United States Patent [19]

Anatalio

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[54] **VESSELL STABILIZATION SYSTEM**

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[52] **U.S. Cl.** **248/154,** 248/358

[51] **Int. Cl.** **F16m 11/00**

[58] **Field of Search** 248/1, 7, 18, 26, 248/154, 358, 417; 267/150, 162, 182

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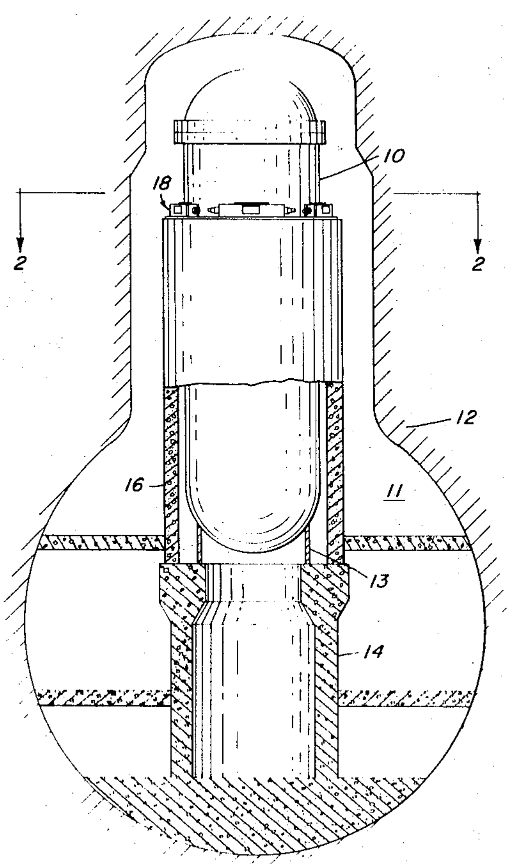
[57] **ABSTRACT**

An arrangement for stabilizing a vertically supported elongated vessel including a system of resiliently supported yokes for engaging respective lugs fixed to the vessel.

2 Claims, 4 Drawing Figures



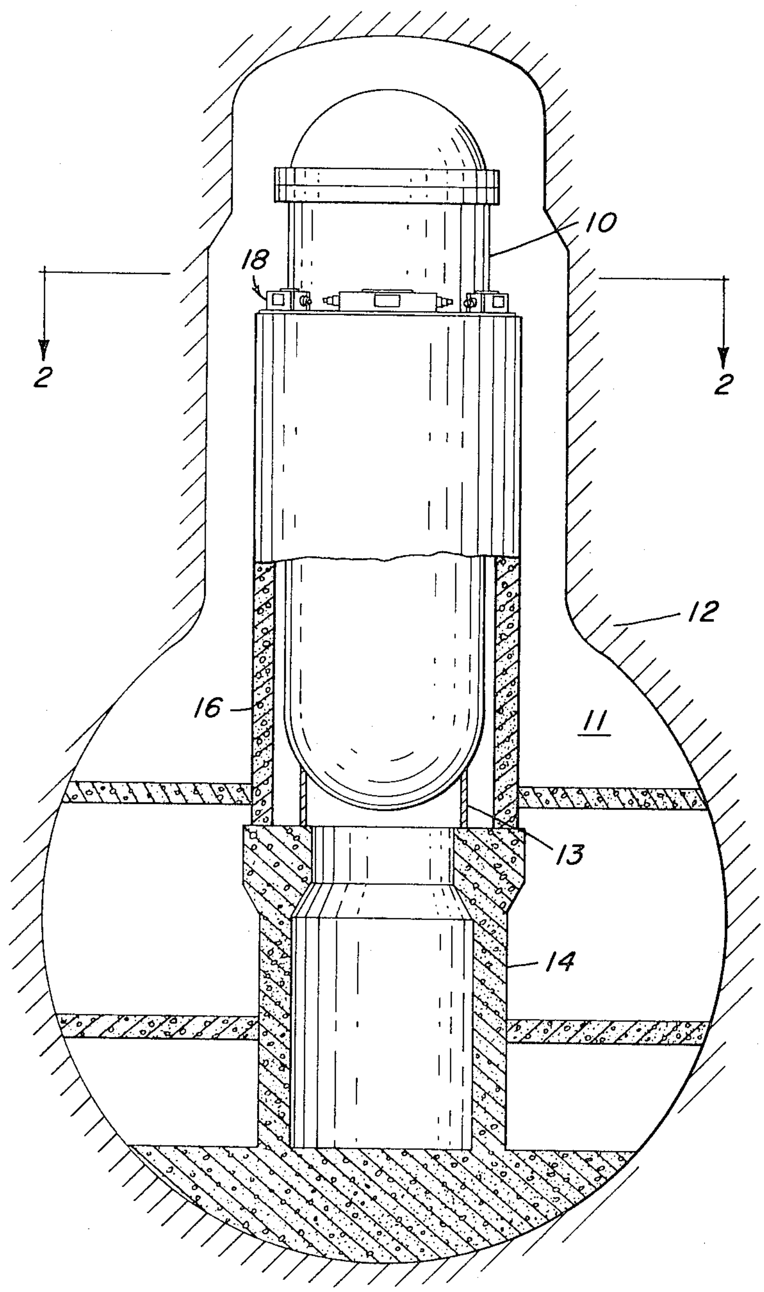


Fig. 1

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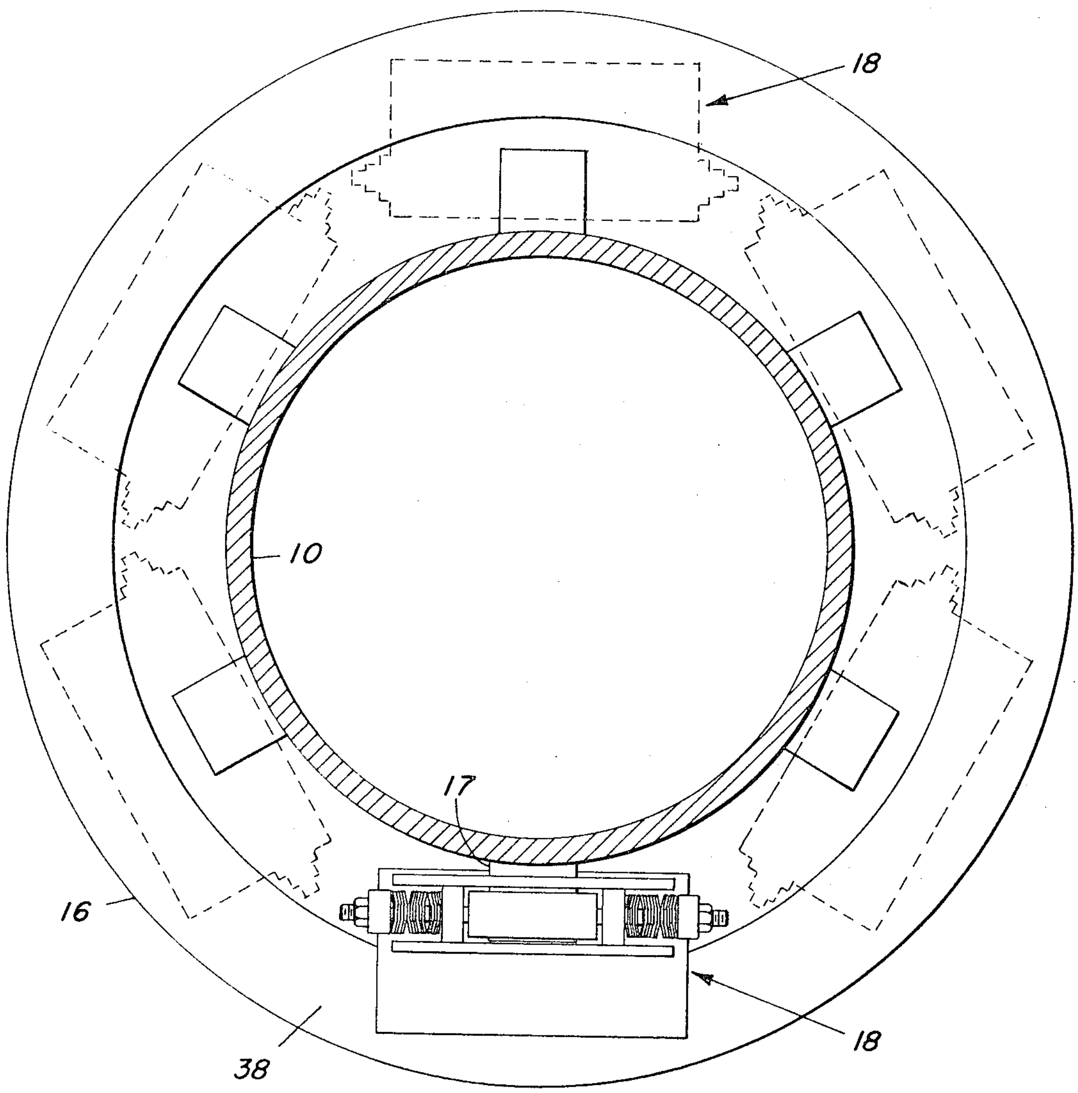

Fig. 2

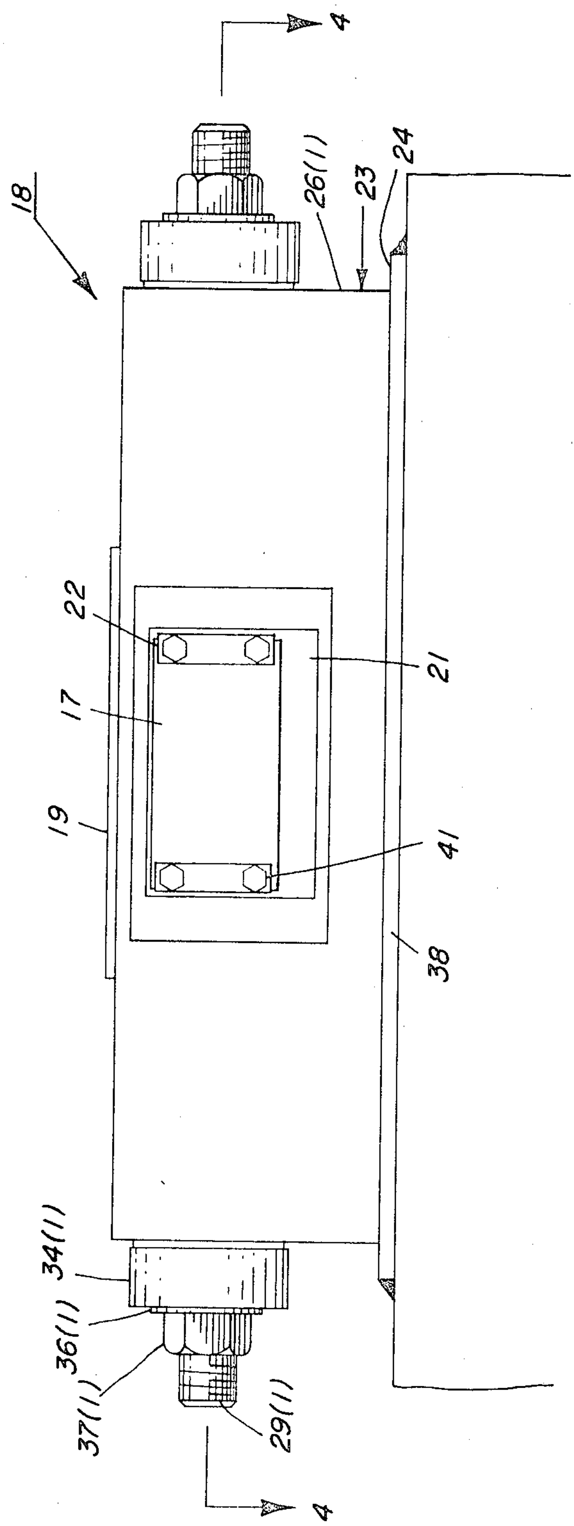

Fig. 3

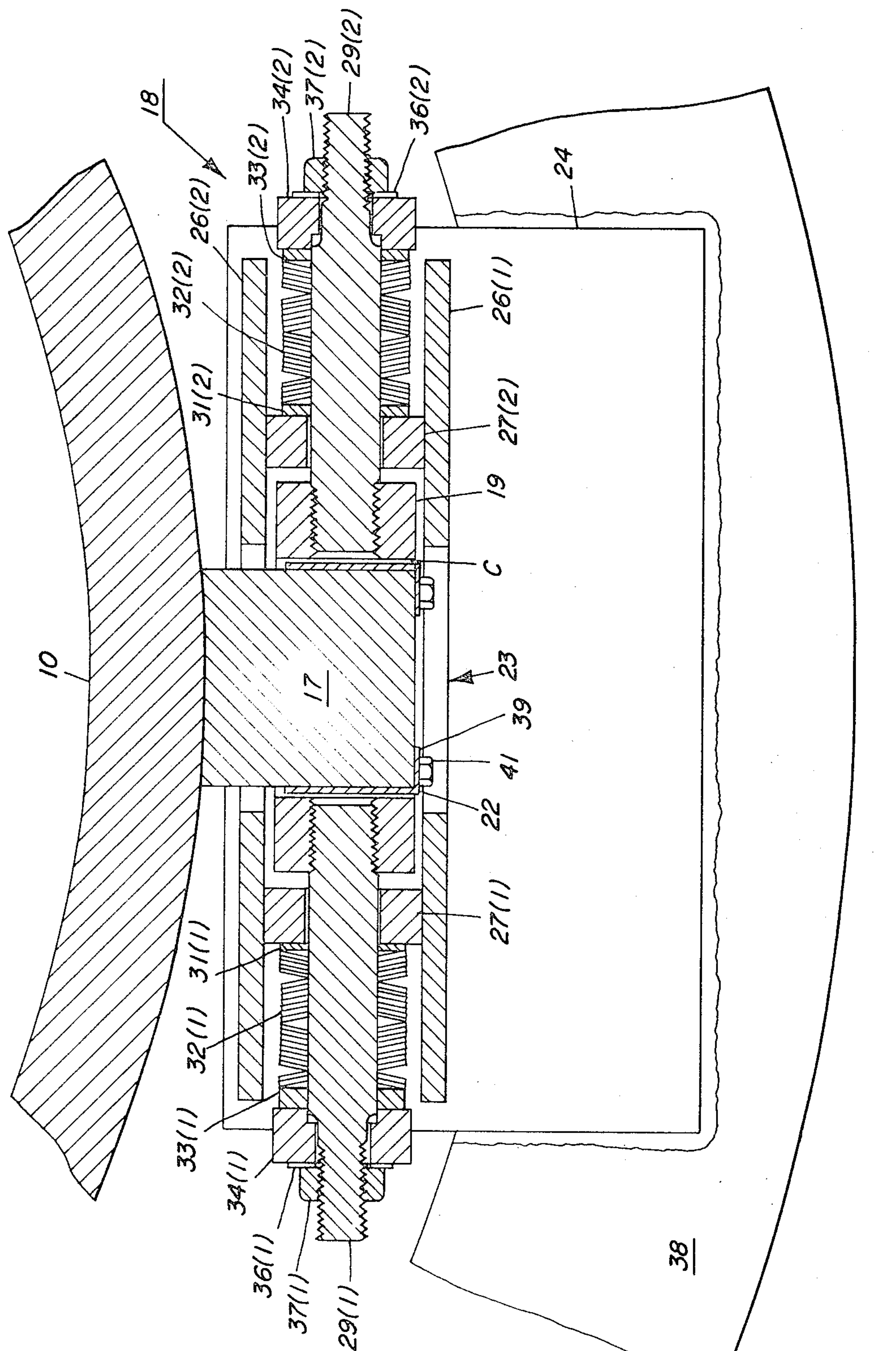
18
29(2)
37(2)
34(2)
36(2)
33(2)
26(2)
24
32(2)
26(1)
31(2)
27(2)
19
C
10
17
23
39
41
22
27(1)
31(1)
32(1)
33(1)
34(1)
36(1)
37(1)
29(1)
38

Fig. 4

VESSELL STABILIZATION SYSTEM

BACKGROUND

Large pressure vessels are used for many applications. For example, a pressure vessel is typically used to house the fuel core and other components of a nuclear power reactor. Such a pressure vessel may be 60–70 feet high, in the order of 20 feet in diameter and contain a pressure of 1,000 pounds per square inch, the vessel being supported by a pedestal or support shroud attached near the bottom of the vessel. Such an elongated vessel generally requres some type of lateral stabilization against earthquake and similar forces.

In a known reactor pressure vessel installation, the vessel is surrounded by a concrete shield wall spaced from the vessel and extending short of the top of the vessel. A plurality of radially extending lugs are welded to the vessel just above the shield wall. The outer ends of each of these lugs is formed with a horizontal clearance hole to receive a rod and each end of this rod engages a bracket secured to the shield wall. Heavy disc springs mounted on the rods and prestressed between the lugs and the brackets provide lateral stabilization of the pressure vessel. This arrangement is found to present several shortcomings. If the lugs are formed with holes in the factory, then installation of the lugs on the pressure vessel must be quite precise. On the other hand, field forming of these holes, after the lugs are welded onto the vessel, is quite costly, such holes being in the order of five inches in diameter. Also, this arrangement does not accommodate, to the extent desirable, the vertical and radial temperature induced expansion and contraction of the pressure vessel.

SUMMARY

Thus an object of the invention is to provide an improved stabilizing arrangement for a pressure vessel.

Another object is to provide a vessel stabilizer which minimizes field fabrication and which accommodates vertical and radial expansion and contraction of the vessel.

These and other objects are achieved by a stabilizer assembly formed of a yoke for engaging the lugs on the pressure vessel. The yoke is tapped to receive oppositely extending threaded rods or bars which pass through clearance holes in a bracket secured to the shield wall or other fixed structure surrounding the vessel. Disc springs are mounted on these rods and are prestressed between the bracket and nuts threaded on the ends of the rods to provide the snubbing force requisite to vessel stabilization. With this arrangement, no large holes are required in the vessel lugs; the yoke can be sized to accommodate thermally induced movement of the vessel; the assembly can be factory assembled including prestressing of the springs; and the yoke opening inexpensively can be adjusted in the field for appropriate clearance from the vessel lug by simply installed shims.

DRAWING

The invention is described more specifically hereinafter with reference to the accompanying drawing wherein:

FIG. 1 is an elevation view of a pressure vessel within a containment;

FIG. 2 is a cross section view of the structure of FIG. 1 taken along the line 2—2 of FIG. 1;

FIG. 3 is a horizontal view of the assembly of the invention; and

FIG. 4 is a top detail view, partly in section, of a stabilizer assembly of FIG. 3 taken along the line 4—4 of FIG. 3.

DESCRIPTION

Shown in FIG. 1 is a cylindrical pressure vessel **10**, housed within a dry well **11** of a containment **12**. The vessel **10** is supported by a shroud **13** where it bears upon a support pedestal **14** of the containment structure. As employed to house a nuclear reactor core, the vessel **10** is surrounded by a cylindrical shield wall **16**, usually formed of concentric steel cylinders filled with concrete.

With reference also to FIG. **2**, the vessel stabilizing arrangement comprises a plurality of lugs **17** fixed (as by welding) to the vessel **10** and projecting radially therefrom just above the top of the shield wall **16**. Each lug **17** is engaged by a respective one of a plurality of stabilizer assemblies **18** mounted on the shield wall **16**. A stabilizer assembly **18** is shown in greater detail in FIGS. **3** and **4**.

Each stabilizer assembly **18** includes a yoke **19** having a central opening **21** sized to receive the lug **17** with appropriate clearance. The opening **21** may be formed oversized in width to accommodate construction tolerances. Shims **22** may then be field installed to provide the desired clearance between the yoke **19** and the lug **17**.

The yoke **19** is positioned with clearance within a bracket **23** formed of a base plate **24**, side members **26(1)** and **26(2)** and cross members **27(1)** and **27(2)**. The side members **26(1)** and **26(2)** are formed with cut outs to clear the lug **17** and to provide access to the opening **21** in yoke **19**.

The yoke **19** is drilled and tapped at opposite sides to receive a pair of oppositely extending threaded rods or bars **29(1)** and **29(2)** which pass through clearance holes in bracket cross members **27(1)** and **27(2)**, respectively. On the rods **29(1)** and **29(2)** are mounted, respectively, the following: washers **31(1)** and **31(2)**, disc spring sets **32(1)** and **32(2)**, spacers **33(1)** and **33(2)**, sleeves **34(1)** and **34(2)**, washers **36(1)** and **36(2)** and nuts **37(1)** and **37(2)**.

The shield wall **16** is ordinarily fitted with a steel top ring **38**. The bracket **23** may be secured to this ring, for example, by bolts, cap screws or the like or by welding as illustrated.

The stabilizer assembly **18** is well adapted for factory assembly and preload. A factory assembly procedure is as follows: the yoke **19** is positioned in the bracket **23**. Rods **29(1)** and **29(2)** are threaded into yoke **19** and are preferably tack welded to prevent disengagement. Washers **31(1)** and **31(2)**, disc spring sets **32(1)** and **32(2)**, spacers **33(1)** and **33(2)**, sleeves **34(1)** and **34(2)**, washers **36(1)** and **36(2)** and nuts **37(1)** and **37(2)** are placed on the rods **29(1)** and **29(2)**. Opposing forces are then applied, preferably to the sleeves **34(1)** and **34(2)** by a suitable tensioner device (not shown) to precompress the spring sets **32(1)** and **32(2)** to the desired preload. The nuts **37(1)** and **37(2)** are run up against the sleeves **34(1)** and **34(2)** to maintain this preload and the tensioner device then may be removed. The stabilizer assembly **18** is now ready for field installation.

A field installation procedure is as follows: the stabilizer assembly **18** is placed on top of the shield wall **16** and is moved toward the pressure vessel **10** so that the lug **17** is inserted into the opening **21** of the yoke **19**. The assembly **18** is positioned so that the sides of the lug **17** and the sides of the opening **19** are as nearly parallel as feasible and so that the gaps between the lug **17** and opening **19** are substantially equal. The assembly **18** is then clamped in place and welded to the ring **38** or otherwise secured to the shield wall **16**. Shims **22** are now installed to provide a predetermined clearance C between the yoke **19** and lug **17** when the pressure vessel is in the hot condition. The shims **22** may be welded in place or, conveniently, they may be formed with a flange **39** by which they may be secured to the lug **17** with cap screws **41**. Advantageously, the shims **22** may be machined with a taper if required to compensate for any lack of parallelism between the lug **17** and the sides of the opening **21** of the yoke **19**.

As shown in FIG. **3** the lug **17** is toward the top of the opening **21**, typical of its position when the pressure vessel **10** is in the hot condition. When the pressure vessel is in the cold condition it is contracted so that the lug **17** is toward the bottom of the opening **21**. The height of the opening **21** is selected to accommodate this change of position of the lug **17** with temperature.

The following table sets forth the principal dimensions and parameters of the elements of a stabilizer assembly arrangement for use with the pressure vessel of a typical nuclear power reactor of about 65 feet in height, about 20 feet in diameter and with a loaded weight of about 600 tons.

Element	
Lug 17	
Radial length	15.5''
Width	12.0''
Height	6.0''
Yoke 19	
Width	23.0''
Height	15.5''
Thickness	10.0''
Opening 21	
Width	13.0''
Height	10.5''
Rods 29 (1), 29 (2)	
Length	42.0''
Diameter	5.0''
Spring sets 32(1), 32(2)	
Number of springs per set	20
OD	10.0''
Deflection (each spring disc) for load of 39 KIPS	0.057''
Preload	380 KIPS
Clearance C	0.005''

What is claimed is:

1. A system for stabilizing a vertically positioned elongated vessel, comprising: a fixed structure adjacent said vessel; a plurality of lugs fixed to said vessel and extending radially therefrom; a plurality of stabilizer assemblies, each assembly being secured to said structure and engaging a respective one of said lugs, each said stabilizer assembly including a bracket secured to said fixed structure and having a pair of spaced cross members, a yoke positioned between said cross members having a central opening surrounding said respective one of said lugs, a pair of bars secured to said yoke and extending oppositely therefrom through clearance holes in said cross members, and resilient means carried by said bars, said resilient means being precompressed between the outer ends of said bars and said cross members.

2. A stabilizer assembly for engaging a lug on a vessel, comprising: a bracket including a relatively rigidly fixed base, a pair of spaced side members fixed to said base and formed with cut outs to pass said lug, a pair of spaced cross members secured between said side members; a yoke positioned between said cross members, said yoke being formed with a central opening to engage said lug; a pair of oppositely extending bars secured to said yoke and extending through clearance holes in said cross members; and a spring set on each of said bars, said spring sets being precompressed between the ends of said bars and said cross members.

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