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DESCRIPTION

BACKGROUND OF THE INVENTION

[0001] The present invention relates to radiation therapy facilities and methods for making and using the same. More particularly, but not exclusively, the present invention relates to a radiotherapy therapy vault module having a base frame for the radiotherapy equipment that is adjustably mounted within the module so as to allow the levelness of the base frame to be adjusted independently from the levelness (or lack thereof) of the surrounding vault module or vault floor.

[0002] Radiation emitting equipment has a number of well known applications. Radiation emitting equipment is used to inspect packages and cargo at borders and to perform non-destructive testing. In the medical field, radiation emitting equipment is used in the diagnosis and treatment of a number of diseases. Not surprisingly, the manufacturers of this equipment are continually making improvements. Radiation emitted by equipment of the type described as "therapeutic" or "for treatment" is often referred to as "high energy", and is typically greater than 1mv.

[0003] For example, radiation therapy (a.k.a. radiotherapy) has become widely used in the treatment of cancer and several other non-malignant conditions, and modern radiotherapy equipment has improved abilities to target and destroy specific tissues while sparing surrounding healthy tissue. As a result, the use of up-to-date radiotherapy equipment can yield improved patient outcomes as well as provide other benefits to the operators of the facility, such as increased ease of use, increased efficiency, and/or increased patient throughput.

[0004] Despite these benefits, it has not been practical for many existing radiotherapy facilities to modernize. Existing radiotherapy equipment, like many other types of radiation emitting equipment, is typically housed within a radiation shielding vault so as to protect the surrounding personnel from the harmful effects of the radiation. Because of the high radiation levels involved (i.e. typically greater than 1MV) existing vaults are often constructed underground and/or with concrete walls that are several feet thick. As a result, the process of removing existing equipment, installing a modern replacement unit, and performing any necessary remodeling and reconfiguration is typically a three to five month process, with some projects taking up to a year. The prospect of a radiotherapy facility being out of service for such an extended duration, with the resultant disruption of treatment to patients, loss of revenue to the facility, and potential loss of referrals, is simply unacceptable to many facility operators. As a result, it is estimated that there are thousands of medical linear accelerators in use today which are technically obsolete and in need of immediate replacement.

[0005] One solution to the challenge is the provide a radiotherapy facility that can be rapidly and cost effectively built and utilized for relatively short durations, such as for only a year.

Document US 2013 111 825 describes one such method of construction in which the facility is largely constructed in a factory and brought to the site in a number of modules, one of which is comes preinstalled with the radiotherapy equipment. While the system described was largely successful, there is room for improvement.

[0006] In one form, the present invention improves on the approach described in US 2013 111 825 by providing the ability to make fine adjustments to the orientation of the very sensitive radiotherapy equipment after some or all of the facility has been constructed. While described herein in the context of modular construction, it is to be understood that the invention is not so limited, and may be usefully employed in other vault constructions techniques to provide the ability to adjust the levelness of radiotherapy equipment independently from the surrounding vault floor.

BRIEF SUMMARY

[0007] The present invention provides systems and techniques for constructing and using integrated radiotherapy treatment facilities which include radiation producing equipment and radiation shielding vaults. While the actual nature of the invention covered herein can only be determined with reference to the claims appended hereto, certain aspects of the invention that are characteristic of the embodiments disclosed herein are described briefly as follows.

[0008] According to one aspect, the present invention provides a temporary, building code compliant radiotherapy facility for use during the time when an existing facility is being upgraded or modernized.

[0009] According to another aspect, the present invention provides a method of maintaining radiotherapy treatment continuity during an equipment transition.

[0010] According to another aspect, the present invention provides a building code compliant temporary radiotherapy facility which can be erected and put into use rapidly and cost effectively.

[0011] According to another aspect, the present invention provides a radiation vault module for supporting a radiotherapy device in which the levelness of the equipment's base frame can be adjusted independently from the levelness of the surrounding module.

[0012] According to another aspect, the present invention provides a radiation vault with an integrated base frame in which adjustments to the orientation of the base frame can be readily made after the equipment has been in use for a period of time.

[0013] The invention is defined in the claims, otherembodiments being merely exemplary.

BRIEF DESCRIPTION OF THE

SEVERAL VIEWS OF THE DRAWINGS

[0014] Although the characteristic features of this invention will be particularly pointed out in the claims, the invention itself, and the manner in which it may be made and used, may be better understood by referring to the following description taken in connection with the accompanying figures forming a part thereof.

FIG. 1 shows the floor plan of a completed radiotherapy facility according to one embodiment.

FIG. 2 is a side elevational view, in full section, of the FIG. 1 facility.

FIG. 3 is an end elevational view, in full section, of the FIG. 1 facility.

FIG. 4 is a top plan view layout of the foundation for the FIG. 1 facility.

FIG. 5 is a partial, end sectional view of the foundation as viewed along line 5-5 in FIG. 4.

FIG. 6 is a diagrammatic perspective view showing the installation of a support in a foundation beam.

FIG. 7 is a diagrammatic perspective view showing the installation of another support in a foundation beam.

FIG. 8 is a diagrammatic perspective view showing the installation of supports in a concrete slab as per existing installations of the system corresponding to US 6,973,758 (the Rad Pro).

FIG. 9 is an elevational view showing the radiation shielding door cassette installed in the facility of FIG. 1.

FIG. 10 is a partial, top view, as viewed along line 10-10 in FIG. 9.

FIG. 11 shows a perspective view in partial section of the base frame within the floor structure of the treatment room module with portions of the surrounding module and foundation removed for clarity.

FIG. 12 shows an enlarged view of the indicated portion of FIG. 11.

DETAILED DESCRIPTION

[0015] For the purposes of promoting an understanding of the principles of the invention,

reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is hereby intended. Alterations and further modifications in the illustrated devices, and such further applications of the principles of the invention as illustrated herein are contemplated as would normally occur to one skilled in the art to which the invention relates.

General Overview

[0016] In one form, the present invention involves the provision of a fully functioning temporary radiotherapy facility intended for short term use. The temporary facility may be provided at a designated site and used to treat patients during the time when an existing radiotherapy facility is being upgraded or modernized. Upon completion of the upgrade, the temporary facility may be removed from the site and redeployed to another site in need of a similar service.

[0017] Referring to FIGS. 1-3, temporary radiotherapy facility 10 includes a treatment room 20 including a radiotherapy device 25 and a control station 22 for the radiotherapy device 25. The interior of facility 10 includes waiting area 30, reception/scheduling area 31, gowning area 35, restroom 34, and storage areas 32, 38. The mechanical area 33 contains any necessary heating and chiller equipment and is accessed externally, as is an additional storage area 36. The facility further includes an electrical closet 27, staff sink 28 and a potable and waste water tanks 29.

[0018] Access to treatment room 20 is via a radiation shielded door 40 and corridor 37. Once inside the treatment room 20, the patient lies on the treatment table 24 and the radiotherapy is administered via radiotherapy device 25 in accordance with the treatment parameters input by the operator at the control station 22. Both the treatment table 24 and the radiotherapy device 25 are mounted to a base frame 26 provided in the floor of the treatment room 20. As is known in the art, the base frame 26 is sufficiently rigid so as to fix the orientation of the device 25 and table 24 relative to each other, though the table 24 and device 25 may themselves be moveable in the conventional fashion relative to the fixed base frame 26. For example, the table 24 is typically mounted to a mounting ring (420 in FIG. 11) in the base frame 26 that allows the table 24 to be rotated about a vertical axis whereas the device 25 is typically provided within a gantry that allows it to be rotated about a horizontal axis. Maintaining the orientation of the device 25 and table 24 is important because radiotherapy equipment is subject to precise targeting. This typically requires the intersection of 4 lasers and the accelerator beam to cross within a small diameter sphere, referred to as isocenter.

[0019] When fully constructed, the facility 10 complies with applicable building codes. Further, the facility 10 is "habitable" in the context of supporting patients and medical personnel during the time of use. As used herein, "code compliant" and "building codes" are intended to encompass an ability to construct and configure the basic structural elements of the disclosed combination so as to meet or adhere to what would be required according to applicable

building codes. Since the codes of local municipalities might change over time, the structural embodiment disclosed herein is geared toward the code requirements as currently set forth in the 2009 Edition of the ICC International Building Code® (ISBN:1580017258), including those other codes referenced therein.

TRV Design

[0020] Facility 10 has been designed using a number of prefabricated modules so as to speed the process of assembling and disassembling the structure, and may be referred to as a Temporary Radiotherapy Vault (TRV). As shown in FIG. 1, the ground floor is composed of four different modules, each of which has a generally rectangular footprint. Modules 101, 102 and 103 are equal in length and are placed along side each other and module 104 is placed across the ends of modules 101, 102, and 103 (right side of FIG. 1). Alternative configurations or embodiments could incorporate more than four different modules. Each of the modules in includes a free standing frame structure, typically made up of a series of interconnected steel C and I beams, that generally define the outer edges of the module. Accordingly, each of the modules may be constructed in the same fashion as the pods detailed in US 2010/0146870, attached hereto.

[0021] In this illustrated configuration, the treatment room is entirely contained within module 102. Modules 101, 102 and 103 are designed such that, when assembled, they define a number of void spaces 50, 52, 54, 56, 58, and 60 around the treatment room 20. These void spaces (i.e., the vessel) are designed to be filled with a radiation shielding material M, such as a flowable granular fill having a density range of 80-125lb/ft^3. Aligned void spaces (e.g. 50 and 54, 54 and 52, 52 and 58) are in fluid communication such that, once filled with the shielding material, a substantially continuous barrier of the radiation shielding material is created around the treatment room 20. By remaining in a perpetually flowable state, the granular fill (i.e., the shielding material M), cannot crack due to settling or seismic events.

[0022] Roof modules 105 and 106 are designed so as to be placed above modules 101, 102 and 103 and to have their trusses 84 and 82 spanning from the shear wall 64 in module 101 to the shear wall 62 in module 103. A supporting panel 80 is then mounted between the trusses 84 and 82, and together with panels 81, 83 integrated into the roof modules 106, 105 supports the shielding material M over the treatment room 20 while maintaining a gap 110 between the underside of the panels 80, 81, 83 and the uppermost portion of the treatment room 20. Alternative configurations and embodiments could incorporate additional roof modules in lieu of supporting panels. As a result, the load of the shielding material directly above the treatment room 20 can be distributed through the trusses to the shear walls 62, 64 rather than bearing on the treatment room itself. This gap isolates the treatment room and protects it from the effects of any foundation shifting or sinking that may occur due to the excessive weight of the shielding material above it. As shown in FIGS. 2 and 3, the upper level shielding areas 70, 72 and 74 that are not directly above the treatment room 20 are open to the lower level void

spaces 50, 52, 54, 58. Connecting rods 88 span between the upper portions of the trusses 84, 82 and help give shape and support to fabric or membrane roof 92 which is installed once all the shielding material has been delivered.

[0023] While some of the floor space for control station 22 is provided by module 104, it is preferable to have the relevant computer equipment hardwired to the radiotherapy device 25 in module 102. In this case, the computer equipment is provided on a wheeled cart so that it can move into the position shown in FIG. 1 from a storage position in module 102.

Radiation Shielding

[0024] The precise quantity and desired distribution of radiation shielding material is dependent on the characteristics of the radiation emitted from device 25. As illustrated, the facility 10 is configured to employ an isocentrically arranged high energy linear accelerator, which typically operates in the range of 4-25MV. An example would be Varian Medical Systems Trilogy, Palo Alto, CA. In order to provide the appropriate level of shielding, the total weight of the shielding material may be 1,000,000 lbs or 2,000,000 lbs or more. To the extent the linear accelerator is operated at high MV energies (i.e. above 10MV), neutron shielding is provided by lining the treatment room with wood panels and borated polyethylene sheets.

[0025] The facility 10 could also be used to perform other types of radiotherapy, such as gamma knife or high dose rate brachytherapy (HDR), which typically operate in the range of 1-3MV. The facility 10 may also be adapted for use with cyclotrons operating in the range of 10-15MV or proton accelerators operating in the range of 40-250MV.

Foundation

Existing Rad Pro Foundations

[0026] Existing modular vaults corresponding to US 6,973,758 (i.e. the Rad Pro System) have been constructed on a reinforced concrete slab foundation in a number of permanent installations. The base of the Pro System pods was typically elevated several inches above the slab by a series of stub columns 150 as shown in FIG. 8. These stub columns 150 were fabricated from high strength steel and included a hollow vertical supporting column 153 with horizontal plates 151, 152 at each end. The vertical column 153 was in the shape of a rectangular solid with a square horizontal cross section. Shear lugs 154 were welded to the underside of the bottom plate in the form of a pair of vertical extension plates intersecting at right angles so as to generally form a "+". In use, a square cross section recess 155 was first provided in the concrete slab 156. The recess 155 was then filled with grout (not shown) and the shear lugs 154 were set into the grout filled recesses.

Foundation for TRV

[0027] With reference to FIGS. 4-7, the foundation 200 for the TRV (facility 10) comprises a pattern (FIG. 4) of elongated beams of reinforced concrete. Individual beams of reinforced concrete are conventionally referred to as grade beams, since they are typically constructed at or above grade level. The grade beams for the TRV foundation are recessed several inches below-grade (e.g. 3-6inches). The use of below-grade, grade beams makes it easier to return the site to its original condition once the TRV has been removed, since one could simply backfill over the below- grade, grade beams.

[0028] The pattern includes a number of parallel and orthogonal beams and beam segments. These beams underlie various portions of the TRV structure and the layout of FIG. 4 corresponds to the floor plan of FIG. 1. Of note, parallel beams 210 and 212 underlie the elongated sides of module 102 and parallel beams 210a and 212a underlie the adjustable supports that are provided along the sides of the base frame 26 and used to level the base frame, as described more fully below. Short transverse beams 214, 215 and 216 span between beams 210, 210a and 212, 212a at multiple locations along the lengths of beams 210, 210a, 212 and 212a. These short transverse beams 214, 215, 216 serve to provide a degree of integration or coupling between beams 210 and 212, and they also serve to underlie and provide support for the base frame 26. On the other hand, beams 214, 215, 216 do not intersect with the outside beams 220 or 230, and thus these outside beams are relatively decoupled from their respective inner beam 212, 212a, , 210, 210a. In other words, the presence of beams 214, 215, 216 assures that beams 210, 210a are more coupled to beams 212, 212a than they are to beams 220, 230.

[0029] This is significant because beams 220 and 230 are designed to underlie and provide support to the shear walls 62 and 64 in modules 103 and 101 respectively. As explained previously, because of the relationship between platforms 80, 81, 83 and trusses 82, 84, these shear walls 62, 64 bear the load of all the suspended shielding material that is positioned over the treatment room 20. Because this is a large mass of material, it provides significant inertial resistance to any lateral movement that would develop during a seismic event (i.e. earthquake). As a result, in order to satisfy various building codes, it is generally necessary to have a lateral coupling between the foundation and the shear wall that can withstand the significant lateral stresses. The dead load of the suspended shielding material is also positioned far enough away from the therapy room 20, to avoid any impairment to the supporting beams 214, 215, 216 and/or the supporting beams 210a, 212a which may impact the room's geometry and/or the levelness of the base frame 26.

Kevways

[0030] With reference to FIGS. 6 and 7, coupling between the TRV modules and the

foundation grade beams is provided by one of two types of supports. Supports 160 are generally in the form of an I beam and have a planar base 164 and top plate 162 coupled by a vertical section 166. Support 160 is designed to be mounted in an elongated horizontal slot 168 such as the one formed in grade beam 240. Grade beams 240 and 250 are illustrated in FIG. 4. By virtue of the planar base 164 of support 160 being recessed into slot 168, the sidewalls of slot 168 provide lateral coupling through contact with the sides of base 164 and vertical span 166. If the slot 168 is initially too long to provide adequate lateral coupling contact, such contact can be facilitated by providing grout into the ends of slot 168.

[0031] While illustrated as having only a single vertical span 166, support 160 may be reconfigured so as to include additional or different vertical spans between top plate 162 and base 168. For example, vertical plates may be added to the ends of the support 160 so as to provide additional coupling between the top plate 162 and the base 168. These end plates would be orthogonal to the vertical span 166 and would increase the overall rigidity of the supports 160.

[0032] Supports 260 are similar to supports 160 in that they also have a planar mounting plate 262 and a planar base 264 and the planar base 264 is received in slot 222 of a grade beam 221. However, the slot 222 includes a pair of intersecting slots such that slot 222 is considered to be elongated in two orthogonal directions. The base 264 of support 260 is also of a "+" or intersecting configuration, and in use the base of support 260 is received in slot 222 and engages therewith so as to provide lateral contact coupling in multiple directions.

[0033] Supports 260 may also be supplemented with additional vertical plates. In particular, it is contemplated that four vertical end plates would be attached to the four ends of support 260. Two opposing plates would be attached orthogonal to vertical support 266 and two would be orthogonal to vertical support 268.

Door Cassette

[0034] FIGS. 9 and 10 illustrate the door cassette 300 installed in module 101. Door cassette 300 includes a shielding door 40, its surrounding frame parts 320, 330, 324, and a radiation shielding transom area 310 directly above the door 40. The entire cassette 300 is configured to be lifted out of module 101 as a whole. When inserted into position, the lower portion of frame 324 (i.e. the threshold) is recessed into a corresponding opening in the floor of module 101 (not shown). The hinge side of frame 330 abuts against channel steel in the module 101 and is bolted in place via clamps 336. The opposing door side of frame 320 has a clearance that is filled with shim plate 338 and then the door side of frame 320 is bolted to module 101 via clamps 337. With reference to FIG. 1, additional shielding plates 66 are provided in module 101 to provide shielding otherwise lost due to corridor 37, which cannot being filled with granular fill shielding material M.

Methods of Use

[0035] One contemplated method according to the present invention involves the identification of a radiotherapy facility having an existing radiotherapy device needing to be taken out of service. Typically, a facility would self identify its needs.

[0036] Next, a site for a temporary radiotherapy facility is identified. The site should be suitably close to the existing facility so as to minimize disruption, and may be an empty field or parking lot. A foundation for the temporary device is created at the identified site. The foundation can be a simple concrete slab, but preferably it is a pattern of recessed grade beams as described previously.

[0037] Next, a temporary radiotherapy facility is assembled on the foundation. The temporary radiotherapy facility typically includes a radiotherapy device within a radiation shielding vault, and it may correspond to the TRV previously described. The vault may include at least about 1,000,000 lbs of radiation shielding material, such as the granular fill or some other type, as previously described, including water.

[0038] When the need for the radiotherapy facility ceases to exist, for example because the renovation has been completed, the facility is removed. For a typical replacement, this would be less than 12 months. Removal of the temporary facility may include removal of some or all of the components of the TRV and some or all of the radiation shielding material included in the void spaces.

[0039] In one refinement, the TRV is equipped with radiotherapy equipment substantially similar to the equipment to be installed at the existing facility. In this way, the personnel can receive training on the new equipment while operating in the TRV.

[0040] Another inventive method contemplated herein involves maintaining treatment continuity to a patient population during the renovation or construction of a radiotherapy facility. This may be accomplished in connection with an existing (first) radiotherapy facility having a first radiotherapy device, wherein services are provided at the existing facility to a patient population by support staff, the support staff including at least one treatment individual. The treatment individual may be, for example, a doctor, a nurse, a therapist, a dosimetrist, or a physicist.

[0041] A second radiotherapy facility is constructed to treat the patient population on a temporary basis, the second facility having a second radiotherapy device within a radiation shielding vault, such as the TRV described previously. Upon completion of the temporary facility, the treatment individual is transitioned to the second facility, and he/she provides services at the second facility to the patient population during the renovation and/or upgrade of the first radiotherapy facility. Then, upon completion of the renovation and/or upgrade of the first radiotherapy facility, the treatment individual is transitioned back to the first facility (or to a newly-constructed third facility) where he/she can continue to serve the same patient

population. The period of transition may be occasioned by an equipment modernization and/or the construction of a wholly-new facility.

Maintaining isocenter for radiotherapy equipment

[0042] In order to be effectively used, radiotherapy equipment must be carefully calibrated. One of the alignment and/or calibration characteristics is referred to as "isocenter" which is a point in three-dimensional space around which all movable axes of the treatment machine revolve. As would be understood, a stable isocenter is critical. In certain applications, isocenter is defined and specified as a sphere having a radius of no more than 2 mm in diameter, for example 1mm in diameter. The targeted treatment area, usually a tumor, is placed at isocenter during treatment. As various components of the treatment machine (gantry, collimator, and couch) are moved to different angles during the treatment delivery, it is essential that no part of the machine flex or move in any manner that would cause the target, at isocenter, to be missed.

[0043] All structures can sink, shift, or even move. They are engineered to do this without any overall impairment to the structure. A shift in a wall, floor or ceiling in a therapy room, however, has consequences not normally part of the engineer's design challenge. With a slab foundation, soil settlement is controlled since the slab can bridge over settlement areas, just like a sheet of plywood would bridge your shoe depressions in the mud. If there is any settlement, it will be mitigated by the slab, or at least slowed down so as to happen over a longer period of time, typically years.

[0044] Rapid settlement in localized areas can have an effect on grade beams, since they do not have the benefit of the monolithic slab. The disclosed approach, as set forth herein, is to build in tolerance by making the therapy room an independent structural sanctuary that is not impacted by any settlement caused by the huge shielding mass, especially the mass directly above the treatment room. This is achieved by creating a six inch gap between the therapy room structure and the supported shielding mass above. Further contributing to this achievement is allowing the grade beams to move independently and further, separating the shielding mass load from the therapy room load by a suitable distance on independent grade beams.

Adjustable Base Frame

[0045] Turning now to FIGS. 11 and 12 additional details of the adjustable base frame 26 for the radiotherapy machine 25 and treatment table 24 are described. The base frame 26 includes mounting ring 240 for the treatment table 24 (not shown) that allows the treatment table 24 to be rotated about a vertical axis, and the radiotherapy machine 25 (not shown) is mounted to the base frame 26 with a gantry that allows the radiation emitting portion of the

machine 25 to be rotated about a horizontal axis, and the base frame is sufficiently rigid and monolithic so as to maintain the relative alignment of the table 24 and machine 25 and their respective horizontal and vertical rotation axes.

[0046] As noted above, the treatment room module 102, or vault module, is made up of a freestanding outer frame assembly. The floor structure of this frame includes lateral side members 102a, 102b. These side members 102a, 102b extend the length of the module 102 and are positioned over the grade beams 210, 212 as shown in FIG. 4. The floor structure of module 102 also includes a pair of cross members 102c, 102d that extend between the side members 102a and 102b so as to be positioned over the grade beams 214 and 216 respectively. For clarity, side member 102a and its underlying grade beam 210 have been omitted from FIG. 11.

[0047] The base frame 26 is provided with a number of mounting flanges 412, only one of which is shown in the detail of FIG. 12. These mounting flanges are welded to the side rails 26a of the base frame 26 at each of its four corners, thereby providing an integral connection between the flanges and the base frame 26. The flanges 412 are coupled to the cross members by a series of bolts 410. The bolt holes in the flanges 412 are enlarged slightly relative to the shank of the bolt, for example being slotted or elongated in the vertical direction. As a result, when the bolts 410 are loosened slightly, there is a degree of play in the connection between the base frame 26 and the module cross member 102c. This allows the orientation of the base frame 26 to be adjusted slightly from the orientation of the remainder of the module 102, as explained more fully below.

[0048] With reference to FIG. 12, an adjustable support 400 is provided near each of the four corners of the base frame 26. Support 400 includes a threaded rod 404 having a base 408 at its lower end. The threaded portion of the rod 404 is received in a correspondingly threaded vertical bore of block 402, which is welded to the side rail 26a of base frame 26. Thus, rotation of the rod 404, which is accomplished by turning the captured nut 406 at its upper end, serves to raise or lower the rod, and thus the base 408, relative to the side rail 26a of the base frame. Accordingly, once the base 408 has come into contact with the underlying foundation (e.g. grade beams 210a, 212a or an interposed support 160), continued rotation of the rod 404 serves to raise the corresponding portion of the base frame 26. Conversely, rotating the rod in the opposite direction would have the effect of lowering the portion of the base frame 26, to the extent permitted by the play in its connection with the cross member 102c. In this way, fine adjustments to the orientation of the base frame 26, for example to level the base frame to the tolerances dictated by the equipment manufacturer can be accomplished without needing to make adjustments to the entire module 102.

[0049] It is to be understood that the adjustments to the orientation of the base frame 26 made possible by the present invention can have a number of beneficial applications, for example, by allowing for adjustments to be made at the time of initial installation or after a period of use, for example to compensate for any adverse effects due to settling. To facilitate access to the adjustable supports 400 after initial installation, trap doors may be provided in the floor of the

treatment room above each of the supports, thereby enabling access to each support with minimal disruption to any floor finishing that may be installed.

[0050] The process of leveling the base frame 26 may proceed as follows. The base frame 26 is adjustable mounted with the outer frame assembly of module 102. This outer frame assembly is then placed on a foundation. Preferably the radiotherapy machine 25 and treatment table 24 have already been mounted to the base frame 26 at the factory, but if not, they may be brought to the site and mounted to the base frame independently. As the module 102 is typically large and difficult to maneuver, the process of placing it on the foundation is typically accomplished with a container mover, such as a crane. As noted above, the foundation may be a concrete slab or a pattern of grade beams, and the outer frame assembly/module 102 may be placed directly on the foundation or onto supports extending from the foundation.

[0051] Once the module 102 has been placed on the foundation, the levelness of the base frame is checked, which may be accomplished using conventional leveling equipment (i.e. bubble levels). If the base frame is determined to be out of level, the mounting bolts 410 securing the base frame 26 the outer fame (i.e. cross members 102c and 102) are loosened and the adjustable supports 400 are used to raise portions of the base frame 26 as described above. Any number of the supports 400 may be utilized to bring the base frame 26 to level, such as one, two, three or all four of the supports, and the levelness of the base frame may be continually checked during the leveling process. Because the base frame 26 is being leveled with the adjustable supports 400, there is no need to make fine adjustments to the overall orientation of the large and difficult to maneuver outer frame assembly/module 102, as would be the case if the base frame 26 were not adjustable within the module 102.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

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STRÅLINGSHVÆLVINGSMODUL MED JUSTERBAR BUNDRAMME

PATENTKRAV

1. Midlertidig radioterapifacilitet (10), der omfatter:

et fundament og

et strålingshvælvingsmodul (102) til at understøtte en radioterapianordning (25) inde i et behandlingsrum (20), hvilket strålingshvælvingsmodul (102) omfatter:

en fritstående ydre rammeenhed (102a-102d), der er placeret over fundamentet;

kendetegnet ved, at strålingshvælvingsmodulet (102) endvidere omfatter:

en bundramme (26), der er justerbart monteret inde i den ydre rammeenhed (102a-102d) for at understøtte radioterapianordningen (25); og

en flerhed af justerbare bærere (400), der kan forlænges i en nedadgående retning fra bundrammen (26), når modulet (102) er placeret på fundamentet, hvor bærerne (400) muliggør orientering af bundrammen (26), der skal justeres, uafhængigt af den ydre rammeenhed (102a-102d), hvor bundrammen (26) er monteret på den ydre rammeenhed (102a-102d) ved hjælp af monteringsbolte (410), der strækker sig gennem aflange huller.

2. Hvælvingsmodul (102) ifølge krav 1, hvor de aflange huller er defineret i monteringsflanger (412), der er integreret med bundrammen (26).

3. Hvælvingsmodul (102) ifølge krav 1 eller krav 2, hvor fundamentet omfatter en flerhed af nivelleringsbjælker (210a, 212a, 214, 216), der er anbragt under de justerbare bærere (400), og som er tilvejebragt langs hver side af bundrammen (26)

4. Hvælvingsmodul (102) ifølge krav 1, hvor der er mindst tre justerbare bærere (400).

5. Hvælvingsmodul (102) ifølge krav 1, hvor de justerbare bærere (400) omfatter en gevindstang (404), der strækker sig gennem en vertikalt orienteret boring, der er integreret med bundrammen (26).

6. Hvælvingsmodul (102) ifølge krav 5, hvor gevindstangen (404) har en base (408) ved dens nedre ende til at blive bragt i kontakt med fundamentet.

7. Hvælvingsmodul (102) ifølge krav 1, hvor en radioterapianordning (25) og et behandlingsbord (24) er monteret på bundrammen (26).

8. Hvælvingsmodul (102) ifølge krav 7, hvor bundrammen (26) indbefatter en monteringsring (420) til at gøre det muligt for behandlingsbordet (24) at rotere omkring en horisontal akse.

9. Radioterapibehandlingsrum (20), der omfatter hvælvingsmodulet (102) ifølge krav 1, hvor rammeenheden (102a-102d) er understøttet på fundamentet ved et første sæt steder og bundrammen (26) er understøttet på fundamentet ved et andet sæt steder ved hjælp af de justerbare bærere (400), hvor det første sæt steder er placeret med afstand fra det andet sæt steder, hvor eventuelt fundamentet omfatter en flerhed af nivelleringsbjælker (210a, 212a, 214, 215, 216), eller hvor eventuelt fundamentet omfatter et betonplade.

10. Fremgangsmåde til nivellering af en bundramme (26) til en radioterapianordning (25), hvilken fremgangsmåde omfatter:

tilvejebringelse af et fundament;

tilvejebringelse af en fritstående ydre rammeenhed (102a-102d);

tilvejebringelse af en bundramme (26), der monteres justerbart inde i den ydre rammeenhed (102a-102d) og har en flerhed af justerbare bærere (400), der strækker sig i en nedadgående retning fra bundrammen (26), hvor bundrammen (26) er fastgjort til den ydre rammeenhed (102a-102d) ved hjælp af monteringsbolte (410), der strækker sig gennem aflange huller;

montering af en radioterapianordning (25) og et behandlingsbord (24) på bundrammen (26);

placering af den ydre rammeenhed (102a-102d) på fundamentet;

kontrol af, at bundrammen (26) er nivelleret; og derefter

hvis bundrammen (26) ikke er nivelleret, løsning af monteringsboltene (410) og anvendelse af de justerbare bærere (400) til at justere orienteringen af bundrammen (26) til nivellering.

11. Fremgangsmåde ifølge krav 10, hvor radioterapianordningen (25) og behandlingsbordet (24) monteres på bundrammen (26) før placering af den ydre rammeenhed (102a-102d) på fundamentet.

12. Fremgangsmåde ifølge krav 10, der endvidere omfatter fastgørelse af bundrammen (26) til den ydre rammeenhed (102a-102d), efter at bundrammen (26) er nivelleret.

13. Fremgangsmåde ifølge krav 10, hvor fundamentet omfatter en flerhed af nivelleringsbjælker (210a, 212a, 214, 216), der er anbragt under de justerbare bærere (400), og som er tilvejebragt langs hver side af bundrammen (26).

14. Fremgangsmåde ifølge krav 10, hvor den ydre rammeenhed (102a-102d) er understøttet på fundamentet ved et første sæt steder og bundrammen (26) er understøttet på fundamentet på et andet sæt steder ved hjælp af de justerbare bærere (400), hvor det første sæt steder er placeret med afstand fra det andet sæt steder, og hvor fundamentet eventuelt omfatter nivelleringsbjælker (210a, 212a, 214, 215, 216).

15. Fremgangsmåde ifølge krav 10, hvor radioterapianordningen (25) og behandlingsbordet (24) er inde i et behandlingsrum (20) og de justerbare bærere (400) tilgås gennem behandlingsrummets (20) gulv for at nivellere bundrammen (26).

DRAWINGS

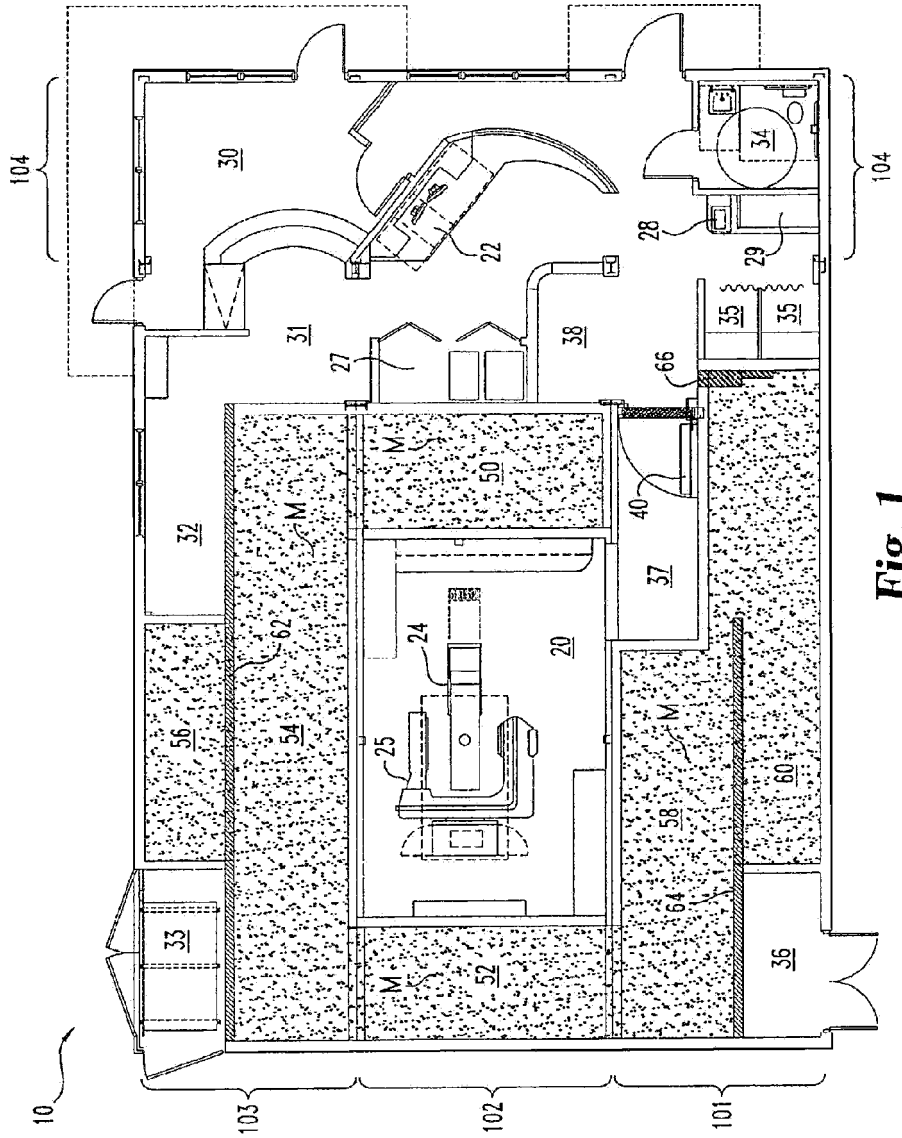


Fig. 1

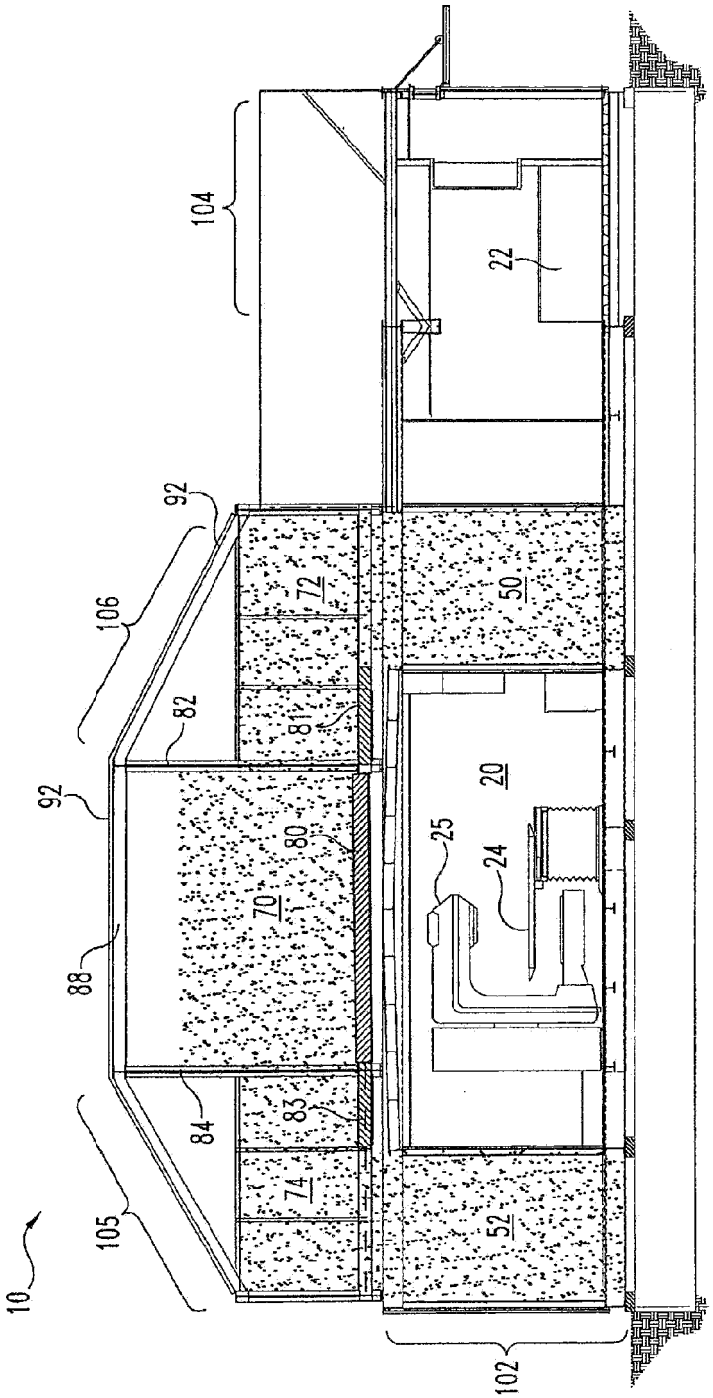
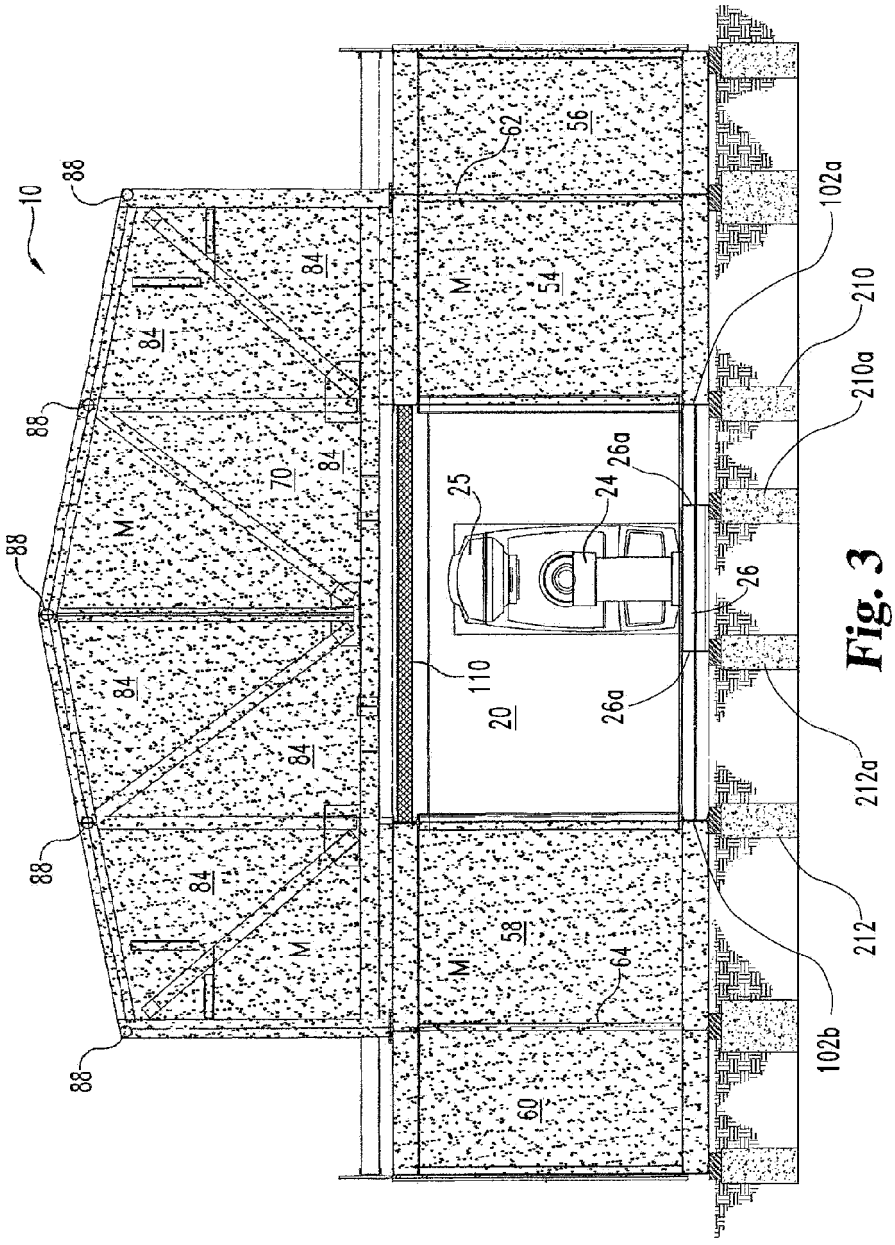


Fig. 2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26a
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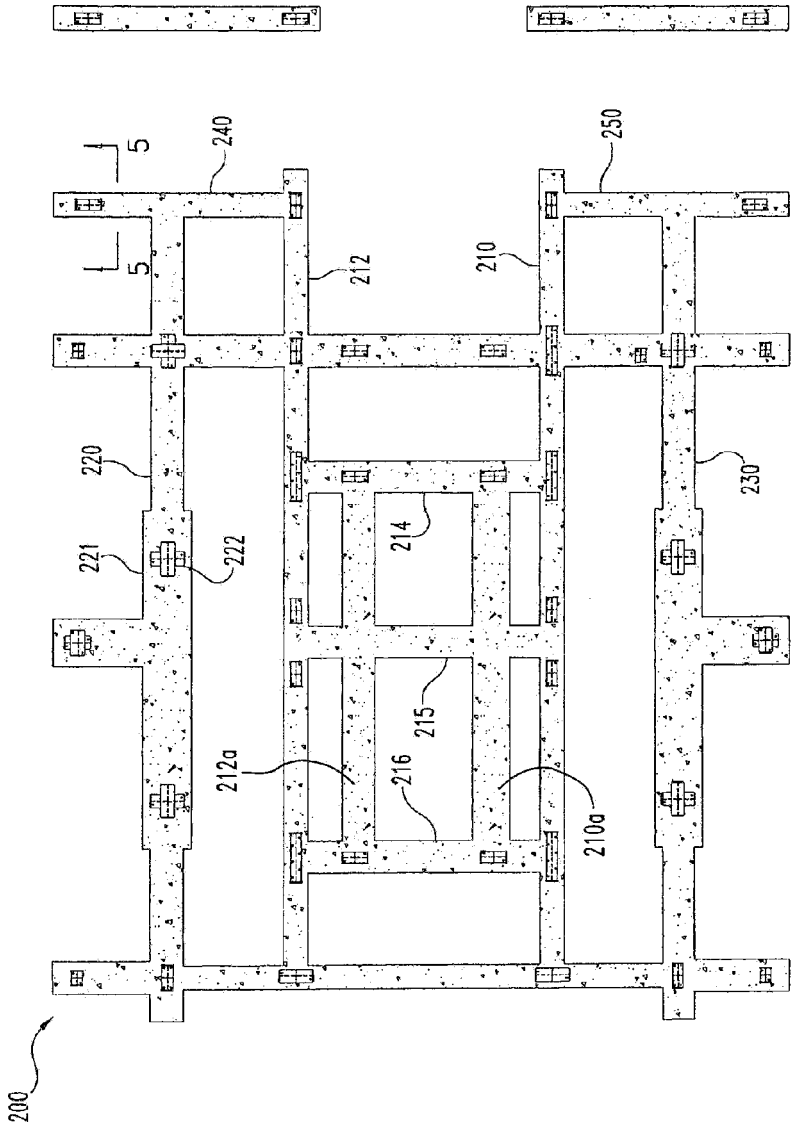
102a
210
210a
212a
212
102b

Fig. 3



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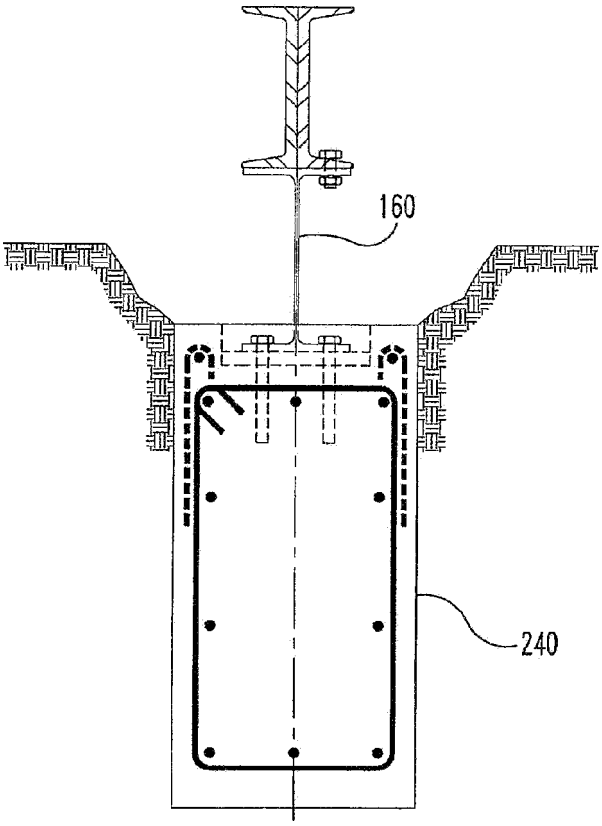
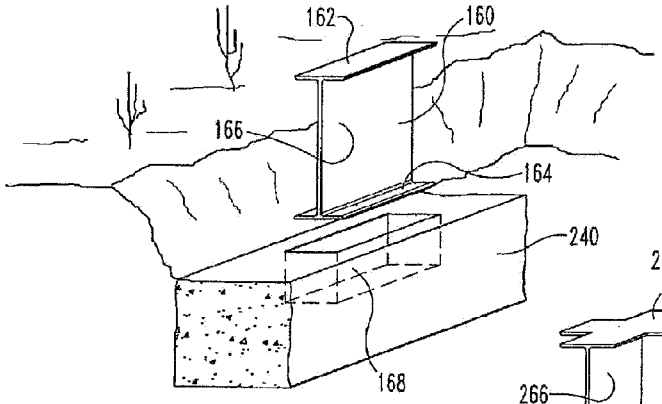


Fig. 5



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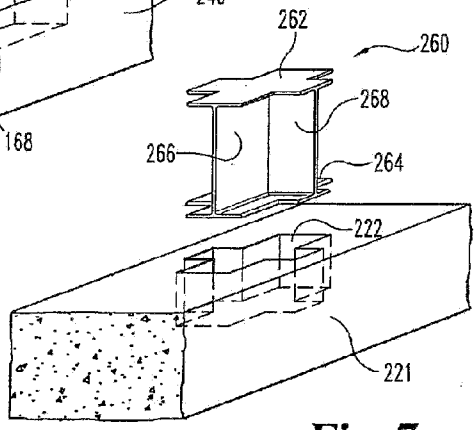

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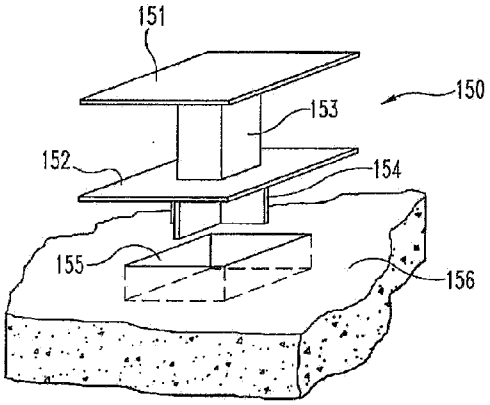

Fig. 8

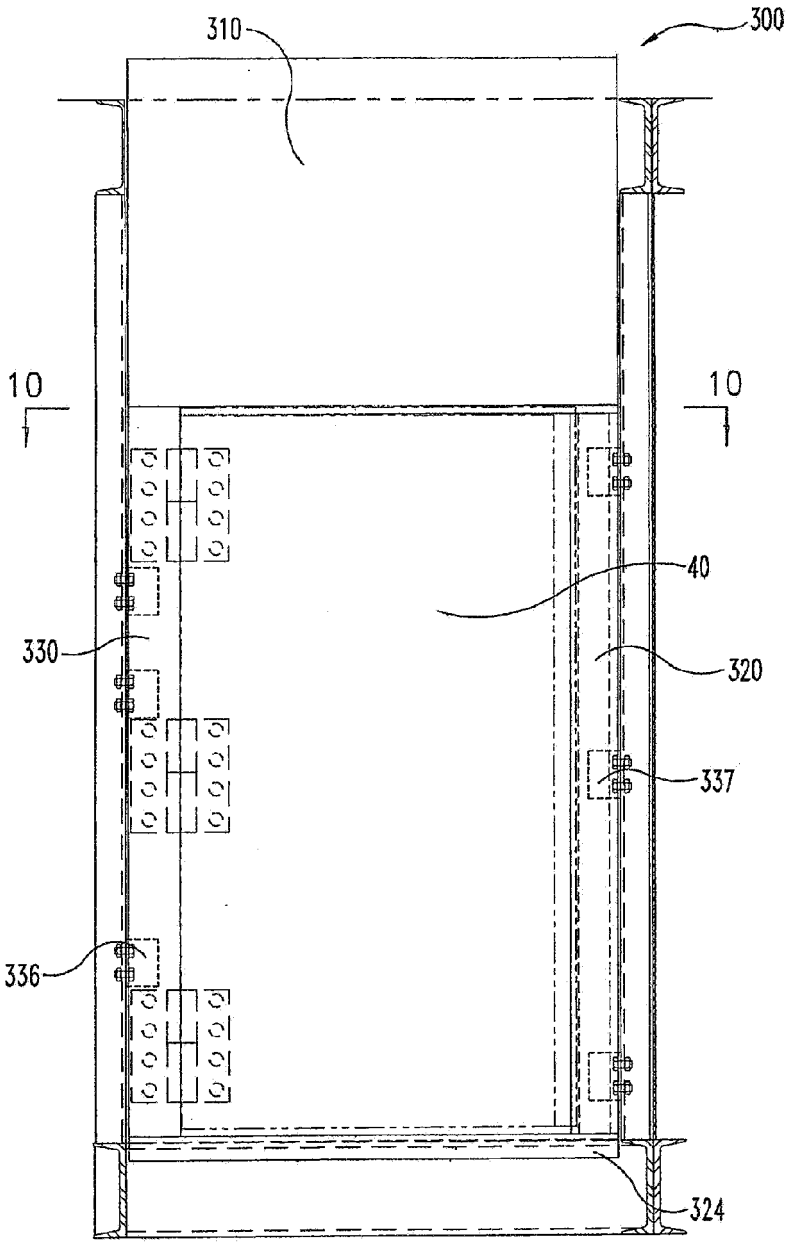

Fig. 9

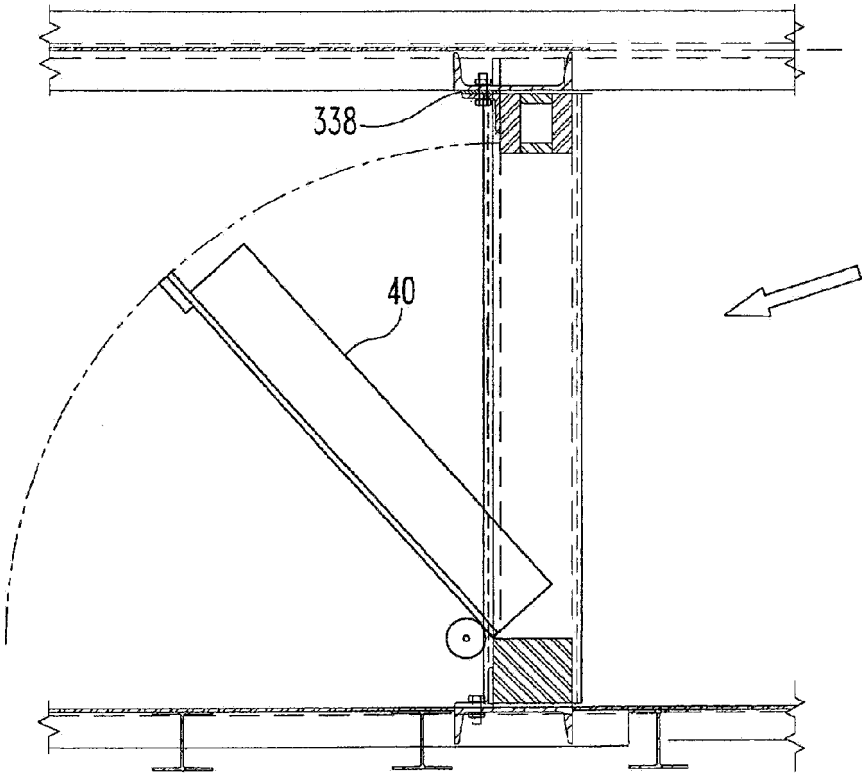

Fig. 10

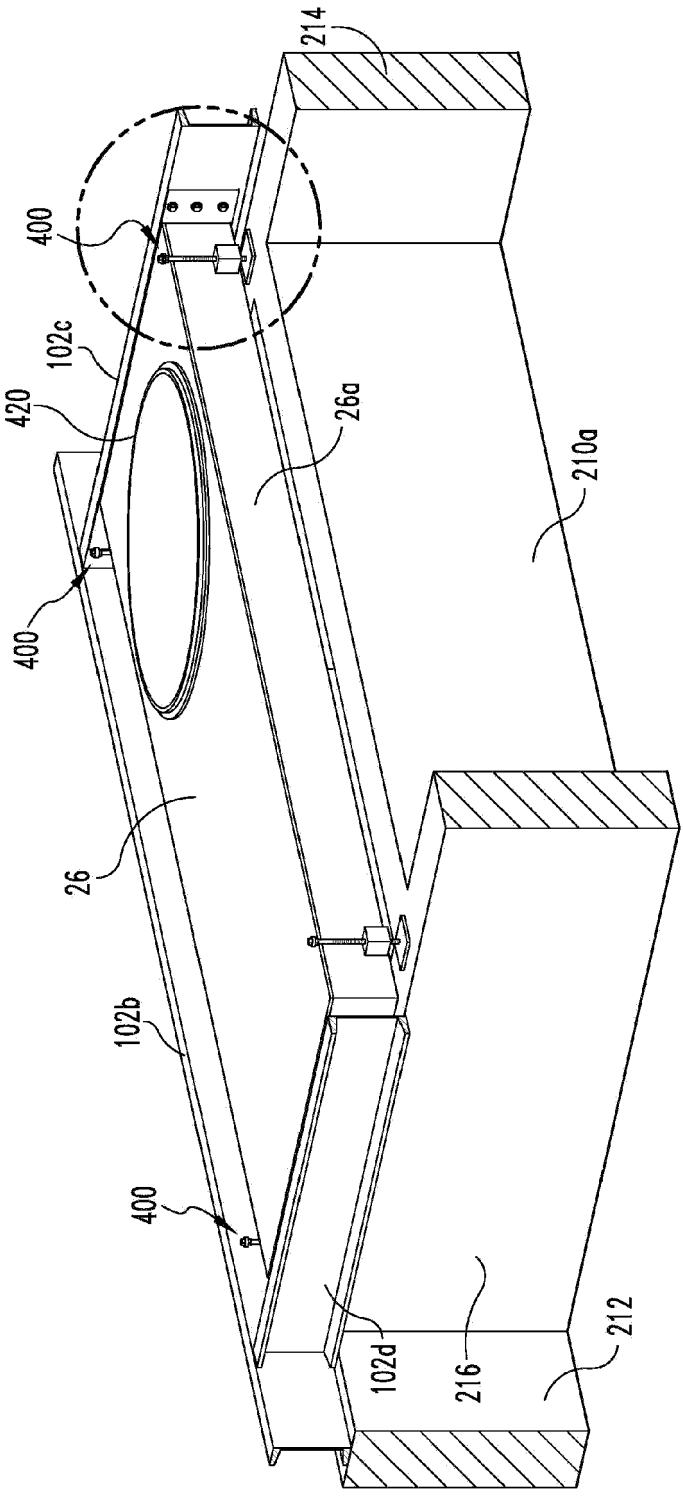

Fig. 11

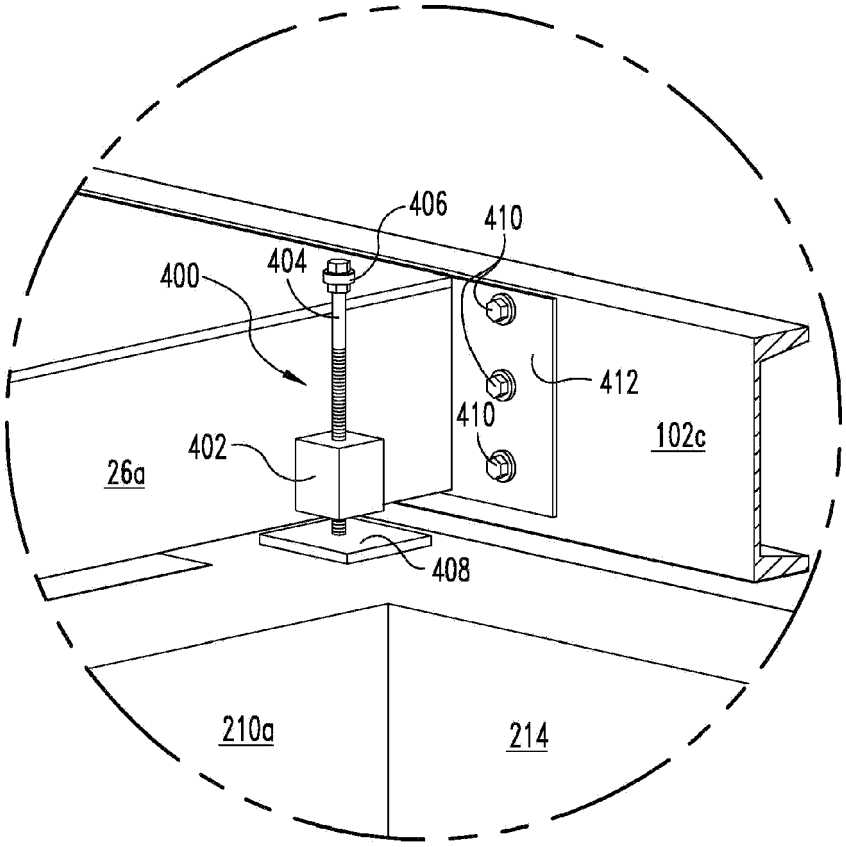

Fig. 12