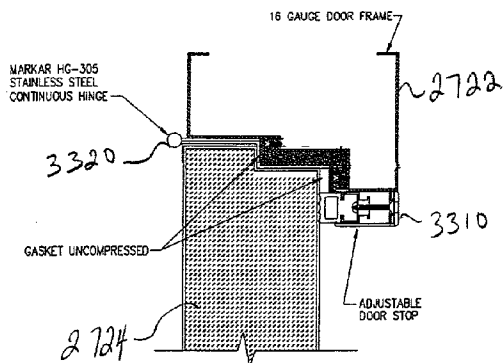
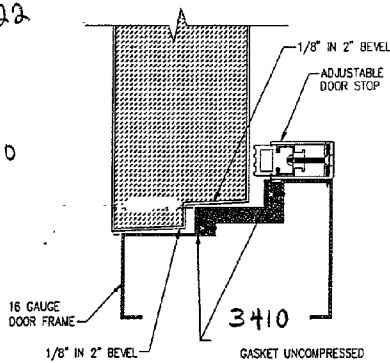


FIG 33



FRAME DETAIL - HINGE SIDE

FIG. 34



FRAME DETAIL - TOP AND LOCKSET SIDE

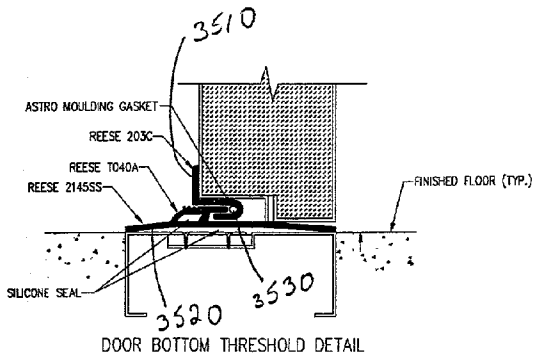


FIG. 35

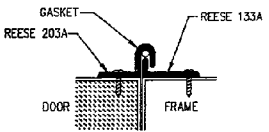


FIG 36

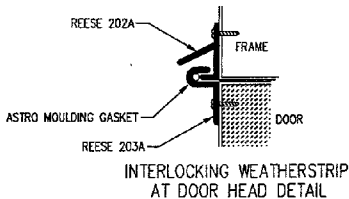
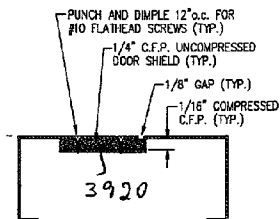
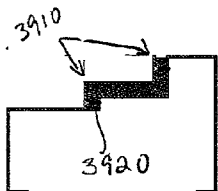


FIG 37



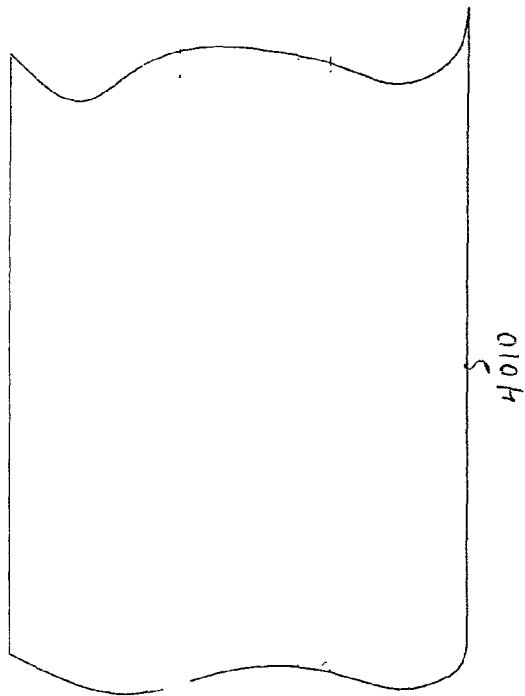
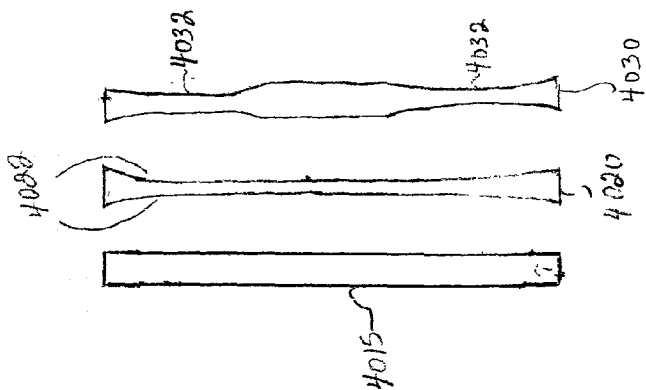
FRAME DIMENSIONS - BOTTOM



FRAME DIMENSIONS - TOP AND SIDE

FIG 38

FIG. 39



4000

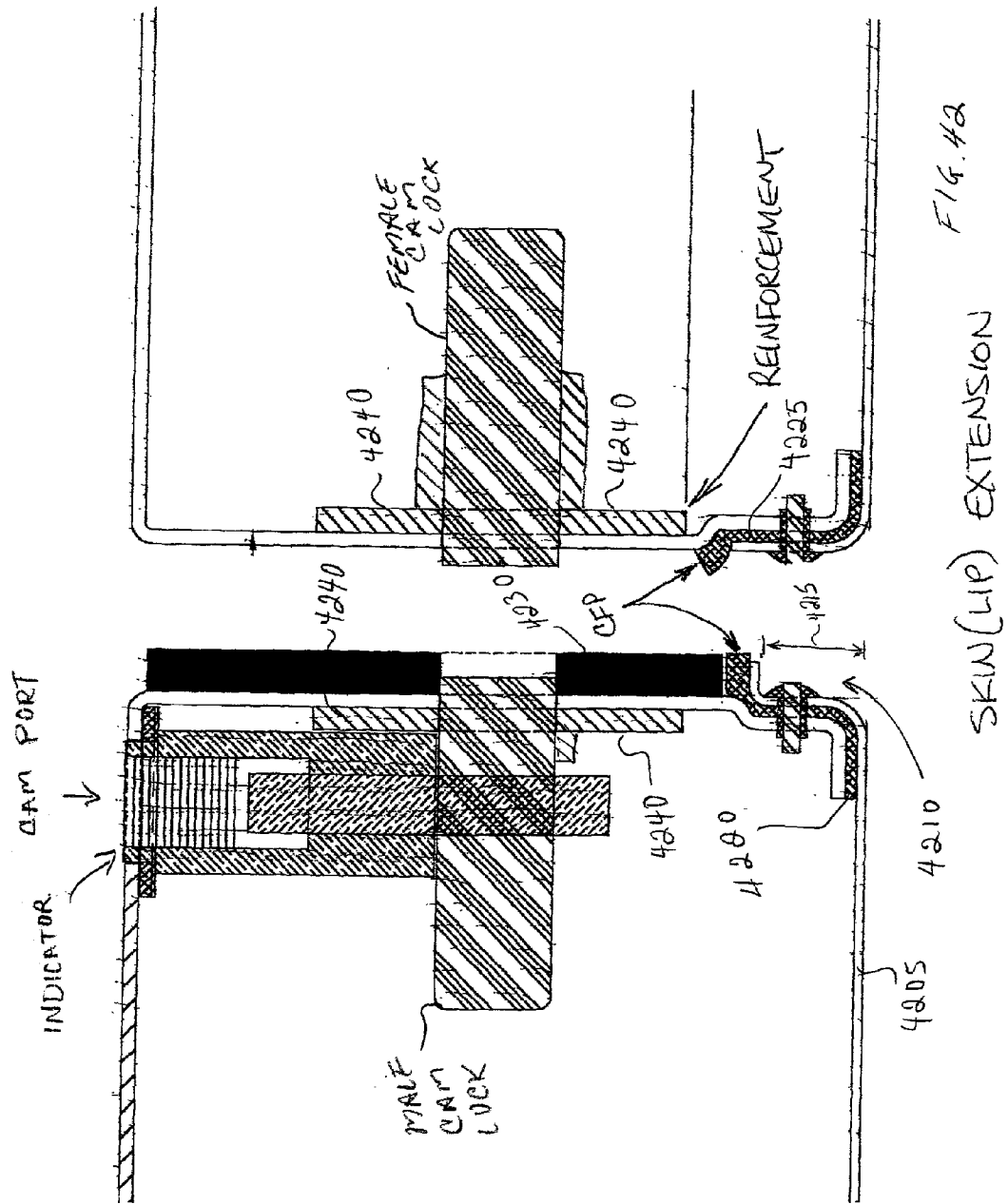
4005

FIG. 40

SHIELD GASKET

<u>ITEM</u>	<u>MATERIAL - DESCRIPTION</u>	<u>QUANTITY</u>
1	GE SILICONES SE 6035 OR WACKER SILICONES R165/35 (SIL/CONE)	100 PARTS
2	HARWICK STANDARD AC-720 (HYDRATED ALUMINA)	100 PARTS
3	DOW CORNING FR-2 (FLAME RETARDANT PASTE)	16 PARTS
4	HARWICK STANDARD PERKADOX S-50S-PS (DI BENZOYL PEROXIDE)	2.5 PARTS
5	CABOT MS-7 CABOT CORP (MINUSIL FILLER)	11 PARTS
6	BENZOYL PEROXIDE (CROSS LINKING) PEROXIDE	1.42 PARTS

Fig. 41



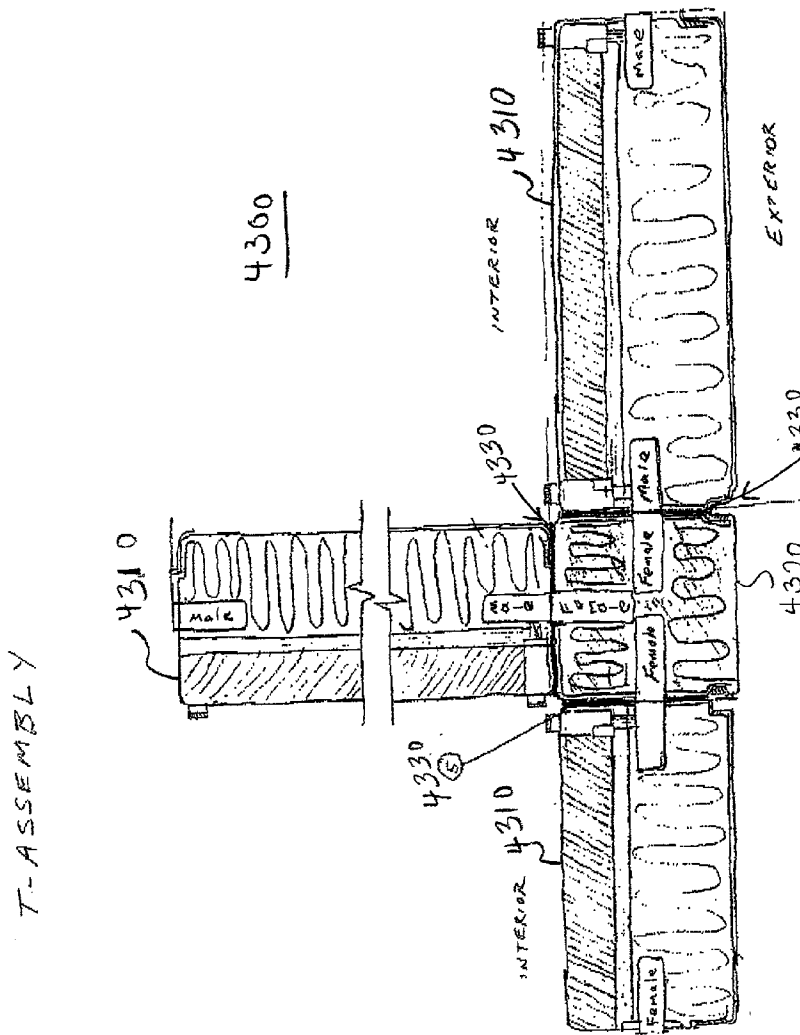
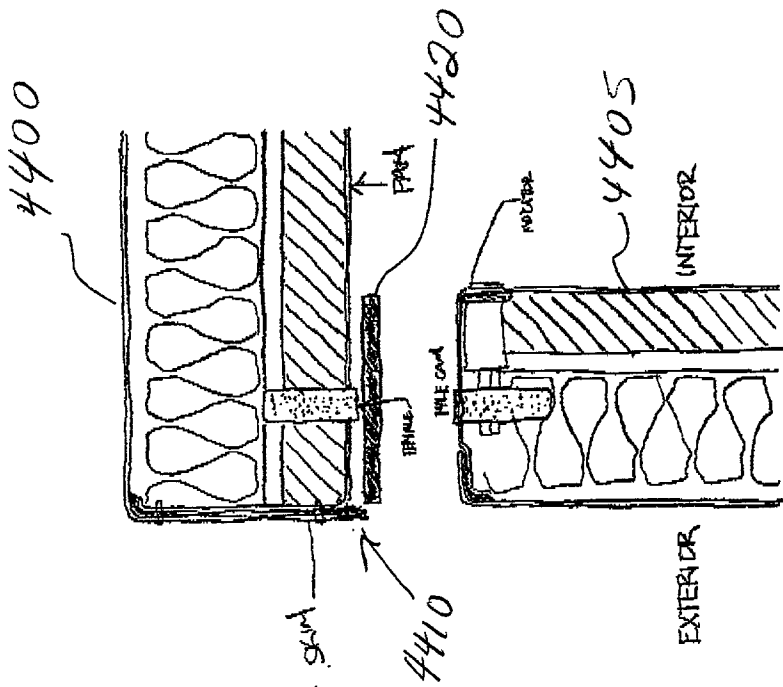


FIG. 43



CAP SHIELD/VERTICAL SHIELD

FIG. 44

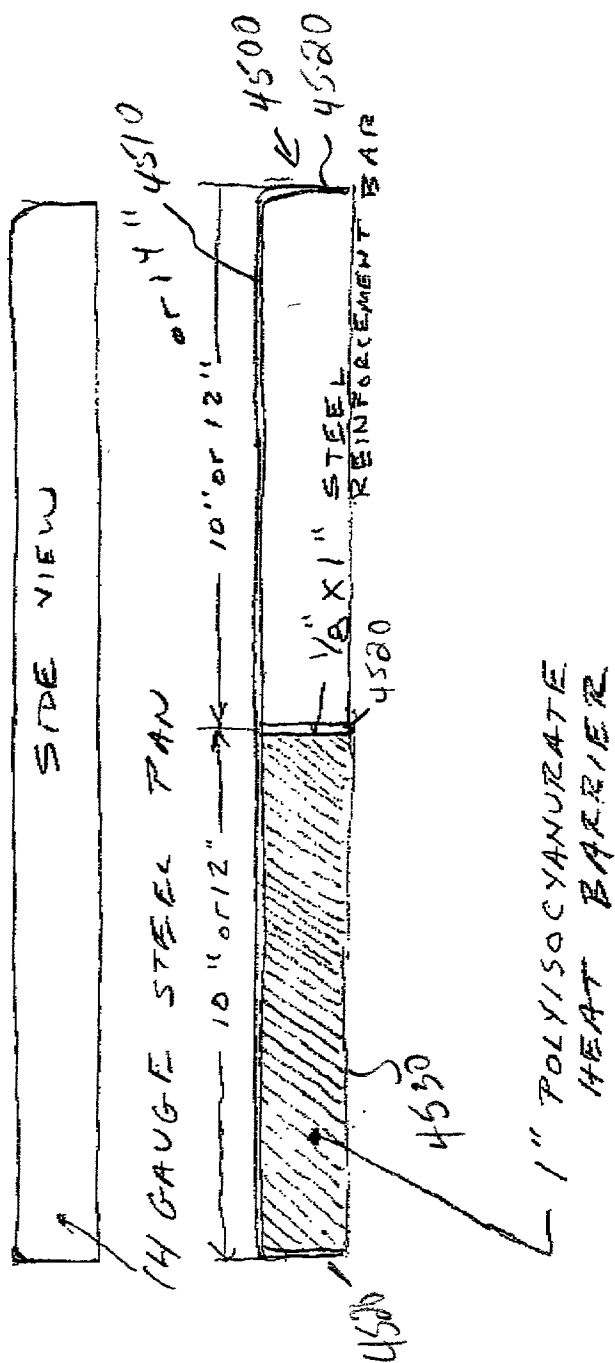


FIG. 45

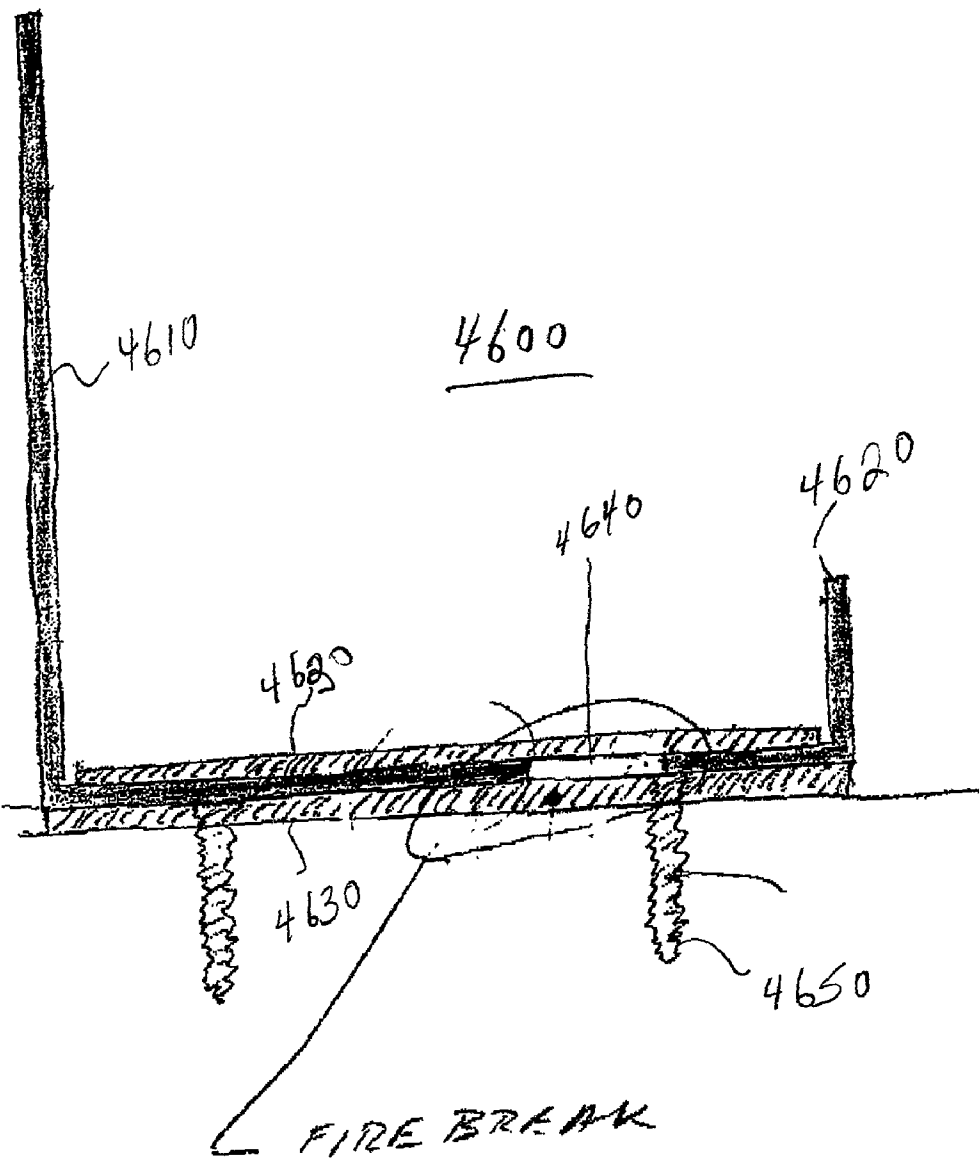
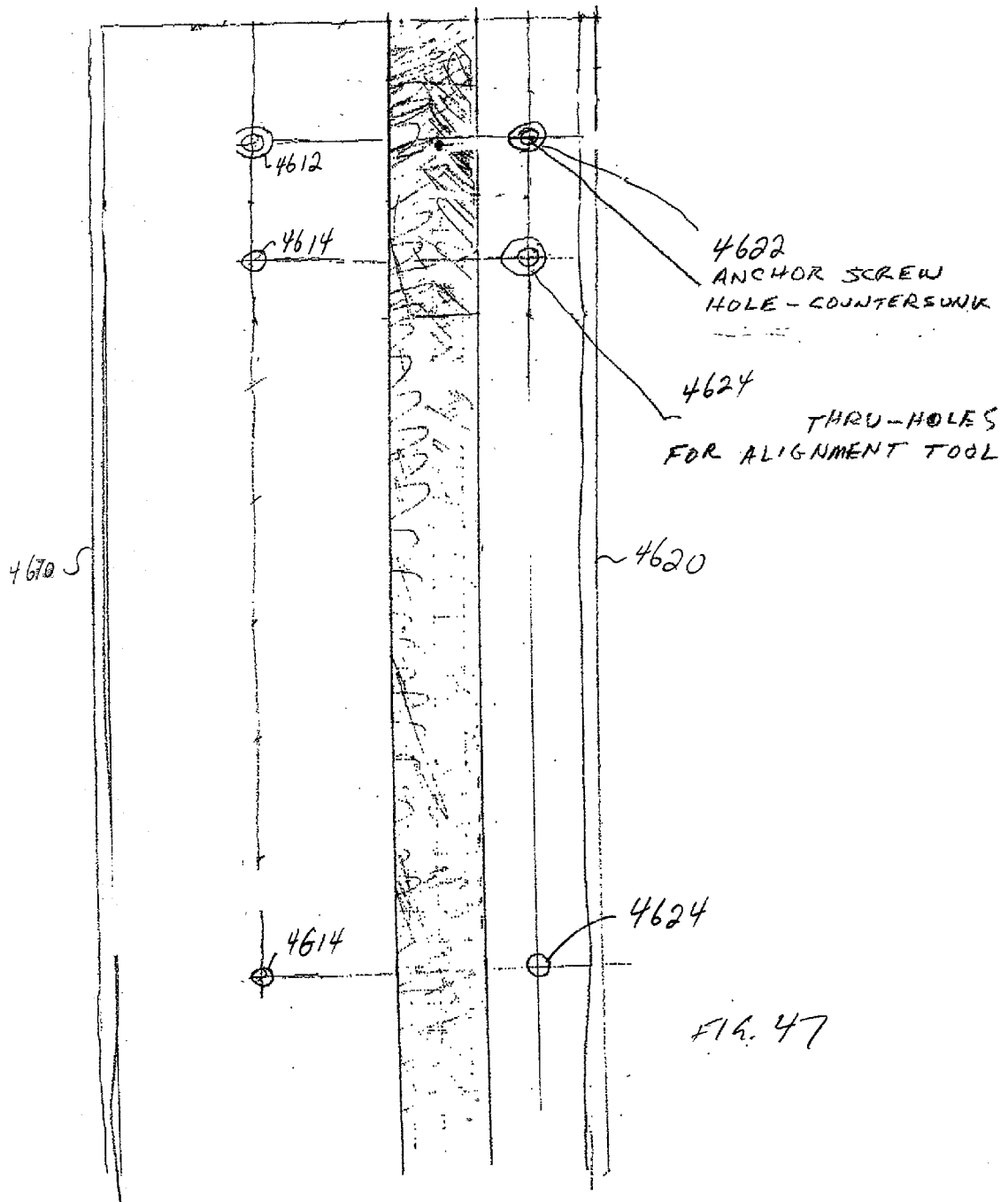


FIG. 46



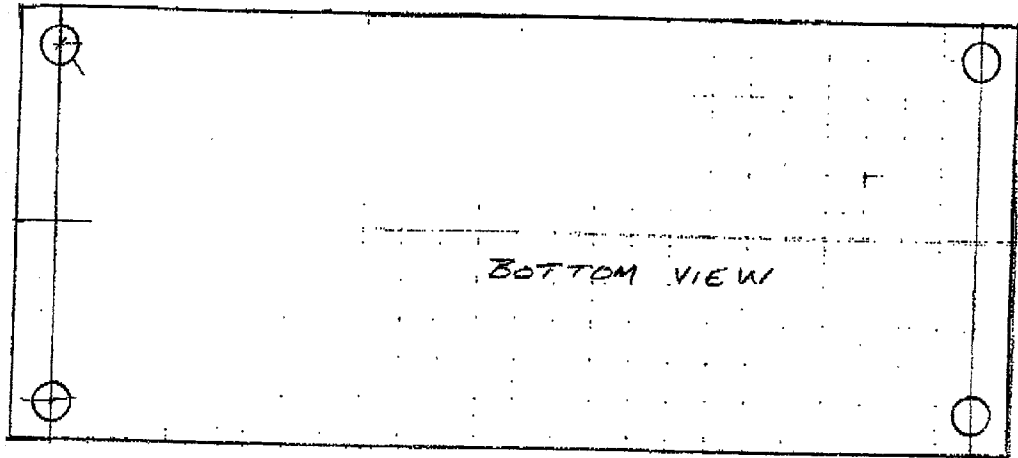
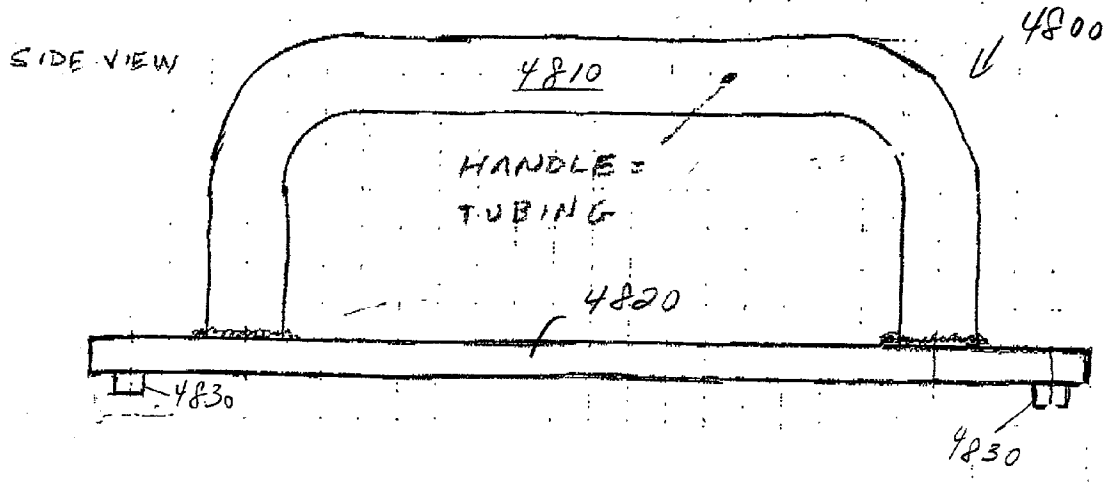


FIG. 48

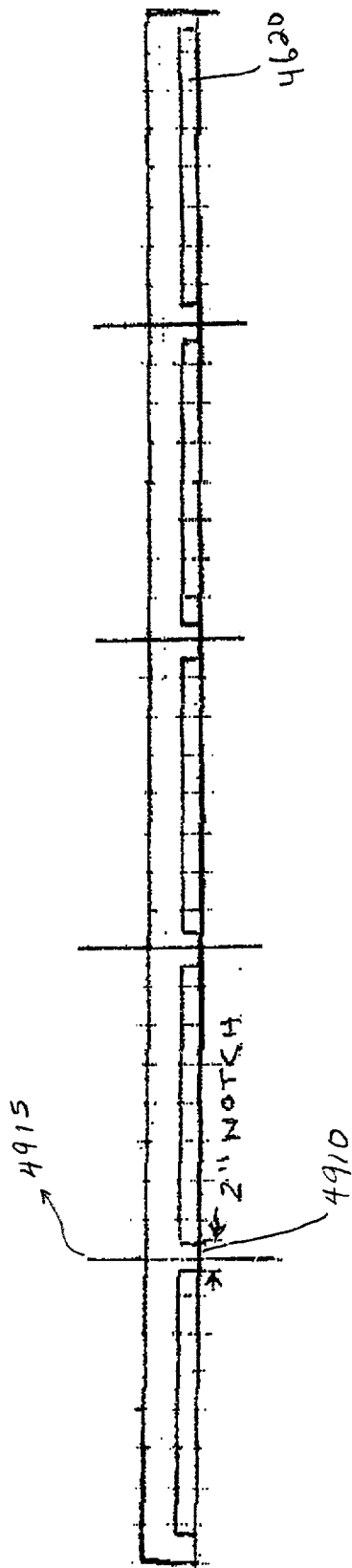
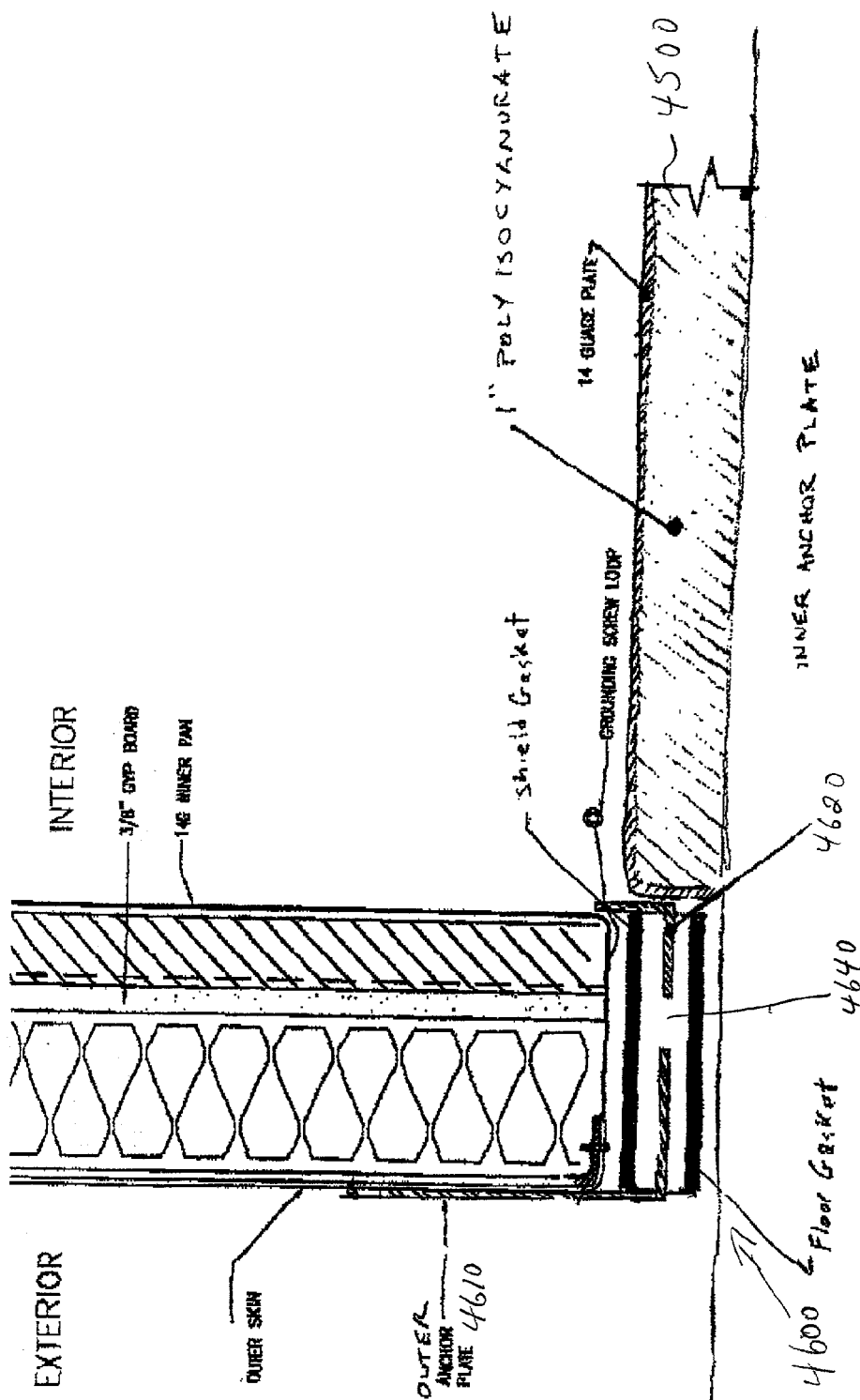
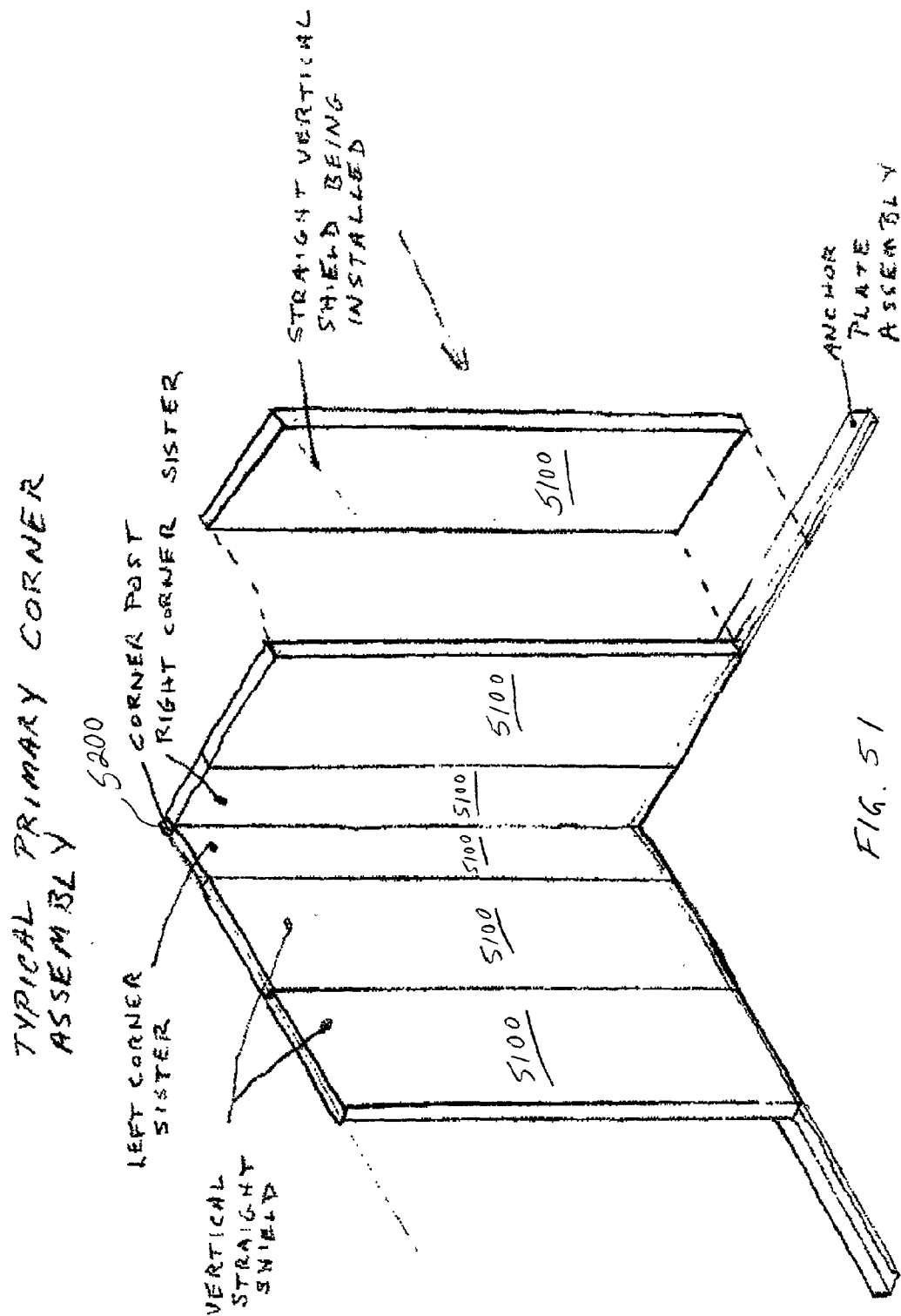


FIG. 49



BASE SHIELD/VERTICAL SHIELD

FIG. 50



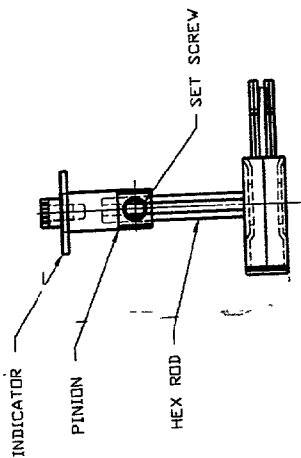
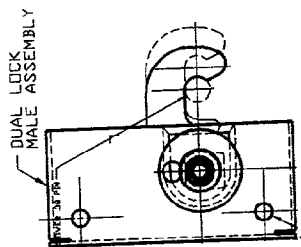
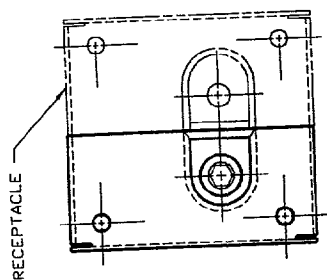
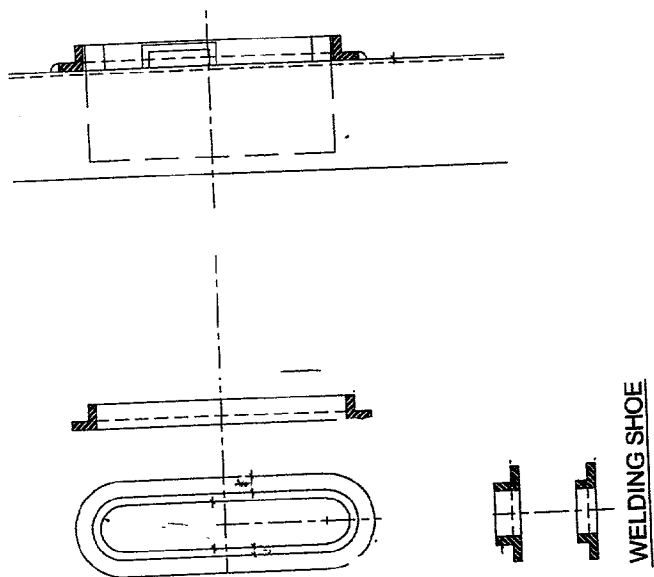
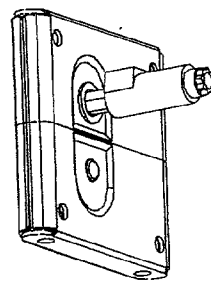


FIG. 52



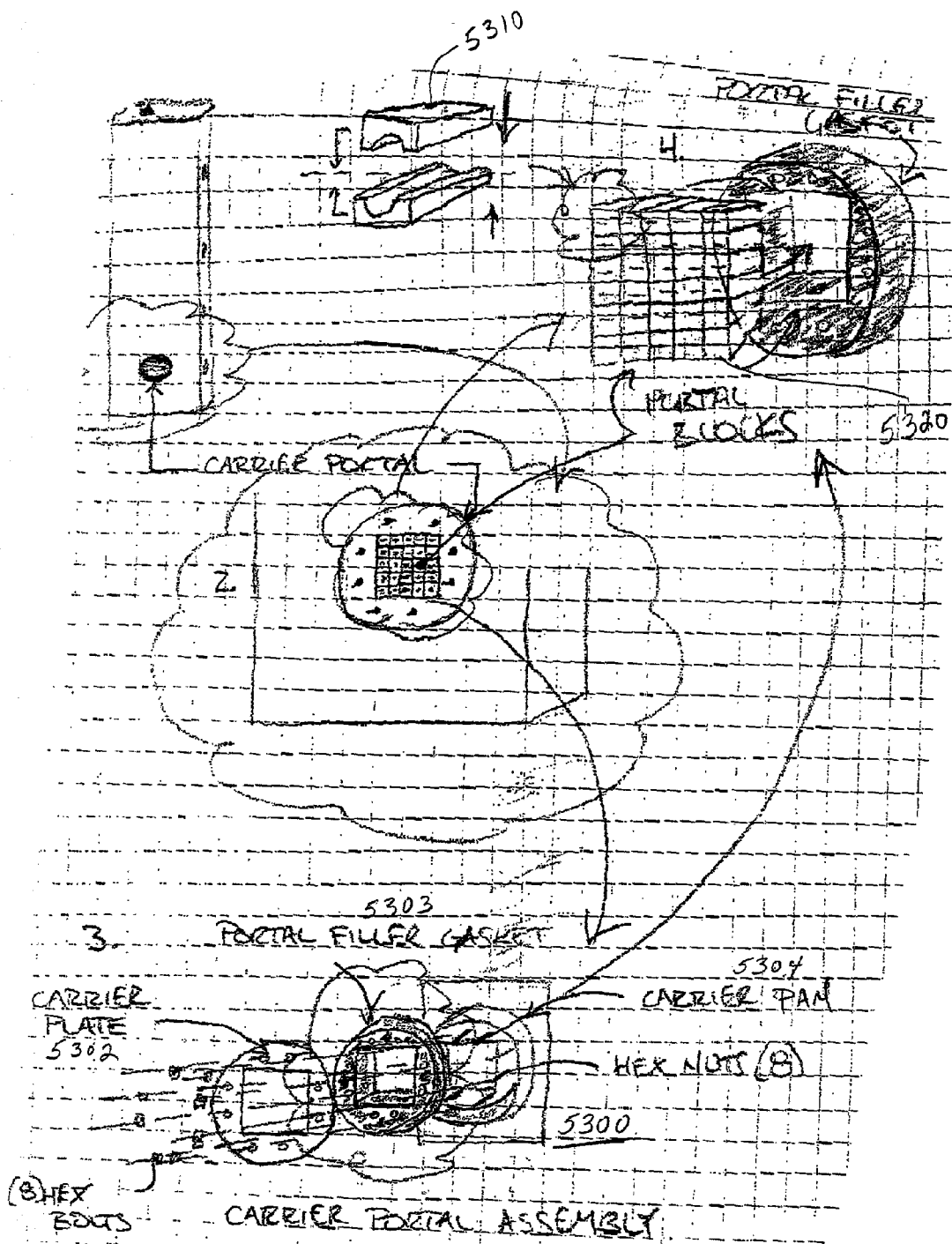


FIG. 53

METHOD AND APPARATUS FOR PROVIDING A MODULAR SHIELDED ENCLOSURE

[0001] This application claims the benefit of U.S. Provisional Application No. 60/295,953 filed Jun. 5, 2001, which is hereby incorporated by reference in its entirety.

[0002] The present invention relates to an apparatus and concomitant method for providing a protective enclosure. More specifically, the apparatus is a modular, shielded enclosure that is engineered to provide structural security for important assets such as information technology (IT), data, telecom equipment, and the like.

BACKGROUND OF THE INVENTION

[0003] Information technology (IT), data, and telecom equipment are important and expensive assets in many businesses, and, as such, appropriate measures are generally taken to insure that the lifetime and functionality of such equipment are not compromised. Due to the sensitive nature of the equipment, many businesses construct facilities within their offices and buildings to protect the equipment from threats that might cause degradation, damage, failure, or consequential loss (i.e., by fire, heat, water, dust, radio frequencies, vandalism, etc.). These facilities are usually permanent sites constructed within the building as part of the occupants initial architecture. As such, they are fixed in both location and size.

[0004] However, if such a protective facility is contemplated after the office building has been constructed, substantial modifications to the structure of the building are often required at considerable cost to meet the stringent protective requirements. Additionally, once such protective facility is integrated into the office, it is very costly to then reconfigure or to enlarge such protective facility.

[0005] Thus, a need exists for a flexible and modular approach that provides a protective enclosure within a facility for protecting sensitive equipment and data.

SUMMARY OF THE INVENTION

[0006] In one embodiment of the present invention, a method and apparatus for providing a modular, shielded enclosure is provided. The enclosure is engineered to provide structural and environmental security for IT, data, and physical equipment, e.g., communication and computer equipment, and is intended to protect any and all contents regardless of function or type from human or environmental threats that may otherwise cause degradation, damage, failure, or consequential loss.

[0007] The present invention is a modular, shielded enclosure that provides protection to sensitive equipment and data, but is advantageously engineered to provide flexibility in its deployment as it can contain and surround unlimited areas of space. Namely, the deployment of the present modular, shielded enclosure is not required to be designed into the initial construction of the building. It is designed to be easily deployed in existing buildings.

[0008] The design and assembly of the enclosure allow not only for easy construction, but also for relocation and even expansion or reduction, should the user's needs change over time. The enclosures are infinitely configurable independent

systems, and other than the structural foundation on which they are assembled, they do not rely on building architecture for structural support.

[0009] Individual periphery shields of varying heights, a series of penetration management devices (PMD), and a control panel constitute the composition of the secure enclosure. The PMD's consist of a door system for human and equipment transfer, mechanical dampers for fresh and mechanical air exchange, and carrier portals to manage wire, cable, and plumbing penetrations. These enclosures are infinitely configurable, and once installed, the entire assembly may be expanded, reduced, or even relocated. Other than the structural foundation on which the enclosure is assembled, the enclosure does not rely on building architecture for structural support. This modularity and independence provides end-users with the flexibility needed to manage the ever-changing, highly specialized, critical facility.

[0010] The enclosure can be deployed to protect contents against such threats as fire, water, heat, dust, humidity, smoke, acrid gases, radio frequencies (RF), electromagnetic interference/electromagnetic pulses (EMI/EMP), theft, vandalism, unauthorized access, construction hazards, and explosions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] So that the manner in which the above recited features, advantages and objects of the present invention are attained and can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to the embodiments thereof which are illustrated in the appended drawings.

[0012] It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

[0013] FIG. 1 illustrates a three-dimensional view of an illustrative modular enclosure of the present invention as deployed in a larger facility;

[0014] FIG. 2 illustrates a three-dimensional view of a typical embodiment of the enclosure;

[0015] FIG. 3 illustrates a top view of a typical embodiment of the modular enclosure of the present invention;

[0016] FIG. 4 illustrates an isometric drawing of a basic flat vertical shield or a standard shield of the present invention;

[0017] FIG. 5 illustrates an isometric drawing of a carrier vertical shield of the present invention;

[0018] FIG. 6 illustrates an isometric drawing of a first mechanical vertical shield of the present invention;

[0019] FIG. 7 illustrates an isometric drawing of a second mechanical vertical shield of the present invention;

[0020] FIG. 8 illustrates the front, side and top views of a basic flat vertical shield or a standard shield of the present invention;

[0021] FIG. 9 illustrates the front and top views of a carrier vertical shield of the present invention;

- [0022] FIG. 10 illustrates the front and top views of a first mechanical vertical shield of the present invention;
- [0023] FIG. 11 illustrates the front and top views of a second mechanical vertical shield of the present invention;
- [0024] FIG. 12 illustrates a cross-sectional top view of a vertical shield of the present invention;
- [0025] FIG. 13 illustrates a cross-sectional top view of a gasket that is disposed between two vertical shields of the present invention;
- [0026] FIG. 14 illustrate a cross-sectional top view of a first vertical T shield of the present invention;
- [0027] FIG. 15 illustrate a cross-sectional top view of a second vertical T shield of the present invention;
- [0028] FIG. 16 illustrate a cross-sectional top view of an inside corner vertical shield of the present invention;
- [0029] FIG. 17 illustrate a cross-sectional top view of an outside corner vertical shield of the present invention;
- [0030] FIG. 18 illustrates an anchor plate of the present invention;
- [0031] FIG. 19 illustrates a cross-sectional side view of the placement of a base shield relative to a vertical shield;
- [0032] FIG. 20 illustrates a coping of the present invention;
- [0033] FIG. 21 illustrates a cross-sectional side view of the placement of a cap shield relative to a vertical shield;
- [0034] FIG. 22 illustrates an isometric view of a damper housing of the present invention;
- [0035] FIG. 23 illustrates a front view and a side view of the damper housing of the present invention;
- [0036] FIG. 24 illustrates a front view of a damper shield of the present invention;
- [0037] FIG. 25 illustrates a cross-sectional top and side view of the damper shield of the present invention;
- [0038] FIG. 26 illustrates a back view of the damper shield of the present invention;
- [0039] FIG. 27 illustrates an isometric drawing of a door set of vertical door shields of the present invention;
- [0040] FIG. 28 illustrates a front view and a top view for each of the vertical door shields of the present invention;
- [0041] FIG. 29 illustrates an isometric cross section of the door of the present invention;
- [0042] FIG. 30 illustrates a top end channel along the periphery of the door of the present invention;
- [0043] FIG. 31 illustrates a bottom end channel along the periphery of the door of the present invention;
- [0044] FIG. 32 illustrates a side end channel along the periphery of the door of the present invention;
- [0045] FIG. 33 illustrates a cross-sectional view from the hinge side of the door engaging the door frame;
- [0046] FIG. 34 illustrates a cross-sectional view from the lockset side of the door engaging the door frame;
- [0047] FIG. 35 illustrates a cross-sectional view from the bottom side of the door engaging the door frame;
- [0048] FIG. 36 illustrates a cross-sectional view of interlocking strips on the lockset side of the door;
- [0049] FIG. 37 illustrates a cross-sectional view of interlocking strips on the door head side of the door;
- [0050] FIG. 38 illustrates a cross-sectional view of the bottom of the door frame;
- [0051] FIG. 39 illustrates a cross-sectional view of the top and sides of the door frame;
- [0052] FIG. 40 illustrates the gasket of the present invention;
- [0053] FIG. 41 illustrates a table for the formulation of the gasket;
- [0054] FIG. 42 illustrates an alternate shield structure;
- [0055] FIG. 43 illustrates an alternate T-assembly of the present invention;
- [0056] FIG. 44 illustrates an alternate structure for a cap shield of the present invention;
- [0057] FIG. 45 illustrates an alternate base shield of the present invention;
- [0058] FIG. 46 illustrates an alternate anchor plate of the present invention;
- [0059] FIG. 47 illustrates an alignment of the front angled portion and a back angled portion of an anchor assembly of the present invention;
- [0060] FIG. 48 illustrates an anchor plate alignment tool of the present invention;
- [0061] FIG. 49 illustrates an interior front view of the back angled portion of the anchor plate assembly of the present invention;
- [0062] FIG. 50 illustrates the alternate anchor plate assembly as deployed next to the alternate base shield of the present invention;
- [0063] FIG. 51 illustrates an isometric view of a plurality of vertical shields that are deployed in conjunction with a post to form a corner of the present invention;
- [0064] FIG. 52 illustrates a latching system of the present invention; and
- [0065] FIG. 53 illustrates the carrier portal assembly of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0066] The present invention relates to a modular, shielded enclosure that is advantageously engineered to provide structural and environmental security for IT, data, and equipment, thereby protecting contents against human and/or environmental threats that may cause degradation, damage, failure, or loss. FIG. 1 shows an illustrative interior hallway of a facility 100 in which a modular protective enclosure 110 is deployed within the facility 100. The modular protective enclosure 110 is constructed from a plurality of modular shields that are described in detail below. One advantage of the present invention is the modularity, configurability and

portability of the overall protective system. Namely, the modular protective enclosure **110** can be deployed within the facility **100** without special accommodation. The modular protective enclosure **110** can be deployed in existing facilities that were previously constructed in a manner that did not address the need for a protective enclosure within the facility.

[0067] Although the present invention is described as a modular protective enclosure that is deployed within a facility, those skilled in the art will realized that the present invention can be adapted to encompass the interior of an entire facility. Namely, the various shields that are disclosed below can be deployed throughout the entire facility to form a protective facility if such requirement is needed or desired.

[0068] **FIG. 2** illustrates a typical configuration of the enclosure **110** disclosed in the present invention. This figure is simply used to illustrate the different types of shields that can be deployed to form a modular protective enclosure **110**. Since the shape, size and configuration of a protective enclosure will vary depending on the particular application, various combinations of these shields can be deployed. In other words, some of the shields may not be deployed at all if a particular application does not call for such a feature, e.g., a T shield for partitioning a room as disclosed below.

[0069] **FIG. 2** illustrates a modular protective enclosure **110** that is composed of three basic types of shields: a cap shield **210**, a vertical shield **220** and a base shield **230**. In operation, a plurality of cap shields **210** are mated together to form the ceiling of the modular protective enclosure **110**, while a plurality of base shields **230** are mated together to form the floor of the modular protective enclosure **110**. Finally, a plurality of vertical shields **220** are mated to form the walls (exterior and interior) of the modular protective enclosure **110**. In fact, the vertical shield **220** can be deployed in a number of different configurations, e.g., a basic flat vertical shield, an inside corner vertical shield to address corner **240**, an outside corner vertical shield to address corner **250**, a T shield, a mechanical shield, a damper shield, a carrier shield, a door frame shield, and a door shield. Each of these shields is described further below.

[0070] **FIG. 3** illustrates a cross sectional top view of a modular protective enclosure **110**. Specifically, **FIG. 3** illustrates a plurality of flat vertical shields **340**, a plurality of outside corner vertical shields **310**, an inside corner shield **320**, and a pair of T shields **330**. Additional vertical shields (not shown) can be coupled to the pair of T shields to serve as a partition to define rooms within the enclosure **110**. **FIG. 3** illustrates the modularity and flexibility of the present invention, where different types of vertical shields can be configured to form the interior and exterior walls for any desired shape and size as required for a particular deployment. It should be noted that specialized vertical shields for providing access to the protective enclosure **110** is not shown in **FIG. 3** for simplicity.

[0071] **FIGS. 4-7** illustrate isometric drawings of a plurality of vertical shields, e.g., a standard flat vertical shield **400**, a carrier vertical shield **500**, a first mechanical vertical shield **600** and a second mechanical vertical shield **700**. Although these vertical shields are designed to perform different functions, they still share many common features, e.g., basis shield construction and installation that are further described below.

[0072] Standard shield **400** is a basic flat vertical shield with no openings. This standard shield **400** is designed to serve as the walls of the modular enclosure **110** and will likely be deployed in greater number than any other vertical shields that are described herein. Standard vertical and cap shield **400** has a plurality of latches **410** (female latches) and **420** (male latches) that are deployed on at least three sides of the vertical shields. Specifically, three male latches **420** are deployed on one side of the standard shield **400**, whereas three female latches **410** are deployed on the other side of the standard shield **400**. A single latch is illustrated on the top side of the vertical shield, where the latch will engage a complementary latch on a cap shield that will form a part of the ceiling. Thus, as vertical shields are aligned vertically next to each other or with a cap shield, these male-female latches are engaged to lock the shields together to form a strong and air-tight seal. The number of male-female latches that are deployed on each side of the shield is a function of the length and width of the shield. A detailed illustration of the latching system is shown in **FIG. 52**.

[0073] **FIG. 5** illustrates a vertical carrier shield **500** of the present invention. The vertical carrier shield **500** is designed to provide a feed-through access to the modular enclosure **110**, e.g., allowing cables to be passed through a vertical shield. Specifically, the vertical carrier shield **500** is similar in construction to that of the standard vertical shield **400** with the exception that it has a carrier portal **510**.

[0074] In one embodiment, the carrier portal is a circular hole assembly as shown in **FIG. 53** that is designed to operate with a plurality of cable blocks or portal blocks **5310** that are deployed around cables that are passed through the carrier portal. In one embodiment, each cable is disposed or sandwiched within two halves of a cable block. In turn, these cable blocks are stacked **5320** within the carrier portal. The cable blocks are manufactured using an insulating material that is designed to expand upon exposure to heat (e.g., the same material that is used to form the gaskets between the shields as discussed below). As such, during a fire condition, the cable blocks will expand and form a tight seal within the carrier portal of the vertical carrier shield. The carrier portal assembly **5300** (carrier plate **5302**, portal filler gasket **5303**, carrier pan **5304**) and the cable blocks **5310** are illustrated in **FIG. 53**.

[0075] **FIGS. 6 and 7** collectively illustrate a pair of vertical mechanical shields **600** and **700** of the present invention. The vertical mechanical carrier shields **600** and **700** are designed to be deployed side by side. These shields are designed to allow ducting, e.g., HVAC ducts, to be attached to the modular enclosure **110**. However, due to the high degree of protection that is required by the modular enclosure in some applications, there are situations where it may be necessary to close the ducts to the modular enclosure during a hazardous condition.

[0076] To address this criticality, the first vertical mechanical shield (or sister shield) contains a duct access aperture **610**. In operation, a duct (not shown) is attached to this duct access aperture **610**. In turn, a damper housing (as shown in **FIG. 22** below) is attached behind the pair of mechanical shields. The mechanical damper is installed over two shields; a mechanical shield and a mechanical sister shield.

[0077] The damper housing carries a movable "damper shield" that is stored behind aperture **710** of the second

vertical mechanical shield **700**, where the two apertures **610** and **710** are laterally aligned. During a hazardous condition, an actuating system will cause the damper shield to slide from behind the second vertical mechanical shield **700** and onto the first vertical mechanical shield **600**, thereby closing the ducting. Again, the vertical mechanical shields **600** and **700** are similar in construction to that of the standard vertical shield **400** with the exception of the duct access aperture **610** and the damper shield assembly.

[0078] FIGS. 8-11 illustrate the front and top views of a basic flat vertical shield, a carrier vertical shield, a first mechanical vertical shield, and a second mechanical vertical shield, respectively, of the present invention. A side view is also provided for the standard vertical shield **400**.

[0079] In one embodiment, the vertical shields are approximately 10'2" in height and 2' in width. The first lowest latch is located approximately 2' from the bottom of the vertical shield with each subsequent latch being disposed approximately 2'7" from a lower latch.

[0080] The carrier portal **510** is disposed approximately 7" from the bottom of the vertical carrier shield. The diameter of the carrier portal **510** is approximately 1'1" in diameter.

[0081] The height of the duct access aperture **610** is approximately 2'7", whereas the width of the duct access aperture **610** is approximately 1'8". The aperture **710** is similar in size to that of duct access aperture **610**.

[0082] It should be noted that the dimensions that are disclosed above for the vertical shields are only illustrative. In fact, the size, quantity and/or placement of various structures can be changed as the need arises. For example, it should be noted that although the above vertical shields are disclosed with three latches on two sides and one latch on a top side, those skilled in the art will realize that any number of latches can be deployed and it is generally a function of the length of a particular side of the shield. As such, although dimensions of numerous structures are disclosed throughout this disclosure, those skilled in the art will realize that the present invention is not so limited. Namely, the specific dimensions of these shields and their components and/or subassemblies can be tailored to meet the requirements of a particular deployment.

[0083] FIG. 12 illustrates a cross-sectional top view of a vertical shield **1200** of the present invention. It should also be noted that FIG. 12 also illustrates the general composition of all the shields of the present invention, unless specifically noted below.

[0084] Each shield has a housing that resembles a box with a lid. In one embodiment, the thickness of the shield is approximately 4". More specifically, the shield housing comprises an inner pan **1205** and an outer skin **1210**. Both the inner pan and the outer skin are constructed from steel, e.g., 14 gauge sheet steel. The interior of each shield has a three-layer core that comprises a milled fiber layer **1220**, a gypsum board layer **1230** and a poly-isocyanurate with heat refracting layer **1240**. In one embodiment, the three-layer core comprises a 21 lb. density milled fiber layer **1220** having an approximate thickness of 2 $\frac{5}{8}$ ", a gypsum board layer **1230** having an approximate thickness of $\frac{3}{8}$ " and a poly-isocyanurate with heat refracting layer **1240** having an approximate thickness of 1".

[0085] Additionally, an insulating material **1250** is disposed between the juncture of the inner pan **1205** and the outer skin **1210**. In one embodiment, the insulating material is a ceramic fiber paper **1250** having an approximate thickness of $\frac{1}{8}$ " that is compressible, e.g., being compressed down to $\frac{1}{16}$ ", upon being compressed between the inner pan **1205** and the outer skin **1210**. A unique function performed by the ceramic fiber paper is its ability to minimize thermal conduction. As the outer skin of a shield is being heated, e.g., from a fire, the thermal energy can be transferred from the outer skin to the inner pan due to the ease of thermal conduction in metals. Without the ceramic fiber paper **1250**, the interior pan may rapidly heat up and degrade the performance of the modular enclosure.

[0086] FIG. 12 also illustrates a novel gasket **1260** that is deployed in conjunction with the various shields of the present invention. In FIG. 12, a single gasket **1260** is shown being positioned to one side of the vertical shield **1200**. However, it should be noted that a gasket **1260** is typically deployed between all adjoining shields. However, depending on the types of shields being joined, the physical size and shape of gasket **1260** may differ.

[0087] Specifically, as heat is applied to the exterior of the modular enclosure **110**, it has been observed that the joints between adjoining shields may potentially be the weaker points of the overall modular enclosure. The gasket is designed to resist heat and to expand in the presence of heat, thereby preventing the breach of the protected environment of the modular enclosure **110** by potentially noxious gases. A detailed disclosure of the gasket is provided below.

[0088] FIG. 13 illustrates a cross-sectional top view of a gasket **1360** that is disposed between two vertical shields **1300** of the present invention. The height and depth of gasket **1360** is simply tailored to match the dimensions of the adjoining shields. The width of the gasket is approximately 0.3" in an uncompressed state. However, once the gasket is deployed between two shields, the flexible gasket compressed down to a width of approximately 0.2".

[0089] FIGS. 14 and 15 illustrate vertical T shields **1400** and **1500** of the present inventions. Vertical T shields **1400** and **1500** are similar with the exception that they are complementary in their configuration relative to each other, e.g., T shield **1400** can be perceived as a left (L) T shield, while T shield **1500** can be perceived as a right (R) T shield.

[0090] Specifically, vertical T shields **1400** and **1500** are similar to the standard vertical shields **1200** in construction. However, unlike the standard vertical shield, each vertical T shield comprises an exterior portion **1410** (or **1510**) that has one side being exposed to the exterior of the modular enclosure **110** and an interior portion **1420** (or **1520**) that is disposed within the modular enclosure **110** in its entirety. As illustrated in FIG. 3 above, the pair of T shields **1400** and **1500** are deployed so that interior rooms can be defined by connecting additional vertical shields to the interior portions **1420** and **1520** in similar manner as described above.

[0091] FIGS. 16 and 17 illustrate a cross-sectional top view of an inside corner vertical shield **1600** and an outside corner vertical shield **1700**, respectively, of the present invention. Inside corner vertical shield **1600** and the outside corner vertical shield **1700** are similar with the exception that they are opposite in their configuration relative to each

other. For example, inside corner vertical shield **1600** provides a concave corner **1605** from a perspective outside of the modular enclosure **110**, whereas outside corner vertical shield **1700** provides a convex corner **1705** from a perspective outside of the modular enclosure **110**.

[0092] Again, the inside corner vertical shield **1600** and the outside corner vertical shield **1700** are similar to the standard vertical shields **1200** in construction. However, unlike the standard vertical shield, each inside or outside corner vertical shield comprises two portions **1610** and **1620** or **1710** and **1720** that are connected at a right angle in one embodiment of the present invention. However, although the present corner vertical shields are disclosed as having two portions that are joined at right angles, those skilled in the art will realize that these two portions can be joined at other angles as required by a particular deployment.

[0093] FIG. 18 illustrates an anchor plate **1800** of the present invention. More specifically, FIG. 18 illustrates a top and side view of a corner anchor plate **1800**. In one embodiment, each side of the corner anchor plate **1800** is approximately 2" long. Anchor plates are deployed throughout the perimeter of the modular enclosure to serve as anchoring platform to receive various vertical shields. In the construction of a modular enclosure **110**, anchor plates are initially mounted to the floor of a facility before the vertical shields can be deployed. A plurality of anchor plates are coupled together using tongue **1805** and groove **1810** slots that are disposed on opposite ends of each anchor plate. Thus, if a rectangular modular enclosure is desired, four corner anchor plates **1800** are deployed with any number of straight anchor plates (not shown) to form a perimeter of anchor plates.

[0094] The anchor plate **1800** is constructed from $\frac{1}{8}$ " steel plate. Each anchor plate has a trough **1830** that is defined by an exterior lip **1820**, a bottom member **1822** and an interior lip **1824**. In one embodiment, exterior lip **1820**, bottom member **1822** and interior lip **1824** are approximately 4", 4" and $\frac{3}{8}$ " in length, respectively.

[0095] FIG. 19 illustrates a cross-sectional side view of the placement of a base shield **1920** relative to a vertical shield **1900**. More specifically, FIG. 19 illustrates the joining of the vertical shield to the anchor plate and the base shield **1920**. In one embodiment, gaskets **1905** are deployed above and below the anchor plate **1910**. The use of gaskets **1905** in this novel configuration provides superior insulating properties because both junctures; vertical shield to anchor plate and anchor plate to the floor are insulated with gaskets **1905**. Once the gaskets **1905** and anchor plate **1910** are secured to the floor of the facility, the vertical shield **1900** is mounted to the anchor plate **1910** with the exterior lip **1820** of the anchor plate being exterior to the modular enclosure.

[0096] In turn, the base shield **1920** is installed on the floor of the building and it abuts the vertical shield **1900**. A plurality of base shields are deployed to form the floor of the modular enclosure **110**. In one embodiment, the base shield **1920** comprises a silicon membrane exterior **1926** that is filled with calcium silicate **1924** and is topped with a 14 gauge steel plate **1922**.

[0097] FIG. 20 illustrates a coping **2000** of the present invention. More specifically, FIG. 20 illustrates a top and side view of a corner coping **2000**. In one embodiment, each

side of the corner coping **2000** is approximately 2' long. Copings are deployed throughout the upper perimeter of the modular enclosure to serve as a covering to cover junctures between the vertical shields and the cap shields. In the construction of a modular enclosure **110**, copings are mounted to the ceiling of a facility after the vertical shields are joined with the cap shields. Thus, if a rectangular modular enclosure is desired, four corner copings **2000** are deployed with any number of straight copings (not shown) to form a upper perimeter of copings.

[0098] The coping **2000** is constructed from 18 gauge steel plate. Each coping has an exterior lip **2010**, and a top member **2020**. In one embodiment, exterior lip **2010** is approximately 6" in length, whereas the top member **2020** is approximately 2" in length.

[0099] FIG. 21 illustrates a cross-sectional side view of the placement of a cap shield **2120** relative to a vertical shield **2100**. More specifically, FIG. 21 illustrates the joining of the vertical shield to the coping and the cap shield **2120**. In one embodiment, gasket **2105** is deployed between the vertical shield **2100** and cap shield **2120**. Once the vertical shield **2100** is mounted to the anchor plate, the gasket **2105** and cap shield **2120** are joined with the vertical shield **2100** via male **2102** and female **2122** latches. Finally, coping **2110** is mounted to cover the juncture between the cap shield **2120** and the vertical shield **2100**.

[0100] In turn, a plurality of cap shields are deployed to form the ceiling of the modular enclosure **110**. In one embodiment, the composition of a cap shield **2120** is identical to that of a standard vertical shield.

[0101] FIG. 22 illustrates an isometric view of a damper housing **2200** of the present invention. The damper housing **2200** is mounted behind the two mechanical shields **600** and **700** of FIGS. 6 and 7. The damper housing **2200** carries a damper shield (as shown in FIGS. 24-26) that is designed to slide over and close the duct access aperture **610** during a hazardous condition. More specifically, the damper housing **2200** has an access aperture **2210** that is aligned with the access aperture **610** of vertical mechanical shield **600**.

[0102] In one embodiment, the damper housing **2200** is approximately 46" in width, 39" in height, and 8" in depth. The damper housing is constructed from 11 gauge steel.

[0103] FIG. 23 illustrates a front view and a side view of the damper housing **2200** of the present invention. The damper housing **2200** contains an upper guide **2320** and a lower guide **2310** that assist the damper shield to slide laterally to an "open" or "closed" position. Both guides contain a lip **2322** and **2312**, respectively, to keep the damper shield properly aligned as it traverses between the "open" and "closed" positions.

[0104] FIG. 24 illustrates a front view of a damper shield **2400** of the present invention. In operation, damper shield **2400** is stored within the damper housing **2200**. If a hazardous condition is detected, the damper shield **2400** is deployed such that it slides across and seals off the access aperture **610** of the vertical mechanical sister shield **600** of FIG. 6.

[0105] In one embodiment, the damper shield **2400** is approximately 2'8" in height, 1'10" in width and 4" in depth.

The damper shield **2400** further comprises a pair of rollers or ball transfers **2410**, e.g., from McMaster-Carr with part # (2415T36).

[0106] FIG. 25 illustrates a cross-sectional top and side views of the damper shield **2400** of the present invention. The damper shield construction is similar to that of the standard vertical shield **1200**. Namely, the damper shield **2400** shares the same core as that of the standard vertical shield **1200**. However, since the damper shield **2400** is a movable shield, there are no male and female latches deployed on the damper shield **2400**. Additionally, the damper shield **2400** employs an additional layer of ceramic fiber paper **2510** on the interior periphery of the damper shield **2400**. This additional layer of ceramic fiber paper **2510** reduces thermal conduction and also assists in providing an air tight seal when the damper shield **2400** is deployed to the closed position.

[0107] FIG. 26 illustrates a back view and a side view of the damper shield **2400** with additional subassemblies. Specifically, FIG. 26 shows a telescopic cylinder **2610**, e.g., from Bimba with a part number of SK0920-DP, that is coupled to a solenoid (not shown) and to the back of the damper shield **2400**. When the solenoid is activated in response to a control signal, the telescopic cylinder **2610** extends and causes the damper shield **2400** to slide along the guides **2320** and **2310**. When the damper shield **2400** comes to a stop at the closed position, a pair of cylinders **2620** are activated to cause pins to bias against the back of the damper shield, thereby ensuring an air-tight seal.

[0108] FIG. 27 illustrates an isometric drawing of a door set **2700** of vertical door shields **2710**, **2720**, and **2730** of the present invention. Specifically, the door set comprises a pair of complementary or sister vertical door shields **2710** and **2730** and a door shield **2720**. As shown in FIG. 27, the door shield **2720** is disposed between the two sister vertical door shields **2710** and **2730**. Each of the three vertical door shields is similar in construction to that of the standard vertical shield **1200**. Namely, each door shield shares the same core as that of the standard vertical shield **1200**. However, as shown in FIG. 27, each of the door shield employs a greater number of latch assemblies or "cam lock" assemblies than the standard shields. In one embodiment, each of the sister door shields employs three latch assemblies (male or female) on one side and five latch assemblies (male or female) of the opposite side, whereas the door shield **2720** employs five latch assemblies (male or female) on both sides. The increase in the number of latch assemblies is in response to the need to reinforce the door assembly due to the stress generated by repetitive opening and closing of the door.

[0109] FIG. 28 illustrates a front view and a top view for each of the vertical door shields **2710**, **2720**, and **2730** of the present invention. Additionally, a side view is provided for vertical sister door shield **2730**. In one embodiment, each of vertical sister door shields **2710** and **2730** is approximately 10'2" in height, 2' in width and 4" in depth. The door shield **2720** is approximately 10'2" in height, 3'12" in width and 4" in depth.

[0110] The door shield **2720** comprises two distinct portions: a door frame **2722** and a door **2724**. Structures surrounding the door **2724** are specifically designed to

ensure an air-tight seal and to provide superior performance under hazardous conditions such as a fire. These structures are disclosed below.

[0111] FIG. 29 illustrates an isometric cross section of the door **2724** of the present invention. Specifically, FIG. 29 again illustrates a cut-away view of the door having a core that is similar to that of the standard vertical shield. In one embodiment, the door **2724** has a different thickness or depth than a standard door shield. As such, the thickness of the core, i.e., the thickness of its components are also different as well, e.g., using 1 $\frac{5}{8}$ " of 22 lb. density cryogenics milled fiber, $\frac{3}{8}$ " of gypsum board and 1" of poly-isocyanurate with foil back.

[0112] Additionally, unlike the vertical standard shield, the door **2724** comprises additional structures that are deployed to strengthen the structural integrity of the door. For example, the door also employs a 12 gauge closer reinforcement **2910** within the door.

[0113] Finally, the door **2724** incorporates edge or end channels **2920** (e.g., top, side or bottom channels) along the periphery of the door. These channels are designed to mate with complementary edge channels located on the door frame **2722** to form a tortuous path. Namely, when the door **2724** is closed, the coupled channels create a "step-like" air-tight path that is very difficult to breach by noxious gas.

[0114] FIGS. 30-32 illustrate the top, bottom and side views of end channels **2920** surrounding the periphery of the door **2724** of the present invention. Specifically, the end channel resembles an indentation (e.g., approximately $\frac{5}{8}$ ") that runs along the entire periphery of the door **2724**. The function of these end channels **2920** is best understood when described in conjunction with the door frame below.

[0115] FIGS. 30-32 also illustrate the use of ceramic fiber paper **3010** disposed between the outer **3020** and inner **3030** skin or pan of the door **2724**. Again, the ceramic fiber paper **3010** serves to minimize thermal conduction such that heat applied to the outer skin of the door would not be transferred to the inner skin of the door.

[0116] FIGS. 33-39 illustrate various cross-sectional views of the door **2724** engaging the door frame **2722**. These various views illustrate various coupling structures that are deployed along the periphery of the door to ensure an air-tight seal when the door is closed. The reader is encouraged to refer to these FIGs. when reading the present description.

[0117] First, the top and sides of the door frame **2722** provide a plurality of steps **3910** for forming a tortuous path when coupled with the door **2724**. This can be seen in FIGS. 34 and 39. Namely, gases that are exterior to the modular enclosure must overcome at least two right angle turns before they are able to penetrate into the interior of the modular enclosure. Additionally, to further enhance this tortuous path, gaskets **3410** are deployed along one side of the steps **3910** (See FIG. 34). Finally, again the inner and outer skins or pans of the door frame is separated by a layer of ceramic fiber paper **3920** to minimize thermal conduction.

[0118] Second, interlocking weatherstrips are provided at the door lockedge and at the door head. This can be seen on FIGS. 36 and 37. The interlocking weatherstrips are made with the same material formulation as the gaskets.

[0119] Third, a bottom portion of the door frame 2722 is provided with a tongue and groove assembly. Specifically, a tongue 3510 is mounted onto the door, whereas a groove 3520 is mounted on the bottom portion of the door frame 2722. Additionally, a thin gasket 3530 is disposed in a trough located on the tongue 3510, such that when the door is closed, the tongue 3510 engages against the groove 3520 by compressing on the thin gasket 3530. This structure again ensures an air-tight seal when the door is closed.

[0120] FIG. 40 illustrates a front view, a top view and a side view of the gasket 4000 of the present invention. In one embodiment, the gasket has a thickness of approximately 0.3", and a width of approximately 3.8". The length of the gasket is tailored to a particular length as required.

[0121] In one embodiment, the gasket 4000 is formed into a long sheet having a rectangular structure as shown in side view 4015. Alternatively, the gasket 4000 can be formed such that there is a slight indentation or depression 4022 on two sides of the gasket as shown in side view 4020. These indentations assist the insulating function performed by the gasket when it is compressed between two adjoining shields. Alternatively, the gasket 4000 can be formed such that there are two or more slight indentations or depressions 4032 on each side of the gasket as shown in side view 4030. It should be noted that these indentations are exaggerated in FIG. 40 for reader appreciation.

[0122] In one embodiment, the formulation of the gasket material is shown in FIG. 41 as a table. FIG. 41 illustrates a gasket formulation that comprises 6 components: silicon compound, hydrated alumina filler, flame retardant ingredient, Di Benzoyl Peroxide, Minusil filler and Cross linking Peroxide. When applicable, FIG. 41 also provides specific manufacturers that carry these materials under their trade names. However, those skilled in the art will realize that equivalent materials from other manufacturers can be substituted. Furthermore, although FIG. 41 provides a specific formulation in terms of approximate proportions, those skilled in the art will realize that slight modification from the disclosed formulation will produce a gasket having similar properties.

[0123] The mixing procedure for the gasket material 4000 is as follows:

[0124] 1) Put SE6035 on mill with a ½ inch gap. Allow to break down and warm up for 2 minutes.

[0125] 2) Slowly add FR-2, AC-720, Cabot MS-7, HCC3144 black, Perkadox S-50S-PS and Benzyl peroxide.

[0126] 3) Sweep pan and return the ingredients back into the batch.

[0127] 4) Once all the ingredients are absorbed by the silicone begin mixing.

[0128] 5) Roll the material up and mix end until all the ingredients are blended homogeneously throughout the batch.

[0129] 6) Verify the batch is mixed properly by the use of an oscillating disc rheometer or equivalent.

[0130] 7) Package material in a manner as not to allow contamination of the material from outside sources.

[0131] It should be noted the above mixing procedure is provided only as an example. Other mixing procedures can be deployed using the formulation disclosed on FIG. 41 to form the gasket of the present invention.

[0132] FIG. 42 illustrates an alternate structure for shields of the present invention. Specifically, FIG. 42 illustrates an outer skin of a shield having a protruding flange 4210, e.g., approximately 0.2". Additionally, the ceramic fiber paper 4220 is extended such that a portion extends and covers the gasket 4230. This extension is similarly applied to the outer skin 4205 such that it, in turn, covers the extended portion of the ceramic fiber paper 4220. A similar extension can be provided on the adjoining shield, where only the ceramic fiber paper 4225 is also extended. This alternate configuration may provide additional insulating properties, because the gasket 4230 is further shielded from a direct hazardous condition, e.g., heat and fire.

[0133] Additionally, FIG. 42 also shows an indentation 4215 in the outer skin, where the gasket edge is recessed from the outer surface of the shield. This structure again minimizes the direct exposure of the gasket to hazardous conditions.

[0134] Furthermore, FIG. 42 also illustrates the use of additional reinforcement or edge stiffeners 4240 on the side of the shields. These stiffeners can be deployed to ensure that when the male/female latches are engaged, uniform pressure is applied along the entire length of the shields. Namely, if the shield is very long and the male/female latches are deployed in wide intervals, then it may be necessary to stiffen the sides of shields to ensure that the air-tight seal is maintained.

[0135] FIG. 43 illustrates an alternate T-assembly or T-shield 4300 of the present invention. More specifically, FIG. 43 illustrates an alternate embodiment in forming a T-shield as disclosed above. In this embodiment, the T-shield 4300 is formed using three standard vertical shields 4310 and a post 4320. One advantage of this embodiment is its ease of installation, since the four pieces can be handled individually, without having to install a fully assembled T-shield which can be unwieldy. The post 4320 is comprised of a pan and skin as disclosed above with the exception that the core is not a three-layer core. Instead, the core of the post 4320 is comprised of milled fiber only. Since the shields are 4" thick in one embodiment, the post 4320 is also 4" by 4" of any desired height.

[0136] Additionally, unlike other shields, the post 4320 deploys only female latches such that it can be mated with male latches from three standard vertical shields 4310. Finally, gaskets 4330 are deployed at the junctures where the three standard shields are mated to the post 4320.

[0137] FIG. 44 illustrates an alternate structure for a cap shield of the present invention. Specifically, FIG. 44 illustrates an outer skin of a cap shield 4400 having a protruding flange 4410. The purpose of this protruding flange 4410 serves the same function as discussed in FIG. 42. Namely, the protruding flange 4410 will further protect the gasket 4420 that is disposed between the cap shield 4400 and the vertical shield 4405.

[0138] FIG. 45 illustrates an alternate base shield 4500 of the present invention. Specifically, the base shield 4500 is not deployed in a pan and skin configuration. Instead, the

base shield **4500** now comprises a top surface **4510** that is supported by a plurality of steel reinforcement bars **4520**, where poly-isocyanurate **4530** is deposited below the top surface **4510**. The top surface and reinforcement bars are formed from 14 gauge steel in one embodiment. In practice, a sealant is typically sprayed onto the floor of the facility before the base shield is deployed. One advantage of this alternate base shield is that it is lighter than the above disclosed base shield and thus, simplifies the installation process.

[0139] FIG. 46 illustrates an alternate anchor plate **4600** of the present invention. Specifically, anchor plate **4600** is now deployed as an assembly having two separate portions: a front angled portion **4610** and a back angled portion **4620**. In contrast to the above described anchor plate, the present alternate anchor plate **4600** has an air gap **4640** separating the two angled portions, thereby minimizing thermal conduction at the anchor plate. Similar to the above embodiment, gaskets **4630** are deployed above and below the anchor plate assembly, with anchor screws **4650**, being deployed to hold the anchor assembly in place.

[0140] FIG. 47 illustrates an alignment of the front angled portion **4610** and a back angled portion **4620** of the present invention. Specifically, front angled portion **4610** carries at least one anchor screw hole **4612** and at least two alignment holes **4614**. Similarly, back angled portion **4620** carries at least one anchor screw hole **4622** and at least two alignment holes **4624**. In practice, it is desirable to align the anchor screw hole **4612** of the front angled portion with the anchor screw hole **4622** of the back angled portion as shown in FIG. 47 during installation. To assist in the alignment, an alignment tool is illustrated in FIG. 48.

[0141] FIG. 48 illustrates an anchor plate alignment tool **4800** of the present invention. The alignment tool **4800** comprises a handle **4810**, a flat plate **4820** and four studs **4830**. In practice, an installer will roughly align the two angled portions side by side. The installer will then insert the align tool **4800** such that the four studs **4830** will engage the alignment holes **4614** and **4624** of FIG. 47. When the alignment tool is engaged, the installer will now be sure that the anchor screw holes **4612** and **4622** are now properly aligned. The reason is that the alignment holes and anchor screw holes are drilled into the angled portions in predefined distances. This novel approach allows for rapid alignment of the anchor plate assembly during installation.

[0142] FIG. 49 illustrates an interior front view of the back angled portion **4620** of the anchor plate assembly **4600** of the present invention. Specifically, the back angled portion **4620** comprises a plurality of notches or openings **4910** that are generally equally spaced in accordance with the width of the deployed vertical shields. These notches **4910** are provided as access openings for shield installation tools. Specifically, the vertical shield can be quite heavy, thereby making it unwieldy during installation or removal of the vertical shields. By providing these access openings, the vertical shields can be lifted and shifted along the anchor plate, as required.

[0143] FIG. 50 illustrates the alternate anchor plate assembly **4600** as deployed next to the alternate base shield **4500** of the present invention. FIG. 50 better illustrates the air gap or fire break **4640** that is provided by the alternate anchor plate assembly **4600**.

[0144] FIG. 51 illustrates an isometric view of a plurality of vertical shields **5100** that are deployed in conjunction with a post **5200** to form a corner of the present invention. Specifically, this FIG. 51 is provided to illustrate the differences between the configuration of a protective enclosure that is formed using a post versus the T-shields and corner shields as disclosed in FIGS. 14-17 above.

[0145] While the foregoing is directed to the preferred embodiment of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

What is claimed is:

1. A modular shield, for constructing a modular enclosure, said modular shield comprises:

a shield housing; and

a three layer core, disposed within said shield housing, having a milled fiber layer, a gypsum board layer and a poly-isocyanurate layer.

2. The modular shield of claim 1, wherein said shield housing comprises an interior pan and an exterior skin.

3. The modular shield of claim 2, wherein said milled fiber layer is proximate to said exterior skin of said shield housing.

4. The modular shield of claim 3, further comprising:

a ceramic fiber paper disposed between said milled fiber layer and at least a portion of said exterior skin of said shield housing.

5. The modular shield of claim 2, wherein said poly-isocyanurate layer is proximate to said interior pan of said shield housing.

6. The modular shield of claim 2, further comprising:

a ceramic fiber paper disposed at a juncture between said inner pan and said exterior skin of said shield housing.

7. The modular shield of claim 2, wherein said exterior skin has a protruding flange.

8. The modular shield of claim 7, wherein said protruding flange is deployed within an indentation of said exterior skin.

9. A modular shield, for constructing a modular enclosure, said modular shield comprises:

a shield housing means; and

a multi-layer core means, disposed within said housing means, having a milled fiber layer means, a gypsum board layer means and a poly-isocyanurate layer means.

10. The modular shield of claim 9, wherein said shield housing means comprises an interior pan and an exterior skin.

11. The modular shield of claim 10, wherein said milled fiber layer means is proximate to said exterior skin of said shield housing means.

12. The modular shield of claim 11, further comprising:

a ceramic fiber paper disposed between said milled fiber layer means and at least a portion of said exterior skin of said shield housing means.

13. The modular shield of claim 10, wherein said poly-isocyanurate layer means is proximate to said interior pan of said shield housing means.

- 14.** The modular shield of claim 10, further comprising:
a ceramic fiber paper disposed at a juncture between said inner pan and said exterior skin of said shield housing means.
- 15.** The modular shield of claim 10, wherein said exterior skin has a protruding flange.
- 16.** The modular shield of claim 15, wherein said protruding flange is deployed within an indentation of said exterior skin.
- 17.** A method for constructing a modular shield, said method comprising the steps:
providing a shield housing; and
providing a three layer core, disposed within said shield housing, having a milled fiber layer, a gypsum board layer and a poly-isocyanurate layer.
- 18.** The method of claim 17, wherein said shield housing comprises an interior pan and an exterior skin.
- 19.** The method of claim 18, wherein said milled fiber layer is provided proximate to said exterior skin of said shield housing.
- 20.** The method of claim 19, further comprising the step of:
providing a ceramic fiber paper disposed between said milled fiber layer and at least a portion of said exterior skin of said shield housing.
- 21.** The method of claim 18, wherein said poly-isocyanurate layer is provided proximate to said interior pan of said shield housing.
- 22.** The method of claim 18, further comprising the step of:
providing a ceramic fiber paper disposed at a juncture between said inner pan and said exterior skin of said shield housing.
- 23.** The method of claim 18, wherein said exterior skin has a protruding flange.
- 24.** The method of claim 23, wherein said protruding flange is deployed within an indentation of said exterior skin.

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