Nov. 14, 1967 J. L. RICHMAN 3,352,028

INDUSTRIAL PROCESS AND APPARATUS

Filed March 4, 1966

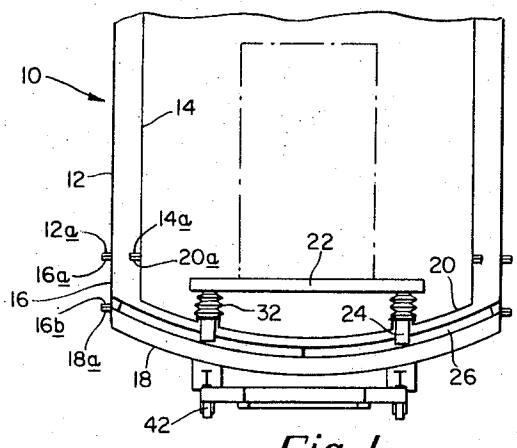


Fig. 1

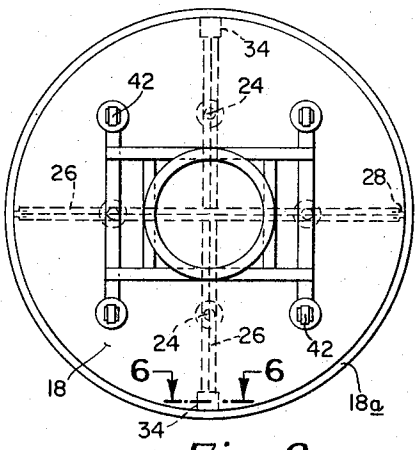


Fig. 2

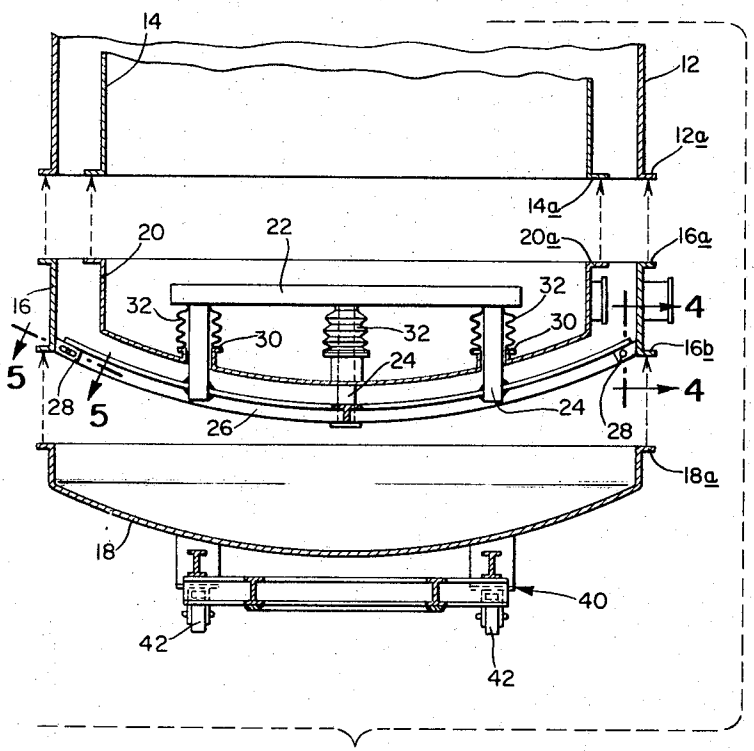


Fig. 3

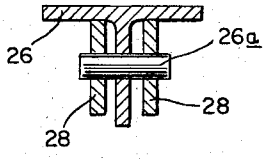


Fig. 4

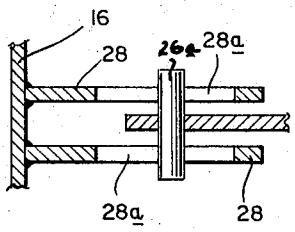


Fig. 5

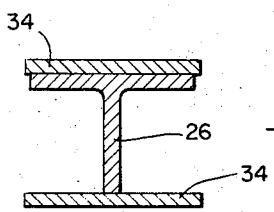


Fig. 6

INVENTOR.
JAY L. RICHMAN
BY Dallett Hoopes
ATTORNEY

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INDUSTRIAL PROCESS AND APPARATUS

Jay L. Richman, Philadelphia, Pa., assignor to Pennsalt Chemicals Corporation, Philadelphia, Pa., a corporation of Pennsylvania

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ABSTRACT OF THE DISCLOSURE

Inner and outer containers are provided with a test object support supported within the inner container by a column extending through an end wall of the inner container for connection to a supporting spider carried by the outer container, with a bellows seal extending between the end wall and the container.

This invention relates to a double-walled pressure vessel especially adapted for use as a chamber for space simulation.

In such a chamber it is desirable to have the inner container walls of a relatively thin gauge material. This reduces the thermal inertia and hence minimizes the load on the refrigeration equipment provided to reduce the temperature in the chamber to outer-space levels. The light gauge inner container is also easy to support in a way which rapidly accommodates expansion and contraction. Problems arise in connection with such construction, however, because the inner chamber must contain relatively heavy objects which would tax the walls of the inner chamber and probably deform them.

The vessel of the invention provides support means for objects (for instance, equipment to be observed under space conditions), the support means not transmitting its load to or through the inner container wall in a manner which might deform it.

Other objects of the invention will be apparent from the following specification including the attached drawings. In the drawings:

FIGURE 1 is a schematic fragmentary sectional view of an apparatus embodying the invention;

FIGURE 2 represents a bottom view of an apparatus embodying the invention;

FIGURE 3 is an enlarged fragmentary exploded elevational view in section;

FIGURE 4 is a sectional view taken on the line 4—4 of FIGURE 3;

FIGURE 5 is a sectional view taken on the line 5—5 of FIGURE 3; and

FIGURE 6 is an enlarged sectional view taken on the line 6—6 of FIGURE 2.

Briefly, the invention relates to a double-walled pressure vessel especially useful for space simulation and having within it support means for an object to be subjected to such conditions. The weight of the support means and object thereon is transmitted in a manner such that no substantial weight is borne by the relatively thin wall of the inner container. The invention is useful for a bottom, side or top loading chamber.

Referring more specifically to the drawings, an apparatus embodying the invention is designated generally **10** in FIGURE 1. It comprises an outer container having a peripheral shell **12**, **16** and an inner container having a peripheral shell **14**. These shells have outward flanges **16***b* and **14***a*, respectively. The outer container has the removable section or spool **16** which may be coupled to the section above it by flanges **12***a* and **16***a* as shown. A bottom end wall **18** having a flange **18***a* is provided for the outer container and is adapted to be attached by its flange to the flange **16***b* of the peripheral shell. A bottom

end wall **20** having a flange **20***a* is adapted to be secured by the flange to the flange **14***a* of the peripheral shell **14** of the inner container.

As indicated in the drawings and for purposes including those outlined above, the walls of the inner container are of relatively thinner material than the walls of the outer container.

As shown in FIGURE 3 the object support means comprises the support shelf **22** adapted to support the equipment or other test object being subjected to the space environment. The object support means also includes a plurality of rigid columns **24** and a cross-shaped spider **26** to which the columns are secured. Each element of the spider **26** as shown in FIGURE 4 has a T-shaped cross section and as shown in FIGURE 3 is preferably concave upwardly to conform more or less to the curvature of the inner container bottom end wall **20**. The end of each piece of the cross-shaped spider **26** is supported in the disassembled condition shown in FIGURE 3 by holding means secured to the shell of the outer chamber. As shown in FIGURES 4 and 5 this means may comprise a pair of parallel spaced ears **28**, the vertical portion of the T being disposed between the ears and pinned as by pins **26***a*. The pins preferably are press fitted into holes in the vertical portion and are received in openings in the ears **28**. On one set of ears the openings are slots **28***a* to allow for expansion and contraction of the spider. The spider **26** is shorter than the diameter of the shell to allow play for assembly in the shell as well as expansion. The holding means at the other end of the spider **26** may comprise parallel clips **34** (FIG. 6) between which the ends are held, in the bottom-loading variation shown, against vertical displacement.

It should be understood that by virtue of the arrangement shown the spider **26** and consequently the shelf **22** is held relative to the shell against movement in all directions. Hence the chamber may be inverted or disposed on its side and the support function of the shelf will not be impaired. At the same time the spider is allowed ample room to expand and contract relative to the shell.

The T-shape cross section of the spider is shown as an example only. It should be understood that the spider could be fabricated from standard bar stock.

In the preferred version the holding means comprising the ears **28** and pads **34** are secured to the peripheral shell of the outer container at the removable section **16** above the bottom end wall of the outer container **18**.

The columns **24** supporting the shelf **22** extend through flanged openings **30** in the bottom end wall of the inner container. The openings in these flanged openings are large enough to permit free vertical movement of the columns **24** relative thereto. Bellows seals **32** are provided from the top of each flanged opening to a point adjacent the top end of each column and assure maintenance of vacuum conditions without leakage through the flanged openings.

A framework **40** is secured to the underside of the wall **18**. This framework **40** is provided with wheels **42** for horizontal movability.

In assembly the test object is secured to the shelf **22**, the assembly including the framework **40**, the bottom end walls **18** and **20** and spool **16** with the spider **26** supported therein is raised until the flanges **12***a* and **16***a* engage. These flanges are bolted together. Subsequently the bottom end wall **18** is lowered, the shelf **22** and the inside bottom end wall **20** being supported by the spider **26** in engagement with the ears **28** and pads **34**. The flanges **20***a* and **14***a* are then bolted together to secure the end wall **20** on the inner shell **14**. Subsequently the bottom end wall **18** is raised until the flanges **16***b* and **18***a* may be bolted tight. The weight of the shelf **22** and the test object thereon is borne by spider **26** and the outer

nd wall **18**, the framework **40** and the wheels **42** and he platform on which they rest. Thus none of the weight of the test object or shelf **22** is borne by the light inner nd wall **20**.

The assembly procedure is the same whether the chamber is as shown, is inverted or is on its side. The objectives of the structure remain the same in all these variations: namely avoidance of placing of stress on the inner chamber walls and achievement of sealing of the inner chamber end wall prior to sealing of the outer chamber end wall.

The term "pressure vessel" as used herein means a vessel adapted to enclose a zone of super- or sub-ambient pressures.

The present invention may be embodied in other specific forms without departing from the spirit or central attributes thereof and, accordingly, reference should be made to the appended claims rather than the foregoing specification as indicating the scope of the invention.

I claim:

1. A space simulation chamber comprising an inner and a relatively more substantial outer container, each container having a peripheral shell and a removable end wall, the end wall of the inner container having an opening therein, the outer container having spider holding means secured thereto, test object support means in the inner chamber and including a column extending through said opening and a spider secured to said column beneath the end wall of the inner container, and sealing means including bellows sealingly extending from about said opening between the end wall of the inner container and the support means.

2. A space simulation chamber as described in claim **1** wherein said spider holding means is secured to a removable spool comprising part of the peripheral shell of the outer container.

3. A space simulation chamber as described in claim **1** wherein the spider is of shorter dimension than the diameter of the outer container and the holding means holds the spider axially relative to the axis of the outer container but permits expansion and contraction of the spider.

4. A space simulation chamber as described in claim **3** wherein the holding means includes pin means penetrating each end of the spider respectively and securing one end against any movement relative to the shell of the outer container and permitting the opposite end axial movement relative to the axis of the spider along said end.

5. A space simulation chamber as described in claim **4** wherein the holding means on the said opposite end includes a slotted structure receiving said pin means.

6. A pressure vessel as described in claim **1** wherein said containers define a relatively thin walled inner container and a relatively thick walled outer container enclosing the inner container, each having its removable end wall at the bottom thereof, and wherein the object support means in said inner container extends through the opening in the bottom end wall of the inner container for support through said spider and spider holding means by the shell of the outer container.

7. A pressure vessel as described in claim **6** wherein said spider holding means are secured to the outer container above the bottom end wall of the outer container and hold against vertical movement the object support means but permit expansion of the support means as it undergoes temperature variations.

8. A pressure vessel as described in claim **7** wherein the outer container has above its bottom end wall an annular removable section of its shell to which the spider holding means are secured.

References Cited

UNITED STATES PATENTS

3,011,674	12/1961	Jackson	220—15
3,044,607	7/1962	Hopper	220—15 XR
3,101,861	8/1963	Mearns et al.	220—10
3,224,277	12/1965	Chamberlin et al.	73—432

EUGENE R. CAPOZIO, *Primary Examiner.*

R. W. WEIG, *Assistant Examiner.*