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DESCRIPTION

FIELD OF THE INVENTION

[0001] This invention relates to enclosures for underground utility lines, and more particularly, to an underground utility enclosure having improved load capacity.

BACKGROUND

[0002] Underground utility equipment enclosures include the so-called grade level vaults, splice boxes, pull boxes, and the like, for various applications requiring access to an underground service. These may include electrical, gas, water, telephone, fiber optics and cable TV installations, for example.

[0003] WO2006/096839 discloses an enhanced strength grade level utility enclosure according to the preamble of claims 1 and 9.

[0004] Grade level enclosures are commonly subjected to different kinds of structural loads during use. Generally speaking, prior art enclosures and their cover plates are made from reinforced concrete, fiberglass, or polymer concrete composite materials for added load strength, to withstand the compression forces during use.

[0005] Grade level enclosures, particularly those used for telecommunications equipment, are adapted to facilitate use with different types of internal equipment. They may include splice cases, fiber optic cables, electrical wires, and the like, supported in the enclosure by metal cable racks fastened to upper portions of the enclosure's inside walls.

[0006] Industry standards have been developed for conformance tests and requirements for the structural integrity of such grade level enclosures. One standard commonly used for underground enclosures is known as ANSI/SCTE 77-2010. This set of standards for underground enclosure integrity has Tier designations that relate to various load ratings to ensure proper performance for different types of underground enclosures. The objective of these standards is to ensure long product service life, minimized maintenance, and reduced product liability for those who design, develop, and market them.

[0007] In one example, the ANSI Tier designations relate to the normal design load x 1000 lbs. For instance, Tier 15 = 15 x 1000 lbs = 15,000 lbs. These ANSI Tier loadings have a corresponding test load which is 50% greater than the design load. For example, the test load for Tier 15 = 15,000 lbs x 1.5 = 22,500 lbs. (Tier 15 [15,000 lb. design load, 22,500 lb. test load] is applicable to driveways, parking lots and off-road applications subject to occasional non-deliberate heavy vehicular traffic.)

[0008] The ANSI/SCTE 77-2010 performance specification includes a three-position structural test simulating wheels rolling over an enclosure where loads are imparted laterally and vertically onto the side wall of the enclosure and vertically onto its cover. The related structural integrity tests comprise:

[0009] (1). Position one -- a lateral side wall test -- a test of the area that must withstand soil forces as vehicles approach.

[0010] (2). Position two -- a vertical side wall test -- a test of load applied directly downward onto the vertical side wall.

[0011] (3). Position three -- a cover test -- a test showing how an enclosure responds to a load applied directly to the center of the cover.

[0012] The present invention provides an enhanced strength grade level utilities enclosure that can be made from lighter weight polymeric materials. In one embodiment, the enclosure's design provides enhanced structural loading capacity in excess of ANSI Tier 15 vertical side wall load and center cover vertical load requirements.

[0013] The ANSI Tier 15 test standards are one example of various industry test standards for grade level enclosures for which the present invention provides enhanced load capacities. Structural improvements, in particular, are demonstrated for enclosures' vertical side wall load capacities; and these improvements would result for different types of enclosures each having their own separate vertical side wall load capacity requirements.

SUMMARY OF THE INVENTION

[0014] The above advantages are achieved with the features of claims 1 and 9.

[0015] These and other aspects of the invention will be more fully understood by referring to the following detailed description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a perspective view showing one embodiment of an enhanced strength grade level utilities enclosure according to principles of this invention.

Fig. 1A is a perspective view showing another embodiment of the utilities enclosure.

Fig. 2 is an enlarged fragmentary perspective view showing the construction of a prior art grade level utilities enclosure.

Fig. 3 is an enlarged fragmentary perspective view showing the detailed construction of the enhanced strength grade level utilities enclosure according to principles of this invention.

Fig. 4 is a front elevational view, partly in cross section, showing an inside wall of the enhanced strength enclosure.

Fig. 5 is a cross sectional view taken on line 5-5 of Fig. 4.

Fig. 6 is a cross sectional view taken on line 6-6 of Fig. 4

Fig. 7 is a schematic perspective view showing a test set up for a side wall load test according to ANSI/SCTE 77-2010 Tier 15.

Fig. 8 is a schematic perspective view showing a test set up for a Tier 15 center load test.

Fig. 9 shows comparative deflection curves for tests conducted on the present invention.

Fig. 10 shows comparative deflection curves for tests conducted on a modified utilities enclosure.

Fig. 11 shows comparative deflection curves for tests conducted on a prior art utilities enclosure.

DETAILED DESCRIPTION

[0017] Fig. 1 illustrates one embodiment of a grade level underground utilities enclosure 10 according to principles of this invention. The enclosure includes a pair of long parallel side walls 12 and a pair of shorter endwalls 14 forming a generally rectangular structure having a hollow interior. The grade level enclosure has an open bottom. An open top of the enclosure receives a flat top cover plate or panel 16. The enclosure is made of hard molded plastic such as high density polyethylene and is molded in halves, split along its longitudinal center axis into two parts, forming a seam 18 at each end. The two halves are rigidly fastened together along the seams at each end by fasteners at 20 extending through upright flanges 22 which face each other along each seam. The enclosure also has a molded integrally formed grid structure facing outwardly along each side wall. The configuration of the grid structure can be in various forms. The illustrated grid structure has an I-beam configuration formed by long horizontal flanges 24 and vertical upright flanges 26, forming an essentially rectangular array. The horizontal flanges wrap around the ends of the enclosure at 28. This construction of the enclosure provides good compressive strength to resist vertical loads on the side walls of the enclosure. Other configurations can include diagonally extending or diamond pattern molded flanges, for example.

[0018] The Appendix to the present application shows features, including dimensions, of one embodiment of the enclosure. Fig. 1A shows the same embodiment, with a top cover plate 30 opened to reveal the interior of the enclosure, described in more detail below. This embodiment also illustrates use of a polymer composite ring 32 positioned on a top edge of the enclosure's vertical side wall structure. In this embodiment the cover plate 30 rests on the polymer composite ring during use. This embodiment also

illustrates use of the cover plate 30 made of a polymer concrete material. The body of the enclosure is made from a non-metal, non-concrete, molded thermoplastic polymeric material such as high density polyethylene. Other thermoplastic materials comprised of polyolefin materials in general also can be used.

[0019] Figs. 2 and 3 illustrate a comparison between the present invention (Fig. 3) and a prior art grade level utilities enclosure (Fig. 2).

[0020] The Fig. 2 illustration shows the prior art enclosure 34 having a vertical wall structure with a flat inside vertical wall surface 35. This embodiment shows narrow elongated recessed slots 36 extending parallel to the top edge of the box. These slots are formed below an inside peripheral rim 38 which extends around and somewhat below a top edge 39 of the enclosure. The slots can be used for interlocking with a cover plate locking device when a cover plate is positioned atop the enclosure. This prior art embodiment also shows a typical prior art use of a narrow, elongated metal cable rack 40 affixed to the flat inside wall surface 35 of the enclosure. The cable rack, as is well known in the art, includes a series of vertically spaced apart stepped connectors 42 for use in attaching various types of equipment used in the interior of the enclosure. The top and bottom of the cable rack are affixed to the side wall of the enclosure by suitable fasteners 44.

[0021] The enclosure of this invention, as shown in Fig. 1A, includes two cable racks 60 on each side, described below, and a hanger bar 33 that provides an organizer feature for internal equipment. The hanger bar is attached to the enclosure at its ends without fasteners.

[0022] Fig. 3 illustrates a more detailed construction of the underground enclosure 10 which is open at its top and reveals the interior of the enclosure. The vertical wall structure of the enclosure is formed by having integrally molded a vertical inner wall panel 46 with the exterior grid structure (formed by the horizontal and vertical flanges 24 and 26). The vertical inner wall has a flat inside surface 48 that extends continuously around and faces toward the open interior of the enclosure.

[0023] The Fig. 3 illustration also shows a narrow horizontal annular rim 50 that extends around the upper inside portion of the enclosure. The rim extends inwardly around and below a short vertical wall 52 that spans an upper portion of the enclosure. An annular outer flange 54 above the shortened wall 52 forms the top edge of the enclosure.

[0024] According to the present invention, the vertical wall structure's load strength is enhanced by a system of substantially vertically extending rigid support bars inserted into corresponding narrow, elongated recessed regions or pockets 58 molded into the otherwise flat inside surface 48 of the vertical inside wall panel 46. The rigid support bars are preferably formed as cable racks 60 adapted for supporting various types of internal equipment used in the enclosure, via a stepped series of vertically spaced apart connectors 61 on the base of each cable rack. Each cable rack is generally U-shaped or channel-shaped in cross sectional configuration, having a flat base 62 flush with the enclosure's inside surface 48 when the bar is positioned in the recessed slotted region. The side walls of the channel-shaped cable racks rigidly engage the bottoms of the recessed pockets 58 in which they are positioned. The cable rack is rigidly affixed to the recessed regions by a series of vertically spaced apart fasteners 64 (and corresponding threaded nuts and washers) screwed into corresponding holes 66 in the wall of the enclosure. The cable racks are preferably made from galvanized steel or stainless steel, although they can be made from hard plastic or fiberglass. In one embodiment the metal cable racks have a depth of about 9/16 inch, a width of about 1 1/2 inches, and a thickness of about 1/8 inch.

[0025] Figs. 4 to 6 illustrate in more detail the structural configuration of the enhanced strength enclosure provided by the invention. Preferably, two cable racks 60 are positioned on each longitudinal side wall of the enclosure, although more cable racks could be positioned on each side of the enclosure. Fig. 4 shows a pair of longitudinally spaced apart cable racks 60 rigidly secured to corresponding slotted recessed regions 58 on one side of the enclosure. There are two cable racks similarly positioned on the opposite side wall of the enclosure. Similar cable racks, or other means of rigid vertical support can be affixed to similar recessed regions or pockets in the end walls of the enclosure.

[0026] In use, the cable racks 60 provide a substantially continuous means of rigid vertical support extending from the top to the bottom of the enclosure's outer wall. The wall of the enclosure has an annular bottom edge 68 on which the enclosure is supported when the enclosure rests on the ground. The bottom edge is formed as an inverted T-shaped structure, integral with the side wall structure of the enclosure. The bottom edge has an integrally formed inner lip 67 facing the interior of the enclosure, near its bottom. The bottom edges of the cable racks 60 rest on the flanged inner lip 67 of the enclosure side wall. The top edges of the cable racks are engaged with a bottom edge of the annular upper rim 50 that faces the interior of the enclosure. When the cover plate 16 is positioned in the top of the enclosure an annular lower rim 70 of the cover plate rests on the annular rim 50, and a downward force on the cover plate is resisted by the substantially vertically-positioned enclosure side walls reinforced by the

substantially vertically-positioned rigid cable racks 60.

[0027] The grade level enclosure of this invention was tested for its load integrity according to standards used for such enclosures in the telecommunications industry.

[0028] These test standards can vary as to load levels, resistance to deflection, and other test parameters. Such test standards also can vary between U.S. and European, for example. One set of these test standards used for testing load integrity of the invention is identified as the ANSI/SCTE 77 2010 Specification for Underground Enclosure Integrity, incorporated herein by this reference. The enclosure under test consisted of the enclosure illustrated in Figs. 1 and 3-6. The vertical load capacity of this test unit was compared with the same enclosure, but with the four cable racks removed from the recessed slotted regions of the enclosure. The ANSI Tier 15 test methods were used, as one example, to determine the enclosure's vertical load capacity in both instances: The vertical load capacity of the enclosure was tested for side wall load capacity and center load body deflection, using vertical side wall test and cover plate test methods for ANSI Tier 15.

[0029] Fig. 7 illustrates the test set up used for the Tier 15 vertical side wall test. This test shows the load plate 80 and load ram 82 positioned over and applying a downward load to the vertical side wall 46 of the enclosure 10. This view also shows a dial indicator 84 of a sensor for measuring deflection. In this test, deflection measuring devices are positioned to indicate vertical and lateral deflection wherever maximum deflection occurs. Design load is cycled 10 times, followed by applying the test load.

[0030] Fig. 8 illustrates the test set up used for the Tier 15 cover plate center load test. In this test set up the load plate 80 applies a downward force to the cover plate 16.

[0031] Tier 15 test results are shown in the following example and are illustrated comparatively by the deflection curves shown in Figs. 9, 10 and 11.

Example

1. Purpose

[0032] Test the strength of the modified enclosure of this invention with the metal cable rack inserts and compare those test results with a modified vault without the metal cable rack inserts.

[0033] Compare those test results with similar tests conducted on a non-modified prior art enclosure as shown in Fig. 2.

2. Test Material

[0034]

- Dake mechanical test frame (Frame, 50K load cell)
- Aerospace digital indicator gauge
- Omega Model DP41-B digital read out
- 10 in (254mm) x 10 in (254mm) x 1 in (25mm) thick steel loading plate backed with ½ in (13mm) thick rubber, per SCTE 77 Tier 15
- One sample with two metal cable racks installed in each long side (four racks total) or three per side (6 racks total) for the non-modified prior art vault
- One sample without racks installed

3. Test Procedure

Center load Test

[0035]

1. 1. Attach 10 in x 10 in (254 mm x 254 mm) loading plate to Dake test frame
2. 2. Place the enclosure on test frame
3. 3. Place standard L-bolt PC lid in the enclosure
4. 4. Locate and align center of lid with center of loading plates. See Fig. 8
5. 5. Attach indicator gauge to test frame and located in on the top surface of the enclosure in the middle of the long side
6. 6. Turn on hydraulics
7. 7. Apply load of 15000 lbs and take displacement reading
8. 8. Remove load and take permanent displacement reading
9. 9. Repeat Steps 7 and 8 for a total of 10 cycles
10. 10. Apply proof load of 22,500 lbs and hold for 30 seconds
11. 11. Release the load and visually inspect sample for any cracks, collapse, or other structural failures

Side wall load Test

[0036]

1. 1. Move load plate so that it is attached using the side wall configuration
2. 2. Locate and align the test plate center with the middle of the long side of the lid and where the lid and vault come together on the side. See Fig. 7
3. 3. Attach indicator gauge to test frame and located in on the top surface of the enclosure as close to the middle of the long side
4. 4. Repeat Steps 6 to 11 above
5. 5. If vault has not failed then take it to failure using the side wall load test

4. Observations

[0037]

- All three vault configurations tested very well during the center load test. After the center load test there were no observed effects on either vault.
- The big difference between the two modified configurations was when the side wall load test was performed. When the vault with the racks installed was loaded there were no observable effects. One could not tell load was being applied. When the vault without racks was loaded it started to collapse while holding the proof load of 22,500 lbs.
- During the side wall load test the non-modified prior art vault passed Tier 15 test with slight deformation observed. The vault was taken to failure, which occurred at 24,000 lbs when a crack was observed at the intersection of the rib pattern.
- Because the vault with racks did not fail during the Tier 15 test, it was taken to failure which still did not happen because the PC (polymer concrete) lid broke at 32,000 lbs.

5. Conclusions

[0038] The vault of this invention withstands the 22,500 lbs test load requirement of Tier 15, and produces a minimum vertical side wall load capacity in excess of 25,000 lbs. The vertical side load capacity is enhanced sufficiently to also meet load capacity standards in excess of at least 30,000 lbs, Side load stiffness k is in excess of 100,000 lbs/in and center load stiffness k is in excess of 150,000 lbs/in. The side load stiffness k is sufficiently enhanced to meet standards in excess of at least 80,000 lbs/in.

[0039] More specifically, according to the comparative test results, vertical side wall load capacity, measured as a function of

side wall deflection, met Tier 15 requirements with a vault body composition comprised of a non-metal, non-concrete, non-fiberglass thermoplastic material. The vault with racks had a stiffness of $k = 189731$ lbs/in and $k = 124342$ lbs/in for the center load and side wall load tests, respectively. The vault without racks had a stiffness of $k = 96985$ lbs/in and $k = 59535$ lbs/in for the center load and side wall load tests respectively. The vault with racks was stiffer by 96% and 109% on the center load and side wall load tests, respectively. The prior art non-modified vault with cable racks had a stiffness $k=134,477$ lbs/in and $k=76,076$ lbs/in for the center and side wall load tests. The present invention's vault with cable racks was stiffer by 41% and 63% on the center load and side wall load tests, respectively, than the prior art non-modified vault.

Test Results:

[0040]

Sample Description						$\delta_{max} = 0.5"$
						$\delta_{sct} = NA$
LOAD CYCLE	Load Applied (lbs)	Body Deflection (in)	Center Load Permanent	Side wall Load Body	Side wall Load Permanent	
10%	1500	0.030		0.039		
20%	3000	0.042		0.059		
30%	4500	0.050		0.076		
40%	6000	0.059		0.087		
50%	7500	0.066		0.094		
60%	9000	0.074		0.104		
70%	10500	0.081		0.114		
80%	12000	0.088		0.127		
90%	13500	0.096		0.140		
Cycle 1	15000	0.103	0.020	0.156	0.025	
Cycle 2	15000	0.103	0.020	0.154	0.029	
Cycle 3	15000	0.103	0.020	0.153	0.030	
Cycle 4	15000	0.103	0.020	0.154	0.033	
Cycle 5	15000	0.103	0.021	0.154	0.035	
Cycle 6	15000	0.104	0.021	0.156	0.034	
Cycle 7	15000	0.104	0.021	0.158	0.034	
Cycle 8	15000	0.103	0.022	0.157	0.033	
Cycle 9	15000	0.105	0.022	0.157	0.034	
Cycle 10	15000	0.104	0.022	0.157	0.036	
Final Cover Load	22500	0.143		0.235		
Failure Load	32000 lbs (PC Lid failed, not the vault)					

Sample Vault with Rack Pockets, but without Racks, Standard Drop in Lid							$\delta_{max} = 0.5''$
Description							$\delta_{rel} = NA$
LOAD CYCLE	Load Applied (lbs)	Body Deflection (in)	Center Load Permanent Center Load	Side wall Load Body	Permanent Load	Side wall Load	
10%	1500	0.032		0.043			
20%	3000	0.051		0.070			
30%	4500	0.065		0.091			
40%	6000	0.080		0.112			
50%	7500	0.094		0.131			
60%	9000	0.109		0.155			
70%	10500	0.125		0.182			
80%	12000	0.141		0.210			
90%	13500	0.157		0.238			
Cycle 1	15000	0.174	0.041	0.278	0.062		
Cycle 2	15000	0.167	0.041	0.266	0.072		
Cycle 3	15000	0.172	0.041	0.265	0.074		
Cycle 4	15000	0.168	0.043	0.267	0.072		
Cycle 5	15000	0.171	0.043	0.266	0.072		
Cycle 6	15000	0.172	0.046	0.267	0.076		
Cycle 7	15000	0.168	0.045	0.270	0.079		
Cycle 8	15000	0.171	0.046	0.272	0.079		
Cycle 9	15000	0.173	0.047	0.273	0.081		
Cycle 10	15000	0.169	0.045	0.272	0.083		
Final Cover Load	22500	0.279	0.075	0.455	0.137		
Failure Load	22500 lbs						

Sample Prior Art Vault w/o Molded in Rack Slots. Vault Fitted with Three Description Racks per Side. Standard Lid							$\delta_{max} = 0.5"$
							$\delta_{set} = NA$
LOAD CYCLE	(lbs.)	Load Applied	Deflection (inch)	Body Permanent	Center Load	Side wall Load Body	Side wall Load Permanent
10%		1500	0.041			0.039	
20%		3000	0.053			0.058	
30%		4500	0.065			0.075	
40%		6000	0.076			0.092	
50%		7500	0.086			0.109	
60%		9000	0.097			0.128	
70%		10500	0.109			0.148	
80%		12000	0.120			0.170	
90%		13500	0.131			0.197	
Cycle 1		15000	0.142	0.021	0.217	0.038	
Cycle 2		15000	0.137	0.020	0.203	0.033	
Cycle 3		15000	0.135	0.020	0.206	0.033	
Cycle 4		15000	0.135	0.020	0.201	0.032	
Cycle 5		15000	0.134	0.020	0.197	0.030	
Cycle 6		15000	0.134	0.020	0.208	0.036	
Cycle 7		15000	0.136	0.022	0.203	0.035	
Cycle 8		15000	0.135	0.022	0.202	0.035	
Cycle 9		15000	0.136	0.022	0.203	0.035	
Cycle 10		15000	0.133	0.021	0.205	0.037	
Final Cover Load		22500	0.185	0.048	0.335	0.108	
Failure Load		24000 lbs					

[0041] The tests conducted on the present invention have demonstrated improvements in vertical side load capacity, as one example, for molded polymeric grade level enclosures, or other non-metal structures, such as fiberglass. The ANSI Tier 15 test results are also one example demonstrating the improvements in vertical side wall load capacity. Other test standards also can be used to measure the level of improvements provided by the invention. As one example, similar comparative tests conducted on similar structures, but having different vertical side wall requirements, would see an improvement in load capacities when utilizing the structural combination of this invention.

APPENDIX

FEATURES:

[0042]

*17X30X26 INCHES (OPEN FLOOR) W/COMPOSITE RING

*HDPE BODY-POLYMER CONCRETE COVER/COMPOSITE FRAME-LOAD RATED TIER 15 (ANSI/SCRE 77 2010)

*2 COVER LOCKING BOLTS, 9/16 STAINLESS STEEL HEX HEAD BOLTS 3.5"X3/8" THREAD BOLTS WITH WASHERS

*2 BOX SELF-CENTERING STAINLESS STEEL CORROSION RESISTANT NUTS

*3 CONDUCT HOLES, 1 ON EACH AND 1 ON ONE SIDEWALL (4.75 INCH KO)

*4 HOT DIPPED GALVANIZED CABLE RACK SUPPORTS, 2 ON EACH SIDE (APPROX.48 INCHES TOTAL OF GALVANIZED

METAL MATERIAL, RACK HARDWARE BOLTS ARE ALSO TO BE STAINLESS STEEL) *1 STAINLESS STEEL BAR FOR SUPPORTING SPLICE CLOSURE *MINIMUM OF 2 LIFTING SLOTS IN COVER EQUIPPED WITH STAINLESS STEEL PINS (SLOTS APPROXIMATELY 3/4"X2")

WEIGHT AND SHIPPING:

[0043]

*COVER WEIGHT: 46LBS

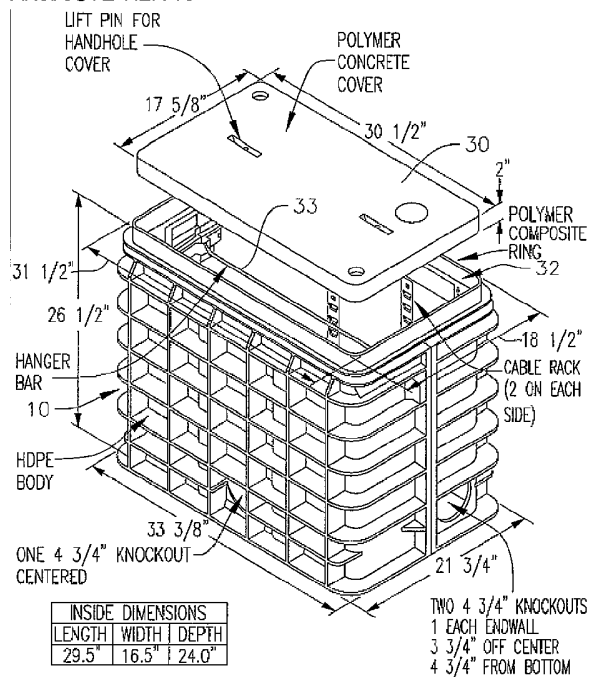
*BOX WEIGHT: 53.2 LBS

*ASSEMBLY WEIGHT: 99 LBS

LOAD RATINGS:

[0044]

ANSI/SCTE TIER 15



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.

Patent documents cited in the description

- WQ2006096839A [0003]

PATENTKRAV

1. Kvalitetsforsyningsomslutning (10) med forbedret styrke til underjordiske forsyningsforbindelser, som omfatter:

en i det væsentlige vertikal vægstruktur (12, 14), som strækker sig kontinuerligt omkring en åben indre region indenfor vægstrukturen (12, 14), idet vægstrukturen (12, 14) er lavet af et støbt polymermateriale;

idet den vertikale vægstruktur har en øvre kant, som strækker sig omkring en åbning til det indre af omslutningen og en bundkant, hvorpå omslutningen er understøttet;

en aftagelig dækplade (16), som er indrettet til at blive monteret på en åbning i kvalitetsomslutningen for dermed at aflukke i det mindste en del af den indre region fra omgivelserne, idet dækpladen er indrettet til at gå i indgreb med i det mindste en del af omslutningens øvre kantstruktur;

idet den vertikale vægstruktur indbefatter et opretstående indre vægpanel (46), som strækker sig fra den øvre kant til bundkanten af den vertikale vægstruktur, idet det indre vægpanel har en opretstående indvendig flade (48), som spænder over det indre af omslutningen;

idet den indvendige flade (48) af det indre vægpanel (46) har venstre og højre sider, som vender imod hinanden;

en eller flere smalle, vertikalt slidsede regioner (58), som er udsparet i den indvendige flade (48) af det indre vægpanel (46) på den venstre side og på den højre side af omslutningen, som strækker sig fra den øvre kant til bundkanten af det indre vægpanel; og

en opretstående stiv understøtningsstang (60), som er indrettet til brug som et kabelstativ, som er anbragt i mindst én slidset region (58) på hver side af vægstrukturens indvendige flade (48);

idet understøtningsstængerne (60) har en flad, kontinuerlig flade (62), som er i niveau med den indvendige flade (48) af det indre vægpanel (46), som definerer et hulrum indenfor den slidsede region (58) bagved den flade, kontinuerlige flade (62), idet understøtningsstængerne (60) tilvejebringer i det væsentlige kontinuerlig, stiv, vertikal understøtning, som strækker sig fra den øvre kant til bundkanten af omslutningens vertikale vægstruktur (12, 14).

2. Apparat ifølge krav 1, hvori de udsparede understøtningsstænger (60) tilvejebringer forbedret vægstyrke til den vertikale vægstruktur, som er tilstrækkelig til at opfylde ANSI/SCTE 77-2010 Tier 15 belastningsteststandarder for vertikale sidevægge.

3. Apparat ifølge krav 1, som indbefatter en vertikalt og horisontalt strækkende ydre understøtningsgitterstruktur, som er lavet af et støbt polymermateriale, som er støbt integreret på den indvendige flade af den vertikale vægstruktur (12, 14), idet gitterstrukturen omfatter vertikale ribber (26), som er anbragt med indbyrdes afstand horisontalt, og som strækker sig kontinuerligt fra en nedre til en øvre del af den vertikale vægstruktur (12, 14), og horisontale ribber (24), som er anbragt med indbyrdes afstand vertikalt, og som strækker sig kontinuerligt

omkring den vertikale vægstruktur (12, 14); og hvori det indre vægpanel (46) er støbt på gitterstrukturen.

4. Apparat ifølge krav 1, hvori den vertikale vægstruktur (12, 14) er lavet af i det mindste én af (a)-(c): (a) polyethylen med høj densitet; (b) et termoplastisk materiale; (c) et polyolefin-materiale og dækpladen (16) er lavet af et polymer/beton-materiale.

5. Apparat ifølge krav 1, hvori den stive understøtningsstang (60) har en U-formet tværsnitskonfiguration med en flad, kontinuerlig flade (62) af stangen (60), der vender imod det indre af omslutningen (10), som indbefatter fastgørelsesorganer (64), som er anbragt med indbyrdes afstand, som stift fikserer hver understøtningsstang (60) gennem hulrummet til den udsparede slidsede region (58), og hvori understøtningsstængerne (60) indbefatter trinvisse konnektorer (61), som strækker sig igennem den flade, kontinuerlige flade (62) til fastgørelse til udstyr, som er anbragt indenfor det indre af omslutningen (58).

6. Apparat ifølge krav 1, som indbefatter underjordisk telekommunikationsudstyr, som er fastgjort til konnektorer (61), som er anbragt med indbyrdes afstand vertikalt, på understøtningsstangen.

7. Apparat ifølge krav 1, hvori belastningskapaciteten for den vertikale sidevæg er større end 25.000 lbs.

8. Apparat ifølge krav 1, hvori vægstrukturen (12, 14) af omslutningskroppen omfatter et i det væsentlige ikke-metallisk, ikke-beton, ikke-glasfiber termoplastisk materiale.

9. Kvalitetsforsyningsomslutning (10) med forbedret styrke til underjordiske forsyningsforbindelser, som omfatter:

en i det væsentlige vertikal vægstruktur (12, 14), som strækker sig kontinuerligt omkring en åben indre region indenfor vægstrukturen, idet vægstrukturen har en åben bund og er lavet af et støbt polymermateriale;

idet den vertikale vægstruktur har en øvre kant, som strækker sig omkring en åbning til det indre af omslutningen og en bundkant, hvorpå omslutningen er understøttet;

idet den vertikale vægstruktur indbefatter et opretstående indre vægpanel, som strækker sig fra den øvre kant til bundkanten af den vertikale vægstruktur, idet det indre vægpanel har en opretstående indvendig flade, som spænder over det indre af omslutningen;

idet den indvendige flade af det indre vægpanel har venstre og højre sider, som vender imod hinanden;

vertikalt slidsede regioner, som er anbragt med indbyrdes afstand i en langsgående retning, som er udsparet i den indvendige flade af det indre vægpanel på den venstre side og på den

højre side af omslutningen, som strækker sig fra den øvre kant til bundkanten af det indre vægpanel; og
en opretstående stiv understøtningsstang (60), som er indrettet til at blive placeret i separate slidsede regioner (58) på hver side af vægstrukturens indvendige flade (48);
hvor i placeringen af understøtningsstængerne (60) i de udsparede slidsede regioner (58) har en flad, kontinuerlig flade (62), som er i niveau med den indvendige flade (62) af det indre vægpanel som definerer et hulrum indeni den vertikalt slidsede region (58) bagved den flade, kontinuerlige flade (62), idet understøtningsstængerne (60) tilvejebringer i det væsentlige kontinuerlig, stiv, vertikal understøtning, som strækker sig fra den øvre kant til bundkanten af omslutningens vertikale vægstruktur (12, 14).

10. Apparat ifølge krav 9, hvori de udsparede understøtningsstænger (60) tilvejebringer forbedret vægstyrke til den vertikale vægstruktur, som er tilstrækkelig til at opfylde ANSI/SCTE 77-2010 Tier 15 belastningsteststandarder for vertikale sidevægge med en sidebelastningsstivhed som er højere end 100.000 lbs/in.

11. Apparat ifølge krav 9, som indbefatter en vertikalt og horisontalt strækkende ydre understøtningsgitterstruktur, som er lavet af et støbt polymermateriale, som er støbt integreret på den indvendige flade af den vertikale vægstruktur (12, 14), idet gitterstrukturen omfatter vertikale ribber (26), som er anbragt med indbyrdes afstand horisontalt, som strækker sig kontinuerligt fra en nedre til en øvre del af den vertikale vægstruktur, og horisontale ribber (24), som er anbragt med indbyrdes afstand vertikalt, som strækker sig kontinuerligt omkring den vertikale vægstruktur (12, 14); og hvori det indre vægpanel er støbt på gitterstrukturen.

12. Apparat ifølge krav 9, hvori omslutningen (10) indbefatter mindst to af de stive understøtningsstænger (60) på hver side af omslutningen.

13. Apparat ifølge krav 10, hvori omslutningens vertikale vægstruktur (12, 14) er lavet af mindst én af (a)-(c): (a) polyethylen med høj densitet; (b) et termoplastisk materiale; (c) et polyolefin-materiale.

14. Apparat ifølge krav 10, hvori den stive understøtningsstang har en U-formet tværsnitskonfiguration med en flad, kontinuerlig flade (62) af stangen, som vender imod det indre af omslutningen (10), som indbefatter fastgørelsesorganer (64), som er indrettet til stift at fiksere understøtningsstængerne (60) gennem hulrummet til de udsparede slidsede regioner (58).

15. Apparat ifølge krav 14, hvori understøtningsstængerne (60) omfatter kabelstativer med trinvisse konnektorer (61), som strækker sig igennem den flade, kontinuerlige flade (62) til fastgørelse til udstyr, som er anbragt indenfor det indre af omslutningen (10).

DRAWINGS

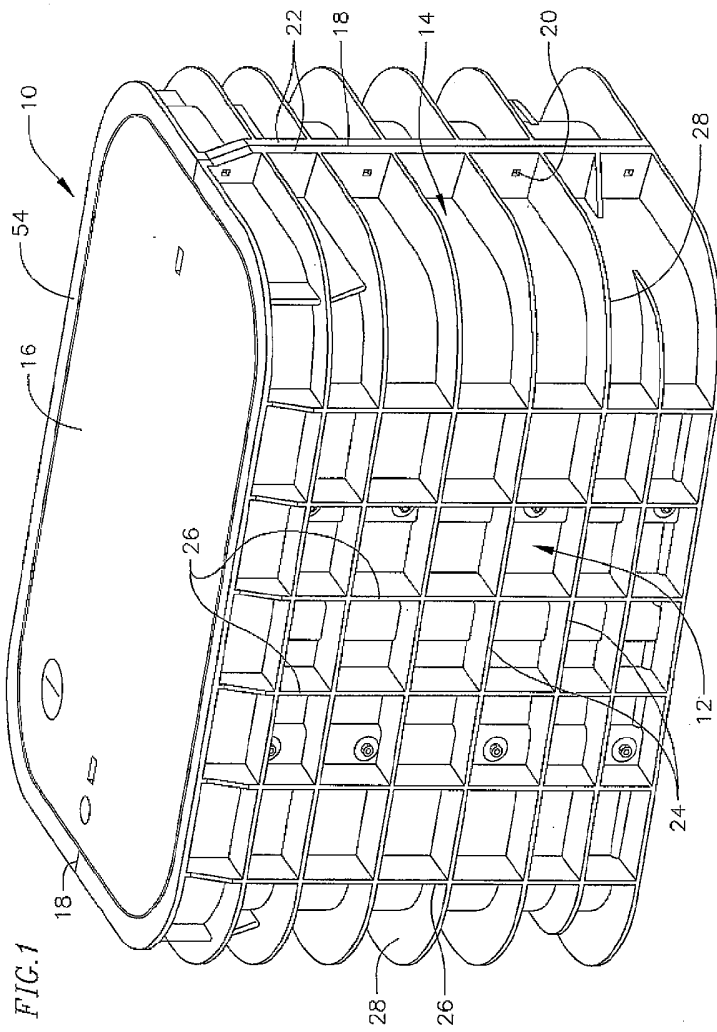
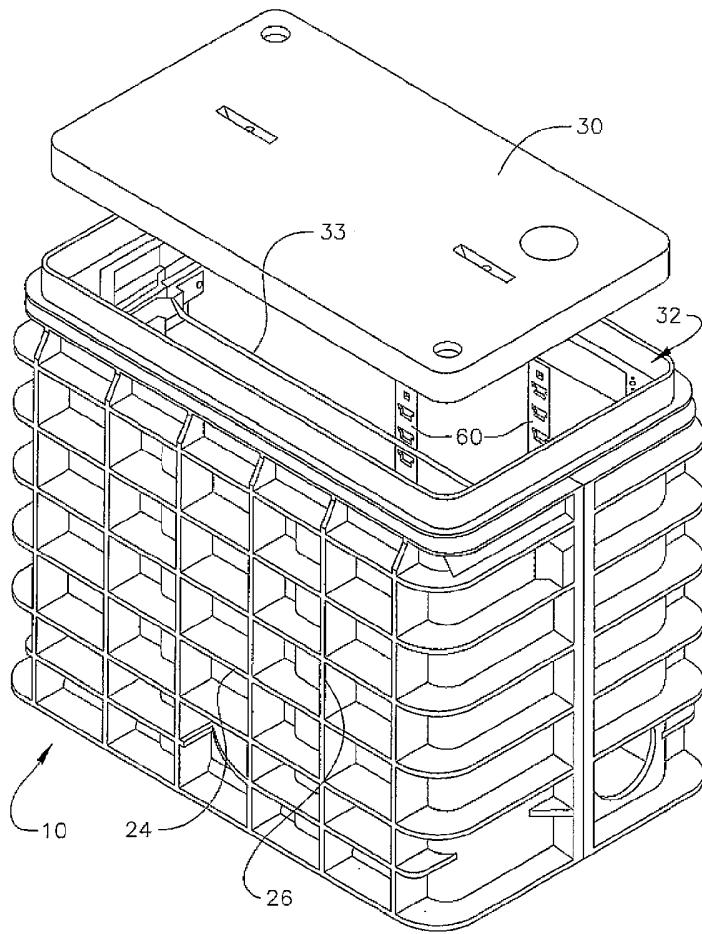


FIG. 1A



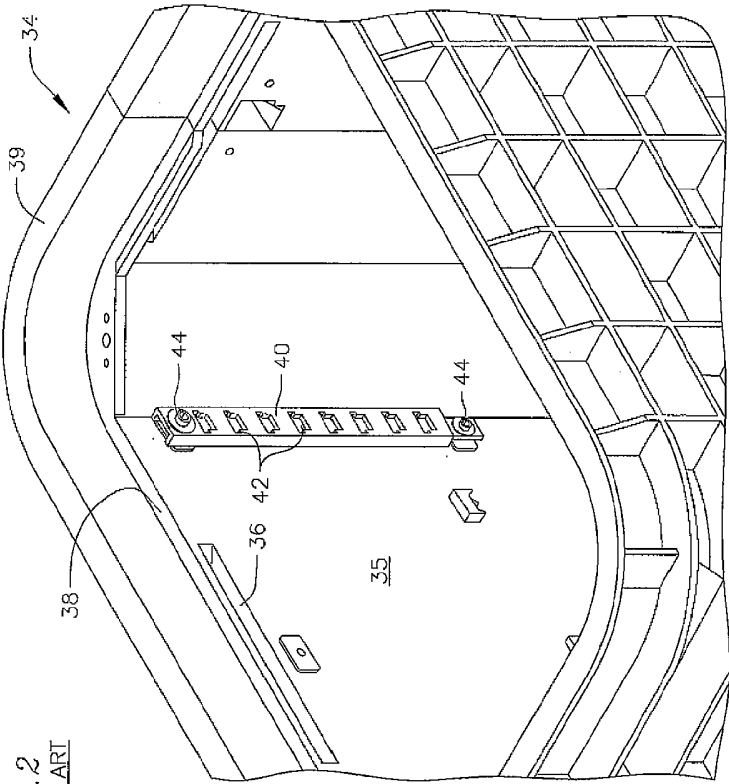
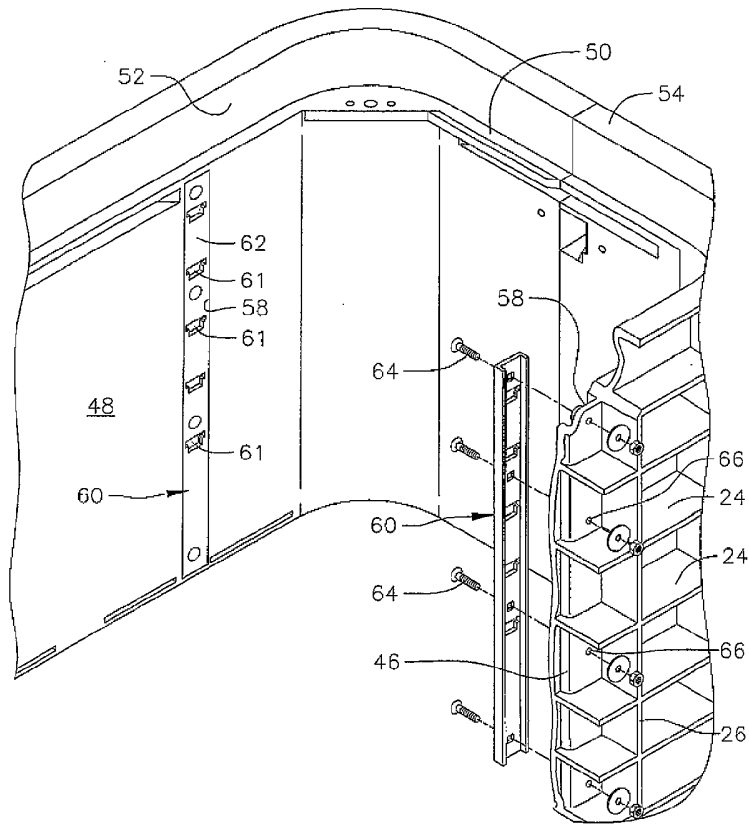


FIG. 3



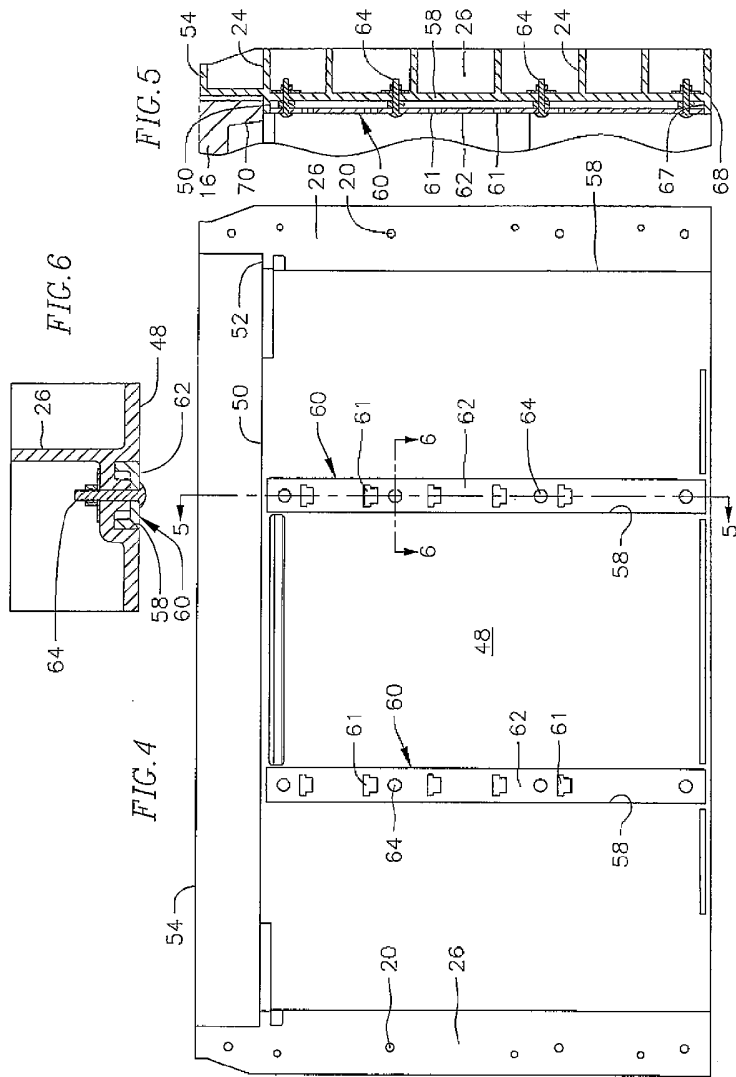


FIG. 7

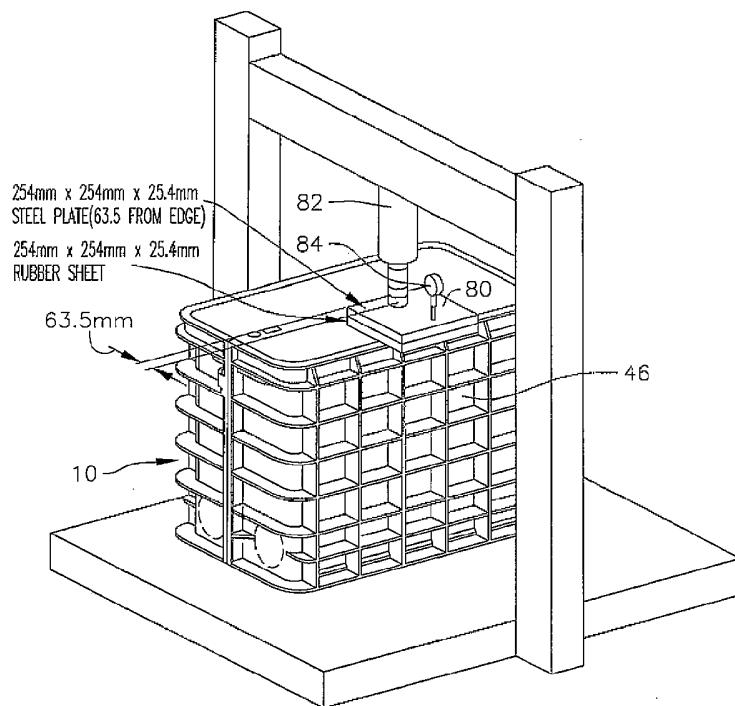


FIG. 8

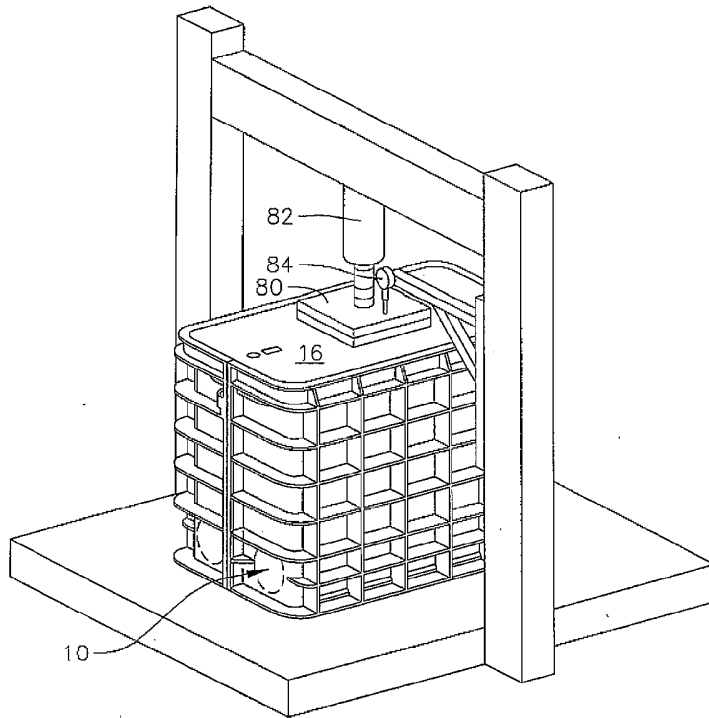
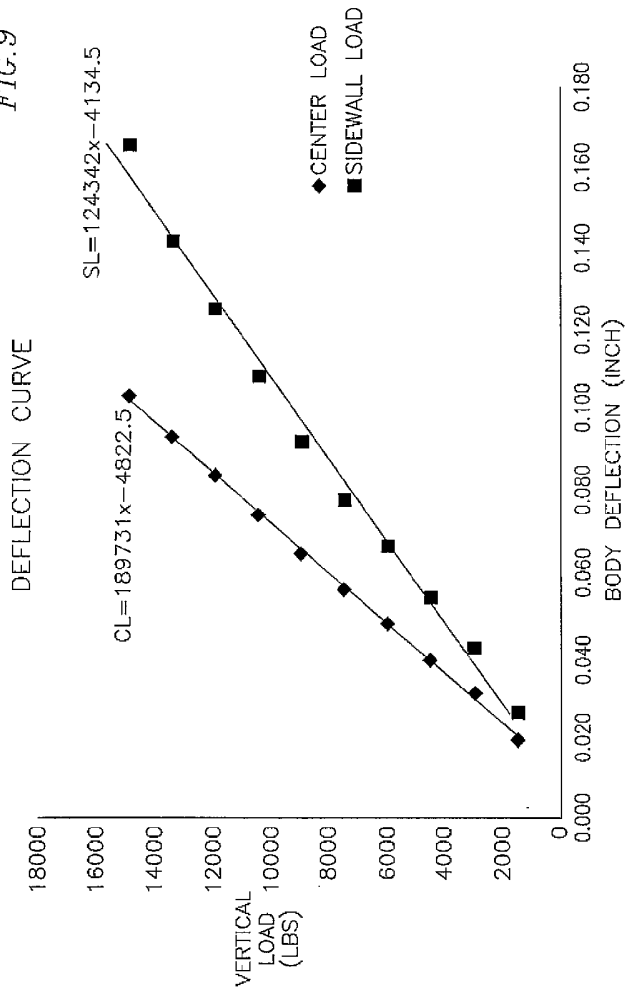
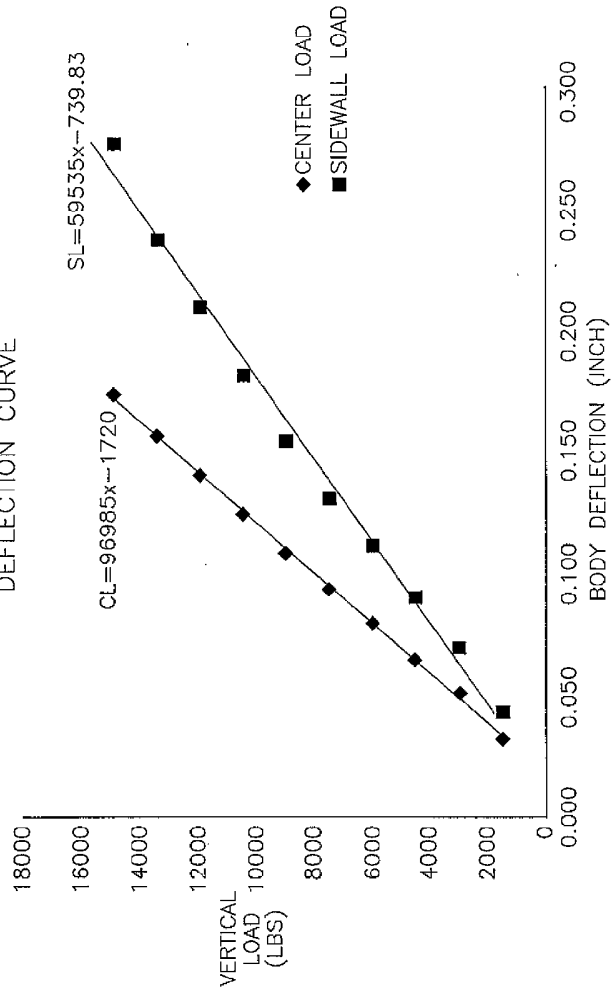


FIG. 9



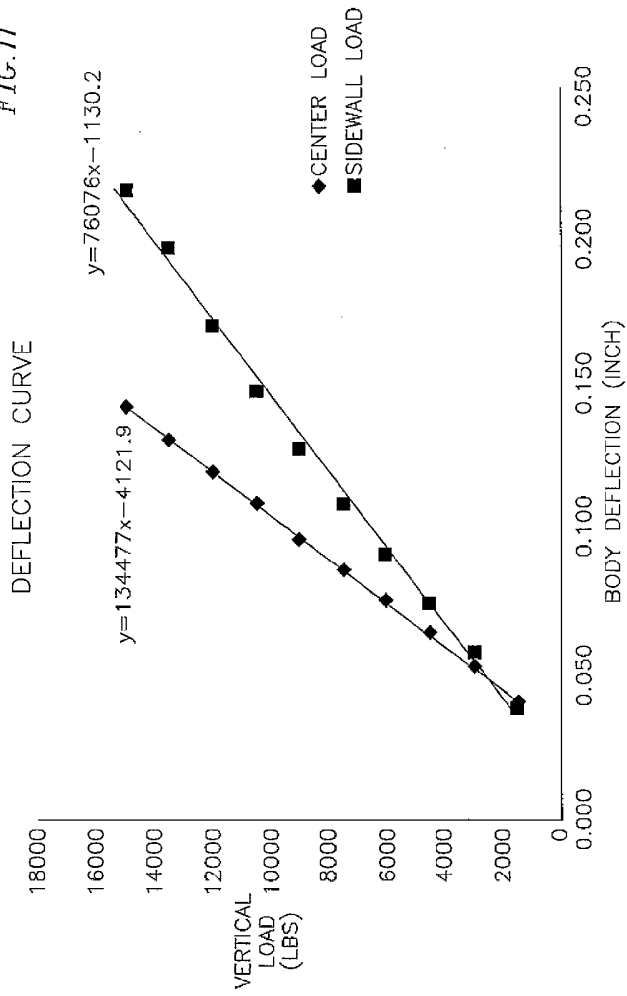
GRAPH SHOWS THE STIFFNESS (k) OF THE VAULT FOR TWO LOAD LOCATIONS.
FOR THE CENTER LOAD $k=189731$ LBS/IN AND FOR THE SIDEWALL LOAD $k=124342$ LBS/IN.

FIG. 10
DEFLECTION CURVE



GRAPH SHOWS THE STIFFNESS (k) OF THE VAULT FOR TWO LOAD LOCATIONS.
FOR THE CENTER LOAD k=96985 LBS/IN AND FOR THE SIDEWALL LOAD k=59535 LBS/IN.

FIG.11



GRAPH SHOWS THE STIFFNESS (k) OF THE VAULT FOR TWO LOAD LOCATIONS.
FOR THE CENTER LOAD $k=13447$ LBS/IN AND FOR THE SIDEWALL LOAD $k=76076$ LBS/IN.