United States Patent

Prost

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[54] **CRYOSTATS**

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[58] **Field of Search**.....62/45, 514, 514 A

[56] **References Cited**

UNITED STATES PATENTS

3,176,473	4/1965	Andonian	62/514
3,182,462	5/1965	Zoug	62/45
3,192,733	7/1965	Goetz	62/45
3,364,687	1/1968	Kohn	62/514
3,424,230	1/1969	Wright	62/514
3,442,091	5/1969	Klipping	62/514
3,588,312	6/1971	Burnier	62/514

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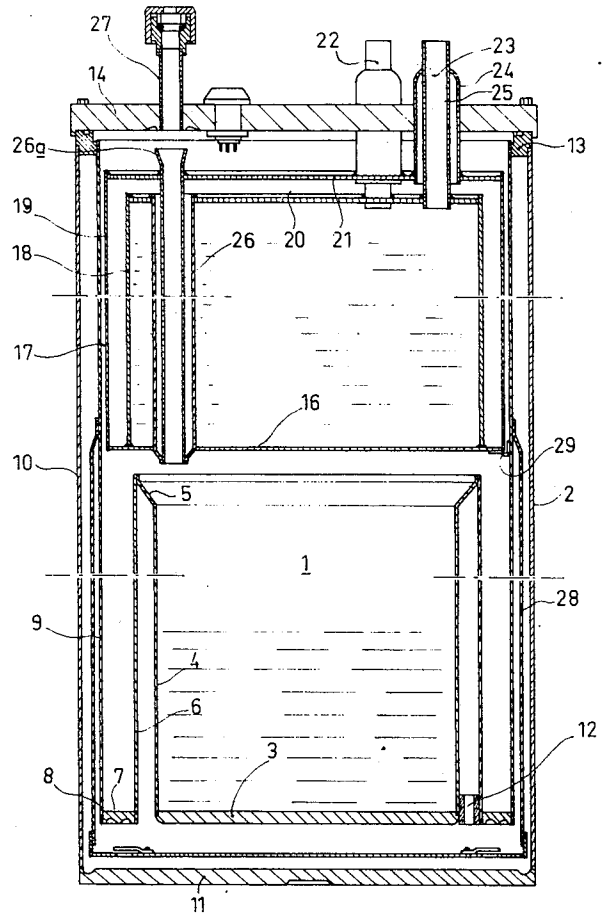
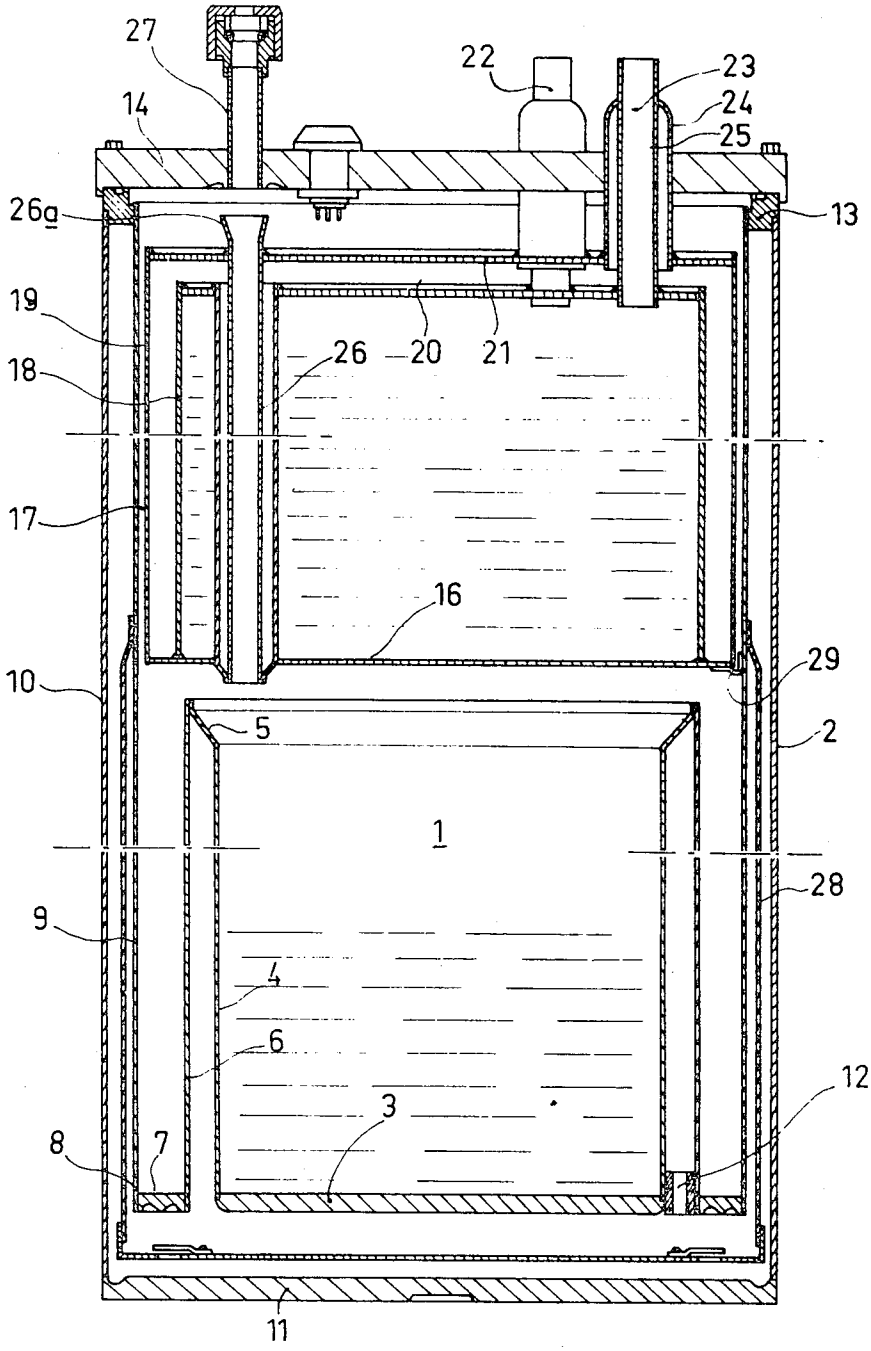
[57] **ABSTRACT**

A cryostat, which makes use of a cryogenic liquid at very low temperature, for example liquid helium, as a medium to surround a specimen being tested, comprises a double-walled tank disposed within and spaced from a double-walled insulating jacket under vacuum. The suspension of the tank is effected by a double annular connection with the bottom of the inner wall of the insulating jacket. A reflector screen is cooled by the nitrogen of a reservoir. The cryostat can be used for testing materials or for enabling apparatus to function at very low temperature.

8 Claims, 1 Drawing Figure





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CRYOSTATS

BACKGROUND OF THE INVENTION

The present invention relates to cryostats which use a cryogenic liquid at very low temperature, for example liquid helium, as a medium to surround a specimen being tested.

There are known cryostats which comprise a tank holding a cryogenic liquid and a specimen, the tank preferably having double walls under vacuum, positioned inside a jacket or casing, which itself has a double side wall under vacuum, the insulating jacket extending to a considerable distance above the tank and being disposed at a distance from the side wall of the tank, with a common bottom space provided between a tank bottom and a jacket bottom with a single wall. In this type of cryostat, the interstitial space between the internal wall of the jacket and the external wall of the tank serves for the circulation of vapors originating from the cryogenic liquid contained in the tank, these vapors first of all circulating downwardly and along the external side wall of the tank and then upwardly and along the internal wall of the external insulating jacket. Cryostats of this type are particularly useful, because they can be made with a large neck, that is to say, with a large opening for inserting the specimens to be tested, which thus may have considerable dimensions; however, they are particularly complex and difficult to construct, particularly because of the method of fixing the tank, which is effected at the upper lever of the external jacket in the immediate vicinity of the cover, passing in succession through the internal tank wall, then to the upper edge of the tank, through the external tank wall and finally through the internal wall of the insulating jacket, so that these walls necessarily all have to be of dimensions for resisting the stresses caused by weight and exerted by the liquid and the specimen placed in the tank.

An object of the present invention is to provide a cryostat, the design of which permits a particularly robust and simple construction. A further object of the invention to provide a cryostat of this type which has improved insulating means for the tank containing the cryogenic liquid.

SUMMARY THE INVENTION

According to the invention, the tank is fixed to the jacket by a double annular connection, one fluid-tight connection extending between the lower edges facing the external wall of the tank and the internal wall of the jacket, while the other is between the lower edges facing the internal and external walls of the tank. This arrangement, which transfers to the bottom of the cryostat the suspension of the tank from the external jacket, has the advantage that the strains which are exerted on the tank, coming from the insulation space, the mass of cryogenic liquid and the specimen subjected to cold, are no longer transmitted through the tank walls, but directly from the tank bottom to the external jacket. It is thus no longer necessary to make the tank wall with a robustness such that it is capable of transmitting the stresses or strains being exerted on the tank: it is sufficient to provide a good direct mechanical connection between the tank bottom and the internal wall of the jacket, the shape of which, being a simple cylindrical surface, is able to transmit these stresses without appreciable risk of deformation.

According to another feature of the invention, in a cryostat of the type in question, also comprising means forming an intermediate refrigerated screen between the internal tank and the external jacket, these means are provided by a nitrogen reservoir completely overhanging the said tank and a heat-conducting screen around the bottom and lateral walls of the tank, in the vacuum space of the insulating jacket, and in thermal contact by its upper edge with the liquid nitrogen reservoir. This arrangement is simple, and not only ensures a thermal protection of the tank in the upward direction, between the cover and the top of the tank, but also a lateral and bottom protection by a single heat-conducting wall, which is regularly and systematically cooled by the nitrogen present in the upper reservoir. This arrangement, which ensures an excellent insulation of the tank, is however very much less clumsy, because it makes use of a reservoir forming a source of cold, established in the necessary clearance volume between the top of the tank and the cover.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The features and advantages of the invention will however become more apparent from the following description, given by way of example and by reference to the accompanying drawing, in which the single FIGURE is a sectional view of a cryostat according to the invention.

Referring to this FIGURE, it is seen that the cryostat comprises a tank **1**, which is adapted for example to be filled with helium, the said tank being mounted in the lower part of an external jacket **2**. The tank **1** is formed of a bottom **3** of adequate thickness and a double lateral wall under vacuum, namely, firstly an internal wall **4** connected by an upper rim **5** to an external wall **6**, which itself is secured by an annular flange **7** to the base **8** of an internal wall **9** of the jacket **2**, the external wall **10** of which is made fast with a cryostat base **11**. A series of annular stays **12**, formed of tube sections, is also disposed between the tank bottom **3** and the annular flange **7**, these tube sections thus permitting communications between the double wall of the tank **1** and the double wall of the jacket **2**. This tank double wall and this jacket double wall are thus simultaneously brought under vacuum. It is understood that a rigid mechanical connection has been produced between the tank bottom **3** and the internal wall **9** of the jacket **2**, firstly by the stays **12** and then by the flange **7**.

As will be seen from the drawing, the lateral wall of the jacket **2** extends a considerable distance above the lateral wall of the tank **1**; the jacket wall **2** is made fast at its upper end, by a flange **13** on which a cover **14** is fixed in fluid-tight manner. Situated in the interstitial space between the cover **14** and the tank **1** is a nitrogen reservoir **16**, which extends over practically all the diametral width of the internal wall **9** of the jacket **2**, while nevertheless providing a small interstitial annular clearance **17**, the purpose of which will be seen later. This nitrogen reservoir **16** is itself formed on one lateral side and on its upper side with a double wall **18, 19, 20, 21**, respectively, permitting the establishment of an insulating jacket under vacuum. The reservoir **16** is suspended from the cover **14** by passage members **22** and **23**, one member **22** serving for the admission of liquid nitrogen into the reservoir **16**, while one member

23 serves for the discharge of the vapors which are released. The said members 22 and 23 are heat insulated by a double wall 24, 25, in communication with the vacuum established around the liquid nitrogen reservoir 16. This liquid nitrogen reservoir also has a flow pipe 26 over its full height and opening at its bottom end opposite the tank 1 and at its upper end in the form of a funnel 26a, beneath a pipe 27 for the admission of helium through the cover 14. This reservoir 16 is thermally associated with a heat shield 28 extending completely around the bottom and lateral walls of the tank, between the walls 9 and 10 of the double jacket 2 and between the bottom walls 3 and 11; this shield 28 is in thermal contact at its upper end with the internal jacket wall and then with a number of spacer members 29, which are themselves in thermal contact with the liquid nitrogen reservoir 16.

It is seen that the arrangement as described permits the transmission of the stresses exerted on the tank 1 essentially by means of the stay tubes 12 and the annular flange 7, without passing through the lateral walls (4, 6) of the tank, and that in addition the interstitial space between the top of the tank 1 and the cover 14 is occupied by a liquid nitrogen reservoir 16, the purpose of which, apart from that of heat protection towards the top of the refrigerating liquid in the tank 1, is essentially to ensure a continuous cooling of the reflector shield 28 located in the vacuum of the jacket 2, all around the lateral walls and the tank bottom 1. It is apparent that this construction is very robust, since it is sufficient to provide a relatively thick bottom 3 for the tank 1, and a small clearance, since the refrigerated reflector shield 28, which is disposed in the double jacket 9, 10 and 3, 11, is associated with a liquid nitrogen reservoir, which occupies the normally free clearance between the top of the tank 1 and the cover 14.

What is claimed is:

1. A cryostat comprising:

a. a tank for receiving a cryogenic liquid and a specimen to be tested, the said tank having a large upper opening, a thick bottom, an internal lateral wall and an external lateral wall, a rim connecting together said walls at their upper ends, said walls defining between them an annular heat-insulating space,

b. a jacket disposed around and spaced from the said tank, said jacket having a thick bottom, an internal lateral wall and an external lateral wall defining between them an annular heat-insulating space, a flange connecting together said walls of the jacket at their upper ends,

c. said tank bottom and said jacket bottom defining between them a lower heat-insulating space communicating with said annular heat-insulating spaces of the tank and jacket,

d. and tank-supporting means comprising radial extension means between said tank bottom and said internal wall of said jacket, said external wall of said tank being fixed to said supporting means, one part of said supporting means being disposed between said tank bottom and said external wall of said tank and being gas permeable, another part of said supporting means being disposed between said external wall of said tank and said internal wall of said jacket and being gas impervious.

2. A cryostat as claimed in claim 1, said jacket extending upwardly beyond said tank, a flange secured between the upper edges of the internal and external lateral walls of the jacket, a cover on said jacket flange, and a reservoir for a cryogenic liquid and occupying most of the space between the jacket, the tank and the cover.

3. A cryostat as claimed in claim 1, said one part of said supporting means comprising stays spaced from one another and defining passages between said lower insulating space and said tank insulating space.

4. A cryostat as claimed in claim 1, said one part of said supporting means comprising stays having internal passages between said lower insulating space and said tank insulating space.

5. A cryostat as claimed in claim 2, and a refrigerated shield in the insulation space of the jacket, said shield being in thermal contact with said reservoir by means of the internal wall of the jacket, and spacers between said internal wall of jacket and said reservoir.

6. A cryostat as claimed in claim 2, and suspension means between said reservoir and said cover.

7. A cryostat as claimed in claim 6, said suspension means including a heat-insulated conduit for filling the reservoir.

8. A cryostat as claimed in claim 2, and a passage pipe extending completely through the reservoir and opening at its lower end below the tank and at its upper end opposite a conduit passing through the cover.

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