Jan. 3, 1956 W. C. NASON, JR., ET AL 2,729,357

VACUUM JACKETED CONTAINER

Filed May 6, 1953 2 Sheets-Sheet 1

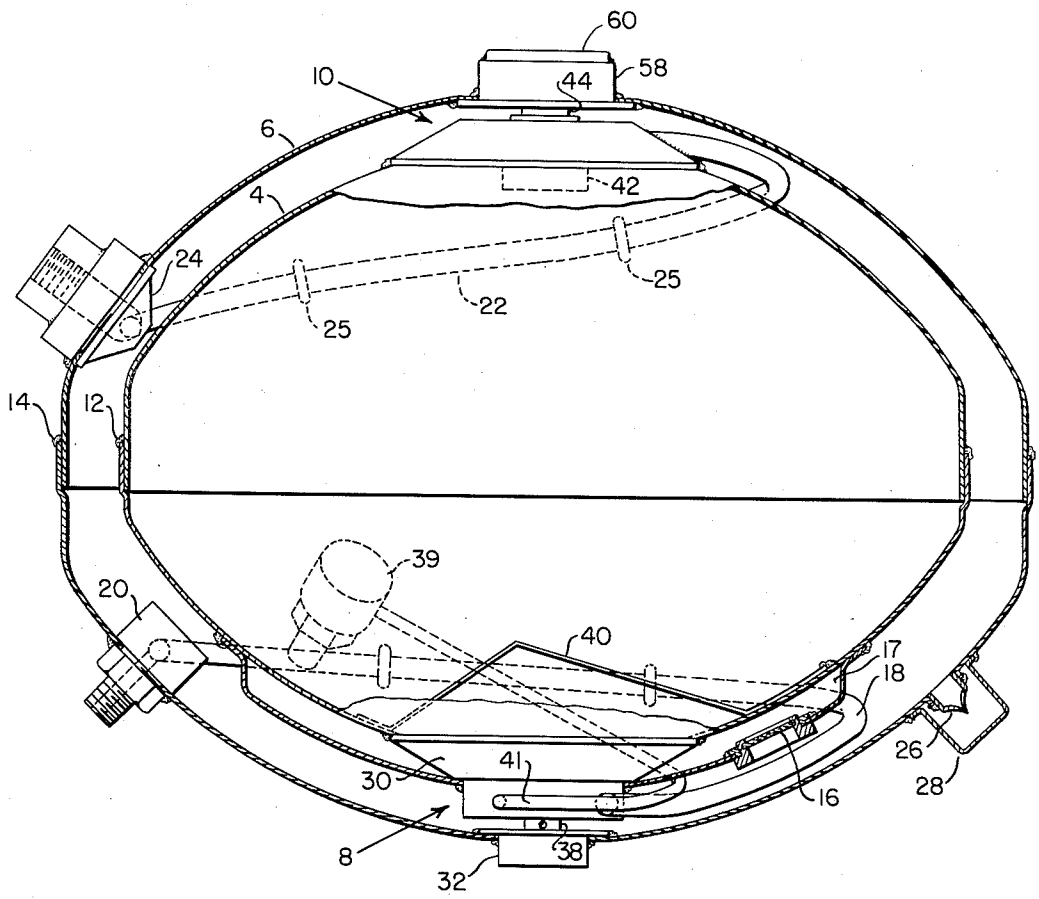


Fig. 1

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Fig. 2

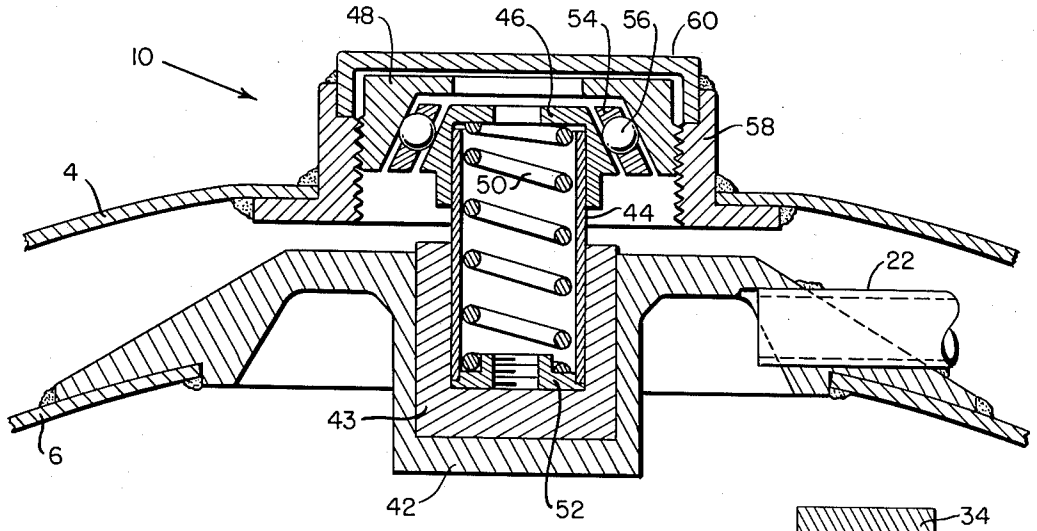


Fig. 4

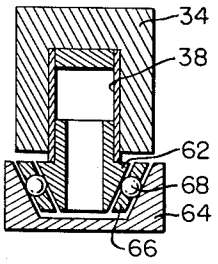
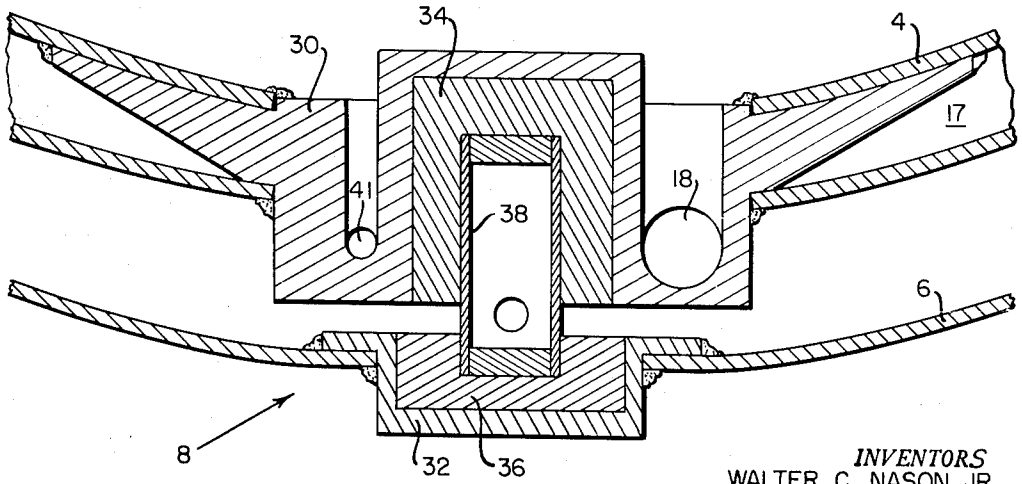


Fig. 3



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United States Patent Office

2,729,357

Patented Jan. 3, 1956

2,729,357

VACUUM JACKETED CONTAINER

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Application May 6, 1953, Serial No. 353,268

9 Claims. (Cl. 220—15)

The present invention relates to vacuum jacketed containers (or Dewars) for containing materials at very low temperatures, as for example, liquid oxygen.

An example of the use of the present invention is in the construction of a Dewar for carrying liquid oxygen for use in aircraft. The requirements for such equipment are very rigorous since a rigid support for the inner vessel must be provided, which will be of sufficient strength to withstand accelerations of the aircraft, and the support must be attained without allowing excessive heat leakage.

The object of the present invention is to provide a vacuum jacketed container in which the requirements of rigid support, adequate strength and minimum heat leakage are satisfied.

With this object in view, the principal feature of the invention comprises an arrangement whereby the separation between inner and outer vessels is effected by the use of load carrying spheres having relatively small areas of contact. In the preferred form of the invention, the spheres are of tempered glass which not only have low heat conductivity, but are of exceptional mechanical strength, as will be hereinafter explained.

Other features of the invention comprise certain combinations and arrangements of parts hereinafter described and particularly defined in the claims.

In the accompanying drawings—

Fig. 1 is a sectional elevation of the preferred form of jacketed container according to the present invention.

Fig. 2 is a sectional elevation on an enlarged scale of the preferred upper support assembly.

Fig. 3 is a sectional elevation on an enlarged scale of the preferred lower support assembly.

Fig. 4 is a sectional elevation showing a modified form of lower support assembly.

The illustrated embodiment of the invention comprises an inner metal vessel **4**, an outer metal vessel **6**, a lower support assembly indicated generally at **8**, and an upper support assembly indicated generally at **10**. As shown in Fig. 1, each of the vessels **4** and **6** is formed in two parts. The two parts of the inner vessel are joined by a circumferential weld **12** and those of the outer vessel by a circumferential weld **14**.

A filter **16** separates a getter space **17** from the vacuum jacket.

The inner vessel communicates with a long metal tube **18** which connects with the outlet fitting **20** in the wall of the outer vessel. A similar tube **22** communicates with the interior of the vessel in the upper assembly **10** and coils about the inner vessel space to the vent fitting **24** whereby excessive pressure is relieved. As indicated in Fig. 1, the tubes **18** and **20** are of sufficient length to prevent excessive conduction of heat through the longitudinal walls of the tubes themselves. The tubes may be fitted with spacing rings **25** at suitable intervals to prevent contact of the tubes with the wall of either vessel.

The outer vessel is provided with an evacuating tube

26 which, after evacuation of the inner vessel space, is sealed off and then covered by a cap **28**.

The lower support assembly includes a fitting or socket member **30** suitably secured, as by welding or soldering, to the inner vessel and another socket member **32** secured to the outer vessel. The members **30** and **32** contain plugs **34** and **36** of metal or plastic to serve as seats for a tube **38** which comprises the load supporting member. The parts **34** and **36** are preferably of a plastic material such as polytrifluoromonochloroethylene (known commercially as Kel-F) which is characterized by good compressive strength at low temperatures, and by low heat conductivity.

A baffle **40** is secured to the interior of the inner vessel over the inlet whereby the rush of liquid into the vessel through the tube **18** will be prevented from escaping into the vent line **22**. A liquid level gage **39** communicates by a tube **41** with the inner vessel. As shown in Fig. 3, the tubes **18** and **41** are connected into the fitting **30**.

The principal feature of the invention comprises the upper support assembly **10**, which will now be described in detail.

The upper support assembly comprises an inner socket member **42** welded to the wall of the inner vessel. Received in the socket is a bushing **43** of low thermal conductivity. Received within the bushing **43** is a tube **44** which is primarily for horizontal support. Mounted over the tube **44** is an inverted socket or thrust member in the form of a cap **46** having a conical sidewall. A cap **48** having an inner conical wall lies above the cap **46**. (The bushing **43** is preferably of the above mentioned plastic, and the cap members **46** and **48** are preferably of metal.) A compression spring **50** engages between a thrust member **52** at the bottom and the inner surface of the cap member **46** at the top, whereby a strong vertical thrust is provided, the spring being of sufficient initial compression to resist contraction under accelerations as large as any encountered in operation of the aircraft.

Between the conical inner face of the cap **48** and the conical outer face of the cap **46** is a ball retainer **54** having a series of load supporting spheres **56**, which spheres have only a contact of small area with the caps **46** and **48**.

The cap **48** is threaded into an upper socket member **58** which is welded into the outer shell. By this means the spring **50** is held under its compression. A vacuum seal cap **60** is applied over the support cap **48** and is suitably welded to the socket member **58**.

The spheres **56** are preferably of tempered glass, the construction and manufacture of which are well known. Such members have exceptional properties for the type of service contemplated by the present invention. In the first place, their heat conductivity is low and their small areas of contact with the metal parts **46** and **48** limits the heat leakage. Furthermore, the spheres are of exceptional strength, each consisting of a central core portion which is under high tension and an outer skin or shell portion which is under high compression. One of the spheres will withstand any stress except a tensile stress sufficient to overcome the compressive stress in the skin. If such a tensile stress can be applied, the sphere will shatter in small pieces. (This fact may be used as a test to segregate good spheres from defective ones. It is only necessary to subject them to a crushing pressure greater than that to which they will be subjected in service. The defective spheres will shatter instantly, while those which are not shattered may be safely relied upon for continuous service under operating conditions.)

It will be understood that other arrangements of sup-

porting the glass balls may be used and that the invention is not to be considered as limited to the particular structure herein shown, since one of the principal features of the invention is in the use of spheres, preferably of glass, which have a small area of contact with the metal support members.

The upper support assembly thermally isolates the containers, while providing for thermal expansion and contraction of the inner container. As heretofore noted, the spring **50** is placed under sufficient compression to withstand any accelerations that may be encountered. The spring is, in fact, sufficient for mechanical support of the parts, without the tube **44**, so far as vertical forces are concerned, but the tube is desirable to provide horizontal stability.

Although the bottom support assembly of Fig. 3 has been found adequate in general, additional thermal isolation may be provided by utilizing the glass ball assembly therefor. The structure is similar to that of Fig. 2, except that it is considerably simplified because no spring is required. A modified lower support assembly is illustrated in Fig. 4, wherein the tube **38** (which is the same as in Fig. 3) is mounted over a conical member **62**, opposing a conical plug member **64** which takes the place of the plug **36**. A retainer **66** carrying tempered glass spheres **68** lies between the parts **62** and **64**. The action of the spheres is identical with that described for the upper support.

Having thus described the invention, we claim:

1. In a vacuum jacketed container having an inner vessel and an outer vessel, a support assembly comprising a compression spring, thrust members for the spring, one of said thrust members being connected with one of the vessels, the other thrust member having a conical wall, a cap member having a conical wall opposed to the conical wall of the thrust member, a ball retainer between the walls, and a plurality of tempered glass spheres in the ball retainer and having small-area contact with said conical walls.

2. In a vacuum jacketed container having an inner vessel and an outer vessel, a support assembly comprising a socket member connected to the inner vessel, a compression spring in the socket member, a thrust member at the outer end of the spring and having a conical wall, a cap member secured to the outer vessel and having a conical wall opposed to the conical wall of the thrust member, and a plurality of tempered glass balls between said walls and having small-area contact therewith for thermal isolation and mechanical support thereof.

3. In a vacuum jacketed container having an inner vessel and an outer vessel, a support assembly comprising a socket member connected to the inner vessel, a compression spring in the socket member, a thrust member at the outer end of the spring and having a conical wall, a cap member secured to the outer vessel and having a conical wall opposed to the conical wall of the thrust member, a plurality of tempered glass balls between said walls and having small-area contact therewith for thermal isolation and mechanical support thereof, and a second support assembly having members with opposed conical walls, said members being connected with the inner and outer vessels, and tempered glass balls between said walls.

4. In a vacuum jacketed container having an inner vessel and an outer vessel, a support assembly comprising a compression spring, thrust members for the spring, one of said thrust members being connected with one of the vessels, a cap member having a wall opposed to the other thrust member, and a ball member between the cap member and said other thrust member and having small areas of contact with both of said members for thermal isolation thereof.

5. In a vacuum jacketed container having an inner vessel and an outer vessel, a support assembly comprising a compression spring, thrust members for the spring, one of said thrust members being connected with one of the vessels, a cap member having a wall opposed to the other thrust member, and a plurality of ball members between the cap member and said other thrust member and having small areas of contact with both of said members for thermal isolation thereof.

6. In a vacuum jacketed container having an inner vessel and an outer vessel, a support assembly comprising a compression spring, thrust members for the spring, one of said thrust members being connected with one of the vessels, a cap member having a conical wall opposed to the other thrust member, and a plurality of ball members between and in engagement with the cap member and said other thrust member and having small areas of contact with both of said members for thermal isolation thereof.

7. In a vacuum jacketed container having an inner vessel and an outer vessel, a support assembly comprising a compression spring, thrust members for the spring, one of said thrust members being connected with one of the vessels, a cap member having a wall opposed to the other thrust member, and a ball member of tempered glass between the cap member and said other thrust member and having small areas of contact with both of said members for thermal isolation thereof.

8. In a vacuum jacketed container having an inner vessel and an outer vessel, a support assembly comprising a compression spring, thrust members for the spring, one of said thrust members being connected with one of the vessels, a cap member having a wall opposed to the other thrust member, and a plurality of ball members of tempered glass between the cap member and said other thrust member and having small areas of contact with both of said members for thermal isolation thereof.

9. In a vacuum jacketed container having an inner vessel and an outer vessel, a support assembly comprising a compression spring, thrust members for the spring, one of said thrust members being connected with one of the vessels, a cap member having a conical wall opposed to the other thrust member, and a plurality of ball members of tempered glass between and in engagement with the cap member and said other thrust member and having small areas of contact with both of said members for thermal isolation thereof.

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