

Dec. 20, 1960

T. D. JAYNE

2,965,218

GETTER

Filed Aug. 16, 1956

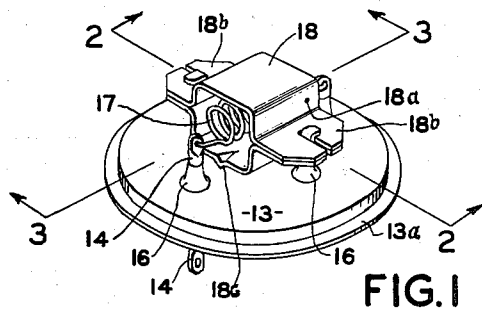


FIG. 1

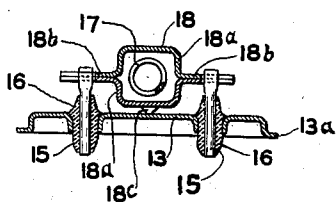


FIG. 2

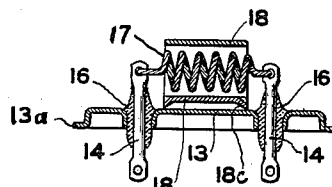


FIG. 3

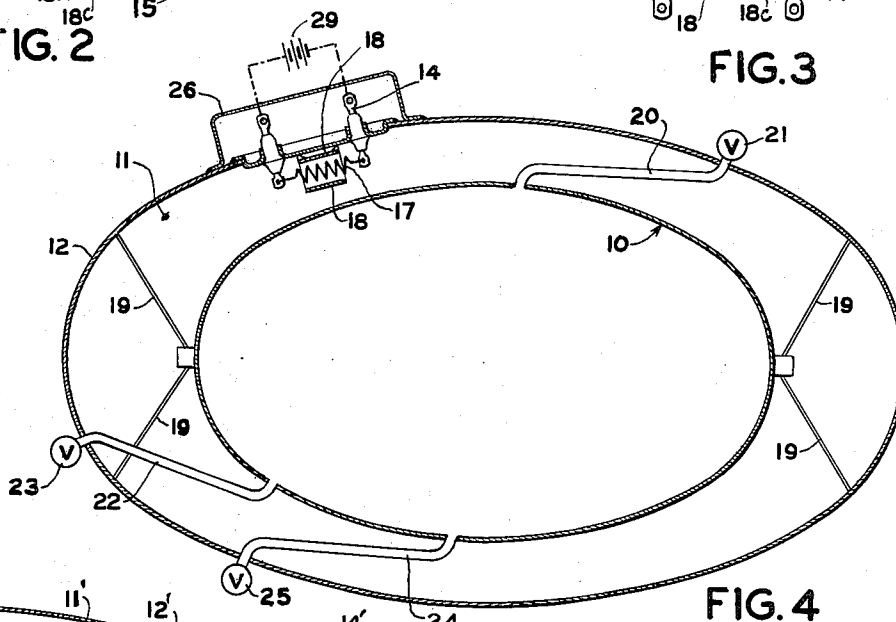


FIG. 4

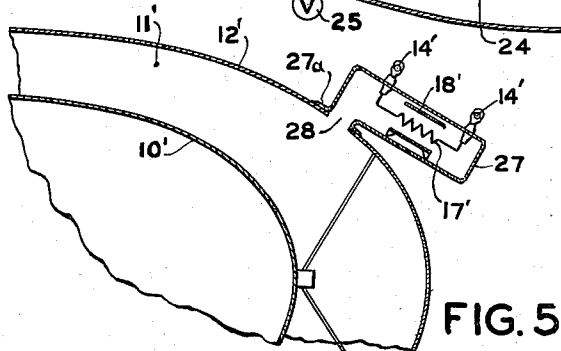


FIG. 5

INVENTOR.
THEODORE DOUGLAS JAYNE
BY
Hyde, Meyer, Baldwin & Doran
ATTORNEYS

1

2,965,218

GETTER

Theodore D. Jayne, Painesville, Ohio, assignor to Rand Development Corporation, Cleveland, Ohio, a corporation of Ohio

Filed Aug. 16, 1956, Ser. No. 604,390

3 Claims. (Cl. 206—4)

This invention relates to improvements in a getter for improving the vacuum in an enclosed space, and to a method for maintaining a very high vacuum in an enclosing chamber surrounding a bottle of liquid gas such as liquefied oxygen.

An object of the present invention is the provision of a unitary getter which combines within itself efficient means for absorbing both oxygen and nitrogen, as well as hydrogen and other gases each time the getter is energized.

Another object of the present invention is to provide a getter which may be completely sealed within the chamber where the high vacuum is to be maintained with electrical leads to the outside and wherein there is connected on the inside between the electrical leads a zirconium filament so spaced with respect to a titanium shield that when electricity is applied to the zirconium filament, that filament is heated to its efficient range for absorbing oxygen and nitrogen and the titanium shield is at such a distance from the filament that it in turn is heated to its most efficient temperature for absorbing hydrogen from the vacuum space.

Another object of the present invention is to provide an efficient means for maintaining an almost perfect vacuum, of the order of one micron or less in a completely enclosed space, comprising the sealing of a getter within said space with electrical connections extending outside of said space, said getter including sufficient metal for absorbing the expected gases within the vacuum chamber over a considerable period, so that electricity may be connected to the electrodes outside of said space intermittently from time to time for short periods of time, at each energization removing the gases from the vacuum space to provide an almost perfect vacuum, and reusable a number of times so that the installation is good for a rather long total period.

Other objects and advantages of the present invention will be apparent from the accompanying drawings and description and the essential features will be set forth in the appended claims.

In the drawings,

Fig. 1 is a slightly enlarged perspective view of my improved getter showing one embodiment adapted to be sealed in the wall of a vacuum chamber;

Figs. 2 and 3 are fragmental sectional views taken along similarly numbered lines of Fig. 1;

Fig. 4 is a view somewhat diagrammatic taken through a bottle for the storage of liquid oxygen; while

Fig. 5 is a fragmental sectional view somewhat diagrammatic showing a modification of the arrangement of Fig. 4.

Liquid gases, such as liquid oxygen, with temperatures in the range of -180 degrees Fahrenheit and lower, must be stored in vacuum jacketed containers. It is known that the adequate vacuum for storage of liquid gas is less than three microns of absolute pressure as measured on a mercury gauge. For storage of large quantities or for aircraft use where a pressure delivery

2

system is used, metal containers are required. The vacuum insulating space in this type of container is subject to continuing outgassing and to diffusion of gas through the metal as well as through microscopic holes in the welds required for fabrication of the container. Over a period of several months this causes a loss of vacuum and the resultant heat transfer to the stored contents due to the lowered vacuum of the insulating chamber. This fault is particularly noticeable in five, eight and twenty liter oxygen converter systems utilized by the United States Air Force.

I have chosen to illustrate the use of my improved getter in connection with such a portable vacuum bottle shown somewhat diagrammatically in Fig. 4 and wherein the liquid oxygen container 10 is approximately five liters in capacity. This is surrounded by the vacuum chamber 11, which is a gas tight chamber between the walls 10 and 12 and has approximately ten liters capacity. This vacuum bottle is spheroidal in shape measuring approximately $12\frac{1}{2}$ inches by $10\frac{1}{2}$ inches outside dimensions and the average distance between the walls 10 and 12 is approximately $\frac{3}{4}$ of an inch. The walls 10 and 12 have been made of copper although more recently they are made of stainless steel.

My improved getter, shown here, comprises a generally circular base plate 13 of any suitable metal, such as stainless steel or a metal having the trade-name "Kovar," into which are sealed two filament supporting electrodes 14, diametrically opposite each other, and two shield supporting posts 15 also diametrically opposite each other and preferably about 90 degrees spaced from the electrodes 14. The electrodes 14 and the posts 15 are supported in and insulated from the base plate 13 by gobs of glass 16. The electrodes 14 and the posts 15 are made of a metal having the trade-name "Kovar" which is a known metal having the same coefficient of expansion as glass and having approximately the analysis of 20 percent nickel, 17 percent cobalt, 0.2 percent manganese and the balance iron. Between the inner ends of the electrodes 14 is electrically connected a zirconium wire filament 17 which, in the present embodiment, comprises two zirconium wires about No. 25 B. and S. gauge, which wires are twisted together and then wound in a helical form with the axis of the helix approximately parallel to the base plate 13 and slightly more than $\frac{1}{16}$ of an inch spaced from the base plate 13. This gives approximately 1 gram of zirconium in this filament.

Spaced from the zirconium filament and generally parallel to it is a titanium shield 18 of sheet metal form. This shield is so placed with respect to the filament that when the filament is heated to a temperature of approximately 1200 degrees F. to 1600 degrees F., it warms the titanium shield to between 600 degrees F. to 800 degrees F. At these temperatures the zirconium filament is very active in picking up and reacting with oxygen and nitrogen, while the titanium shield is active in picking up and holding hydrogen. Other gases such as carbon dioxide are also absorbed by my improved getter. The titanium shield shown here completely surrounds the filament 17 along almost its entire length but with the ends of the shield open for the easy access of gases to the interior of the shield. In the form shown here, the shield 18 is placed on both sides of the filament 17 (although it could be on one side only (and is about $\frac{1}{16}$ inch wide, parallel to the axis of the filament, and approximately $\frac{1}{2}$ inch long opposite the filament, with flange portions 18a bent toward each other and then provided with ears 18b extending laterally away from the filament and approximately in the plane of the axis of the filament. These ears 18b are secured firmly to the posts 15. The spacing between the posts 15, in this embodiment, is approximately $\frac{7}{8}$ inch and the electrodes 14 are similarly

spaced. Referring to Fig. 2, the diameter across the helix of the filament 17 is approximately 1/4 inch and the dimension between the two flat portions of the shield 18 is approximately 1/2 inch. This leaves approximately 1/16 inch between the base 13 and the titanium shield 18 which is adjacent thereto. Preferably, but not necessarily, the metal of shield 18 nearest plate 13 is bent into a projection 18c opposite each electrode 14, these projections 18c preventing tilting of the titanium shield on its supporting posts 15.

Referring to Figs. 1 to 4 inclusive, the base plate 13 has a continuous annular flange 13a around its periphery and this flange is suitably secured as by solder around the edges of a suitable circular opening in the wall 12 so that the getter is within the vacuum space 11 and the electrodes 14 extend outside of this space as seen in Fig. 4, and the base plate completely seals the opening in wall 12.

The other details of Fig. 4 have no connection with the present invention but illustrate a common construction of one of these vacuum bottles wherein the bottle 10 is supported by a plurality of wires 19 from the wall 12, and suitable lines of communication with the bottle are provided such as the vent line 20, closed by a valve 21, a gauge line 22 closed by a gauge or plug at 23, and an oxygen outlet line 24 closed by a control valve 25. These lines of communication are shown diagrammatically, whereas in the actual bottle, these lines are approximately 20 inches long to reduce the conduction of heat and they are formed of wrought Inconel approximately 0.005 inch thick which is a very poor conductor of heat and comprises approximately 80 percent nickel, 13 percent chromium and 6 1/2 percent iron.

The use of my invention should now be apparent. With the getter in the position of Fig. 4, but without the protective cover 26, a source of either alternating or direct current (diagrammatically illustrated at 29) is connected across the electrodes 14 so that between 30 and 40 watts of current at 8 or 10 volts, and drawing about 3 or 4 amperes, is applied between the electrodes 14 to heat the zirconium filament directly and to heat the titanium shield indirectly as mentioned above. By means of a controlled air leak, I have admitted about 100 microns, mercury gauge, of air to the chamber 11 and energization of my improved getter for about fifteen minutes has reduced this to approximately 1 micron of mercury gauge pressure. When the chamber 11 is outgassed, the electrical source 29 is disconnected. By a similar procedure, I have removed a calculated 1000 micron liters of a gaseous mixture consisting of oxygen, nitrogen and hydrogen and repeated this action as many as seven times using the same getter. When it is considered that it normally takes a period of several months to cause any great loss of vacuum within the chamber 11, it will be seen that my invention will maintain the insulating value of the vacuum chamber over a long period of time. When the getter is used up, it is only necessary to unseal the flange 13a, place a new getter in the same position and re-evacuate the container. In normal use, while the electrical source is disconnected, a protective cover 26 is sealed over the electrodes 14 and the posts 15 in the position shown in Fig. 4 by means of a solder seal around the edges.

In the modification shown in Fig. 5, the getter is constructed in such a way as to keep the heat away from the oxygen bottle. Here the bottle is shown diagrammatically at 10' with a vacuum chamber 11' between the bottle and the outer wall 12'. Secured to a suitable opening in the wall 12' is a small closed container 27 which is sealed as by solder at the continuous flange 27a to the wall 12' around the opening 28. Supported within

the container 27 between the electrodes 14' is a zirconium filament 17', these parts being constructed exactly like those previously described except that this permits the construction of a longer filament if desired. Spaced from the filament is a titanium shield 18' which is supported on posts, not shown, analogous to the posts 15 of the first described form. It is obvious that the operation of this form of the invention is exactly like that first described because the gases in the chamber 11' have free access to the interior of the container 27 through the opening 28 for the purpose of the getter action.

When heat is applied to the filament 17 or 17', in either form of my invention, but more particularly in connection with the first described form involving the filament 17, oxygen which may be occluded in the inner shell 10 due to seepage, is to some extent released in the space 11 between the shells 10 and 12 and is outgassed by my improved getter.

What is claimed is:

1. A unitary getter comprising a base plate, two spaced electrodes extending through said plate and sealed and electrically insulated there, a zirconium filament connected to and supported between said electrodes on one side of said plate and spaced from said plate, and a titanium shield mounted on said base plate on said one side thereof and spaced from said filament in position to be heated to the range of 600 degrees Fahrenheit to 800 degrees Fahrenheit for outgassing hydrogen when said filament is heated to the range of 1200 degrees Fahrenheit to 1600 degrees Fahrenheit for outgassing oxygen and nitrogen.

2. A unitary getter as defined in claim 1 wherein the amounts of zirconium and titanium are sufficient to outgas a vacuum chamber surrounding said getter a plurality of times, whereby electrical energy may be connected to said electrodes from time to time to carry out a plurality of such outgassing operations utilizing a single getter.

3. The method of maintaining a high vacuum in a portable vacuum bottle having a vacuum chamber surrounding a gas-tight storage chamber and having zirconium and titanium spaced close to and electrically insulated from each other on a frame mounted inside said vacuum chamber with an electrical heating circuit connected to said zirconium and extending to electrodes outside said bottle; comprising the steps of connecting a source of electricity to said electrodes, heating said zirconium to a temperature at which it effectively outgasses oxygen and nitrogen from said chamber and at the same time and at the said temperature the zirconium heats the titanium by transmitted heat to a temperature at which it effectively outgasses hydrogen from said chamber, and then disconnecting said electrical source when said outgassing is completed.

References Cited in the file of this patent

UNITED STATES PATENTS

2,130,190	Lederer	Sept. 13, 1938
2,208,692	Wamsley	July 23, 1940
2,329,765	Jackson et al.	Sept. 21, 1943
2,426,247	Steiger	Aug. 26, 1947
2,453,930	Paul et al.	Nov. 16, 1948
2,462,813	Reiner	Feb. 22, 1949
2,668,253	Taylor	Feb. 2, 1954
2,706,554	King	Apr. 19, 1955
2,722,355	Anderson	Nov. 1, 1955
2,758,239	Schmidt	Aug. 7, 1956

FOREIGN PATENTS

385,061	Germany	Dec. 3, 1923
397,613	Germany	July 5, 1924