United States Patent

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[33] **Italy**
[31] **844739**

[54] **GETTER PUMP**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **417/48,** 313/138
[51] **Int. Cl.** **F04b 37/02,** H01k 1/52
[50] **Field of Search** 417/48, 49, 51; 313/7, 69, 174, 178, 180, 231; 315/108

[56] **References Cited**

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ABSTRACT: A getter pump having a central axis and a nonevaporable getter material coated on a radially folded substrate. These pumps are useful for producing and maintaining vacuum in closed vessels wherein they sorb active gases.

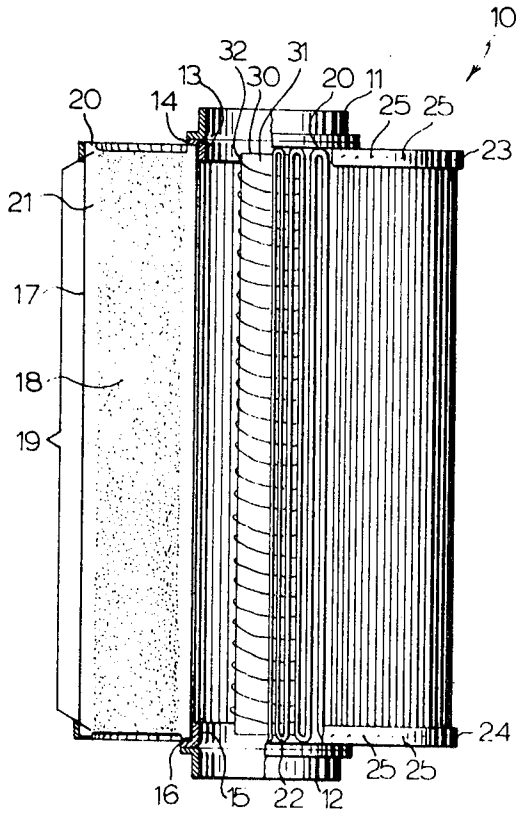


FIG. 1

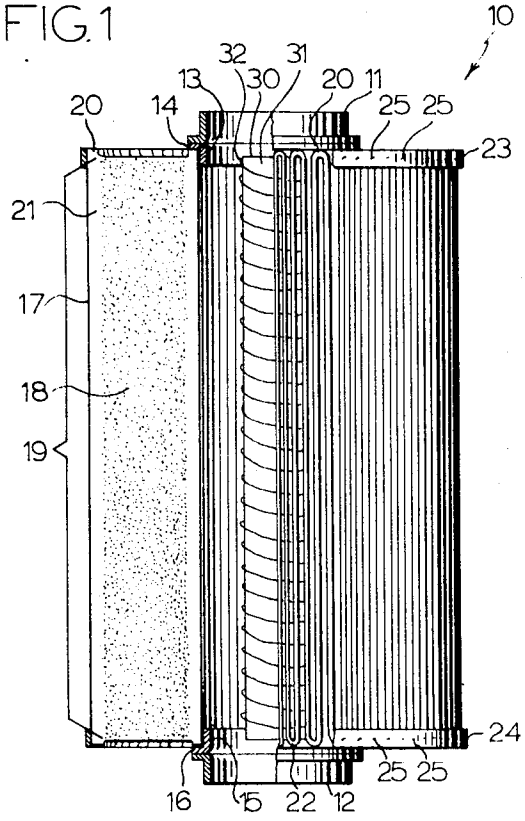


FIG. 2

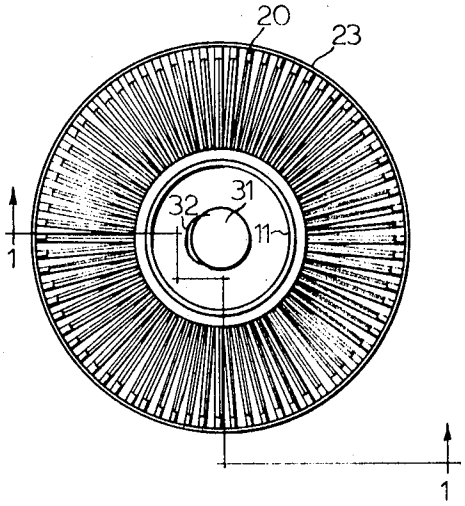
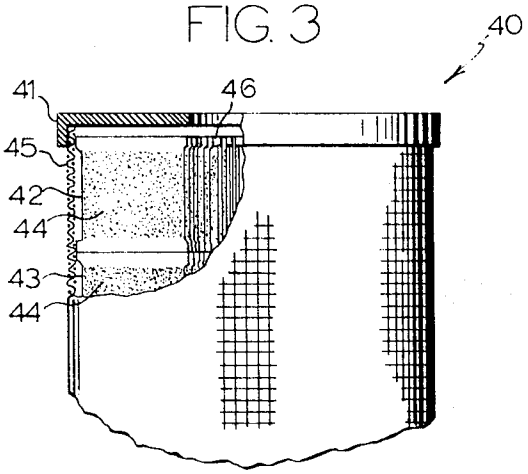


FIG. 3



GETTER PUMP

DISCLOSURE

Getter pumps have found wide acceptance for producing and maintaining vacuum in closed vessels. These getter pumps generally have a substrate coated with a nonevaporable getter material. In these prior pumps the substrate is horizontally pleated and then formed into a circle which is coaxially disposed around a central heater. In operation the heater heats the substrate and the nonevaporable getter material rendering it sorptive to active gases such as oxygen and nitrogen. The nonevaporable getter material then sorbs these gases reducing the pressure in the closed vessel. While such pumps have found great acceptance, they suffer from a number of disadvantages which has limited their wider use. For example, in order to provide sufficient gettering capacity, it is generally necessary to employ a plurality of horizontally pleated, coated substrates. These must be coaxially positioned around the heater by some external retainer such as a cylindrical screen. This screen inhibits the passage of gas to the coated substrate and limits the rate of sorption generally termed the pumping speed. The pumping speed of these devices is further limited by virtue of the fact that the inner surfaces of adjacent pleats lie so closely to one another that their sorptive capacity is adversely affected.

Accordingly it is an object of the present invention to provide novel getter pumps substantially free of one or more of the disadvantages of prior pumps.

Another object is to provide getter pumps which can be manufactured with a large total sorptive capacity while having a single pleated strip.

A further object is to provide getter pumps having an increased pumping speed.

A still further object is to provide getter pumps which do not require the presence of an external retainer to coaxially position the pleated strip around the central heater.

Yet another object is to provide getter pumps wherein substantially all of the getter material is useful for pumping.

Additional objects and advantages will be apparent by reference to the following detailed description and drawings wherein:

FIG. 1 is a partially cut away view of the getter pump of the present invention taken along line 1—1 of FIG. 2;

FIG. 2 is a top view of the getter pump of FIG. 1; and

FIG. 3 is a partially cutaway view of a prior getter pump not representative of those of the present invention.

The above and other objects have been accomplished according to the present invention by providing a getter pump wherein the strips coated with the nonevaporable getter material are radially folded.

Referring now to the drawings and in particular to FIG. 1, there is shown a pump 10 having a central axis and comprising an upper retainer 11 and a lower retainer 12. The upper retainer 11 can be made as a single piece but as shown is made of two pieces attached to one another. The upper retainer 11 comprises a cylindrical sleeve 13 and a flange 14. The lower retainer 12 is identical also having a sleeve 15 and a flange 16. The retainers 11 and 12 can be attached to a strip 17 by any convenient means such as spot welding. Circularly disposed around the retainers 11 and 12 in contact with sleeves 13 and 15 and flanges 14 and 16 is the strip 17 the central portion of which is coated with a nonevaporable getter material 18. The strip 17 has a plurality of discrete segments 19. Adjacent discrete segments 19 are connected to each other by means of bridging attachments 20 lying in a getter-free margin 21 of the strip 17. Adjacent discrete segments 19 are connected via bridging attachments 20 whereas alternate discrete portions 19 are connected via bridging attachments 22. The bridging attachments 20 and 22 constitute folds in the strip 17 which are along lines radial to the axis of the pump 10. Surrounding the strip 17 is an upper band 23 and a lower band 24 attached to the strip 17 by any convenient means such as spot welds shown schematically as indentations 25. Within the circle

formed by the strip 17 is a heater 30 comprising an insulator 31 wound with a wire 32 which can be connected to a source of power not shown.

The strip 17 can be of any suitable material, but is preferably a metal such as iron or stainless steel, which is softer than the getter material 18. The getter material 18 can be any well-known nonevaporable getter material, examples of which include, among others, zirconium, titanium, tantalum or niobium, as well as alloys of two or more of the above. The preferred getter material 18 is an alloy of zirconium and aluminum containing 5 to 30 weight percent aluminum, balance zirconium and most preferably 16 percent aluminum and 84 percent zirconium available commercially as St101 from S. A. E. S. Getters S. p. A. of Milan, Italy.

The getter material 18 is employed as a powder in order to have a high surface area to mass ratio facilitating gas sorption. The powder is preferably one which passes through a U.S. standard screen of 140 mesh/inch and is attached to the strip 17 by any suitable means such as rolling or pressing which does not materially reduce the total surface area of the powder.

In operation, the pump 10 is placed in the tube or vessel to be evacuated and the wire 32 connected in series with a switch and a source of power not shown, preferably outside the vessel. The vessel is then evacuated to the extent possible by any suitable means, such as a mechanical pump, a zeolite pump, a sputter ion pump, or a diffusion pump in order to conserve the pumping capacity of the pump 10. To activate the pump 10 and cause it to getter residual active gases, the switch is closed, causing the wire 32 to heat. This heat is radiated to the strip 17 and the getter material 18 activating the getter material 18 is a known manner by driving previously sorbed gases to the center of each particle of getter material leaving a fresh and clean gas-sorptive surface. Power is supplied to the wire 32 such that the temperature of the getter material 18 is held at 600 to 900 and preferably 700° to 800° C. At temperatures below the broad range activation is too slow to be practical whereas at temperatures above this range sinterization of the particles of the getter material 18 begins to occur together with diffusion of the metal of the strip 17 both of which tend to reduce the gas-sorptive capacity of the getter material 18.

Once activation is accomplished the getter material 18 is gas sorptive at room temperature but the rate of gas sorption can be increased by heating the getter material 18 as described above or more preferably at temperatures of 250° to 400° C. to avoid the evolution of hydrogen, which can be present in the getter material as a solid solution due to previous hydrogen sorption. The getter material 18 remains gas sorptive after heating is terminated and continues to sorb gases evolved during subsequent running of the system. Other methods of heating the strip 17 such as by passing a current through it can also be employed.

The advantages of the present invention are clearly illustrated by reference to FIG. 3 wherein there is shown a partially cutaway view of pump 40 representative of prior pumps. Pump 40 comprises an upper retainer 41 and a plurality of horizontally pleated strips 42 and 43, each of which is coated with the getter material 44. The strips 42 and 43 are coaxially held by a screen 45 and are positioned around a central heater not shown. The discrete portions of each strip 42 and 43 are attached to one another by small bridging attachments 46. The pumping rate is further reduced by virtue of the impedance to gas flow caused by the screen 45 and retainer 41. As can be seen by reference to FIG. 1, no corresponding screen or cover is required in the pumps 10 of the present invention. The discrete portions 19 are spaced from one another permitting effective sorption by all of the getter material 18.

The getter pumps of the present invention find utility as supplements to sputter ion pumps and diffusion pumps and can be used to create and maintain vacuum in continuously pumped vacuum systems as well as in sorbed vacuum systems. These pumps can also be permanently installed in klystron tubes and image intensifier tubes as so-called appendage pumps.

Although the invention has been described in considerable detail with reference to certain preferred embodiments thereof, it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described above and as defined in the appended claims.

What is claimed is:

1. A getter pump having a central axis and a nonevaporable getter material coated on a substrate wherein the substrate is folded along lines which are radial to the central axis.

2. The getter pump of claim 1 wherein the getter material is a zirconium aluminum alloy.

3. The getter pump of claim 2 wherein the getter material is an alloy of 5 to 30 weight percent aluminum, balance zirconium.

4. The getter pump of claim 3 wherein the getter material is an alloy of 16 percent aluminum and 84 percent zirconium.

5. A getter pump having a central axis the pump comprising:

A. an upper retainer;

B. a lower retainer; and

C. a folded strip coated with a nonevaporable getter material, the strip resting against the upper and lower retainers wherein the strip is folded along lines which are radial to the central axis.

6. A getter pump for sorbing gases having a vertical axis and a substrate having a nonevaporable getter metal adhering to the surface of the substrate, the substrate being folded at regular intervals along lines which are radial to said vertical axis.

7. A getter pump comprising:

A. an upper retainer comprising a cylindrical sleeve, and a flange attached to the sleeve;

B. a lower retainer comprising a cylindrical sleeve, and a flange attached to the sleeve;

C. a strip coated with a nonevaporable getter material, the strip comprising a plurality of coaxially disposed, substantially parallel discrete segments wherein adjacent discrete segments are attached to each other at one end and adjacent alternate discrete segments are attached to each other at the other end, the ends of said discrete segments resting on facing portions of the flanges and outside portions of the sleeves;

D. an axially disposed central heater; and

E. an upper band and a lower band each encircling the plurality of discrete segments.