June 27, 1972 J. R. YOUNG 3,672,789

HYDROCARBON RESPONSIVE GETTER ION PUMP

Filed Sept. 21, 1970

FIG. 1.

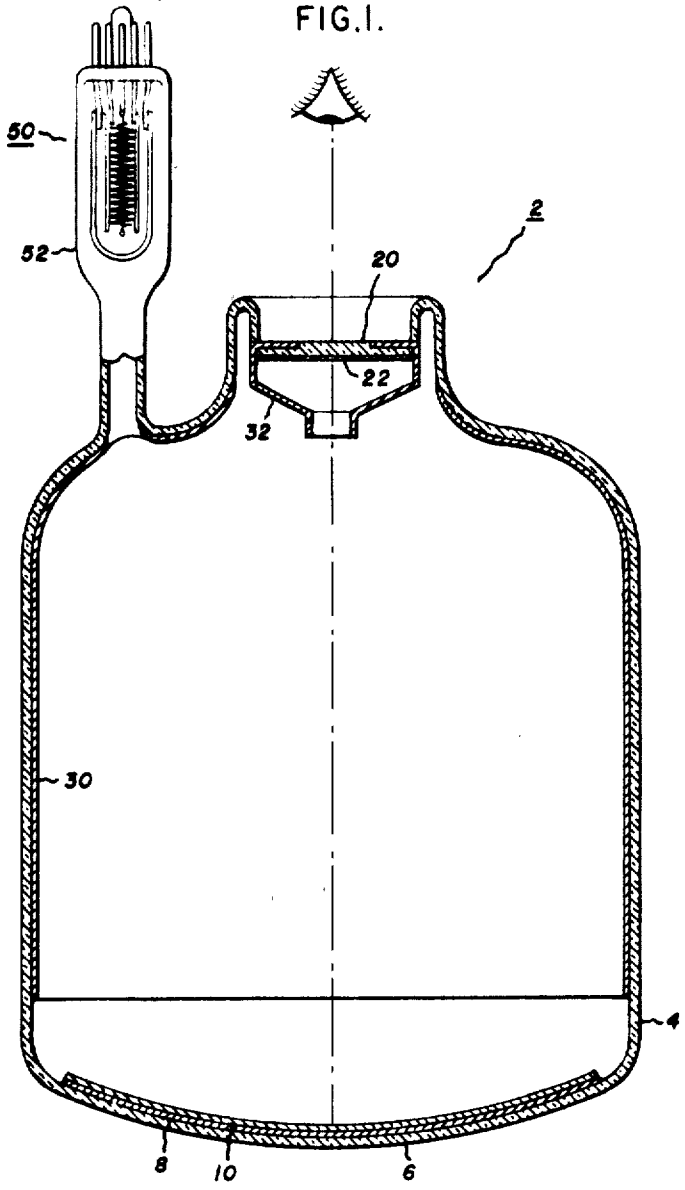
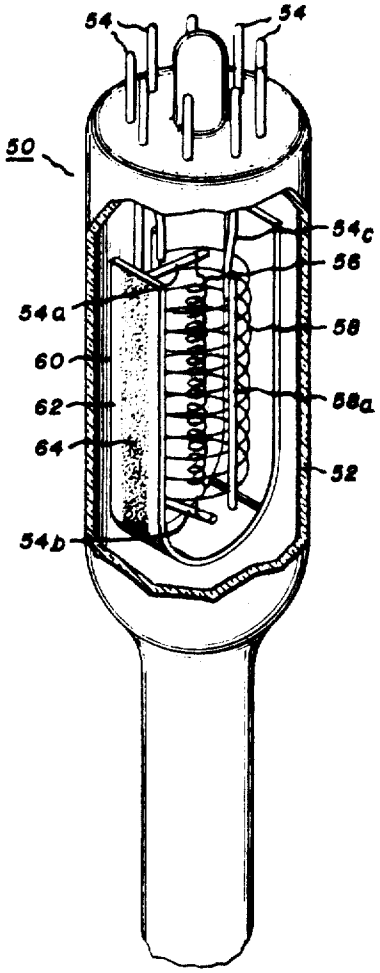


FIG. 2.



INVENTOR:
JAMES ROGER YOUNG,
BY John R. Taylor
HIS ATTORNEY.

United States Patent Office 3,672,789 Patented June 27, 1972

3,672,789

HYDROCARBON RESPONSIVE GETTER ION PUMP

James Roger Young, Rexford, N.Y., assignor to General Electric Company

Filed Sept. 21, 1970, Ser. No. 73,848
Int. Cl. F04b 37/02; F04f 11/00; H01j 7/16
U.S. Cl. 417—51 8 Claims

ABSTRACT OF THE DISCLOSURE

A getter pump which is sensitive to hydrocarbon gases as well as active inorganic gases is disclosed. The pump is particularly useful in image converter tubes having organic materials therein. The getter pump includes electrode means for dissociating the hydrocarbon gases into their atomic constituents and heating means to improve the gettering characteristics of particular porous getter materials such as titanium, zirconium, alloys of titanium and zirconium, or alloys of zirconium and aluminum.

BACKGROUND OF THE INVENTION

This invention relates to a getter pump, and more particularly to a getter pump which is sensitive to hydrocarbon gases as well as active inorganic gases.

Certain electron discharge devices, such as, for example, image intensifier or converter tubes utilize coatings within the device which outgas hydrocarbons such as methane gas. Conventional getters which react with active gases such as hydrogen, oxygen, carbon monoxide, carbon dioxide, and nitrogen are relatively insensitive to hydrocarbons such as, for example, methane gas. Conventional getter pumps therefore do not operate satisfactorily in devices such as described above.

Certain porous getter materials such as titanium and zirconium or alloys of titanium and zirconium or alloys of zirconium and aluminum will pump larger quantities of active gases if operated at higher temperatures such as, for example, a temperature approaching 400° C. This is possible due to the large active surface available in the pore structure of the getter material and the high diffusion rate of these gases into these materials at such temperatures.

It is therefore an object of the invention to provide an improved getter pump sensitive to hydrocarbon gases. It is another object of the invention to provide improved getter means to getter hydrocarbon gases including means for breaking down hydrocarbon gases into their atomic constituents. It is a further object of this invention to provide means for heating the getter material to operate the getter pump at an elevated temperature. Further objects of the invention will become apparent from a reading of the description of the preferred embodiment.

SUMMARY OF THE INVENTION

In accordance with a preferred embodiment of the invention, an electron discharge device is provided having getter means therein sensitive to hydrocarbons and comprising means for dissociating the hydrocarbon molecules, means for gettering the gaseous constituents of the dissociated hydrocarbon molecules, and means for heating the getter material.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross section view of the invention.

FIG. 2 is a partially broken away view of a portion of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, an image converter tube is generally illustrated at **2** comprising an evacuated glass envelope **4** having a faceplate **6** at one end thereof to receive a radiation image and a viewing station **20** at the opposite end. Radiation entering tube **2** thru faceplate **6** is converted by coatings **8** and **10** on the inner surface of faceplate **6** to a corresponding photoelectron image. This image is then accelerated and focused onto a phosphor coating **22** which converts the photoelectron image to a light pattern which is viewed at viewing station **20** as illustrated in FIG. 1.

In the illustrated embodiment, two layers **8** and **10** are illustrated on the inner surface of faceplate **6**. In this particular embodiment, invisible wavelengths of electromagnetic radiation pass through faceplate **6** striking first layer **8**. Layer **8** is a phosphor layer which converts the invisible radiation into radiation of a wavelength capable, in turn, of being converted into a photoelectron pattern by photocathode layer **10** which is superimposed on phosphor layer **8**. Thus, for example, a pattern of X-ray radiation falling upon window **6** is converted by layer **8** into a corresponding pattern of light radiation of a wavelength capable of being sensed by photocathode layer **10**. Photocathode layer **10** then emits a pattern of photoelectrons corresponding to the initial X-ray radiation pattern. The photoelectrons are accelerated by electrode **30**, which comprises a metal coating on the inner wall of envelope **4**, and anode **32** which is located adjacent viewing surface **20**. The photoelectrons are focused onto viewing surface **20**. The accelerating and focusing means cause the photoelectrons to strike phosphor layer **22**, causing phosphor layer **22** to emit a light radiation pattern visible at surface **20** which corresponds to the photoelectron image impinging thereon.

It should be noted that, in the illustrated embodiment, envelope **4** need not be constructed of glass, but could also be constructed of metal at least in so far as its opacity to X-ray radiation. Viewing surface **20**, however, must be constructed of a material which is transparent to visible light.

The construction of an image converter tube in which a first layer adjacent the faceplate converts radiation to wavelengths which are sensed by a subsequent photocathode layer superimposed thereon entails certain difficulties. While it is desirable to place photocathode layer **10** as close as possible to phosphor layer **8** the conventional materials which make up the two layers have been found to have a deleterious effect upon one another, particularly, at the temperatures used to initially process the formation of the layers. For example, the use of cesium in the photocathode layer may result in a poisoning of the phosphor layer thus rendering the device inoperative. It is therefore preferable to construct the device utilizing some type of protective coating, such as an organic resin or the like, between phosphor layer **8** and photocathode layer **10**. The use of such a protective coating, however, can result in the formation, within the evacuated tube, of harmful hydrocarbon gases, such as, for example, methane gas. To remove such hydrocarbon from the gases from the tube, as well as to remove more conventionally occuring gases such as H_2, O_2, and N_2 a getter pump, generally indicated at **50**, is provided as an appendage to image tube **2**.

Getter pump **50**, in the illustrated embodiment, includes an evacuated glass envelope **52** which is contiguous, and integral with glass envelope **4**. Glass envelope **52** terminates in a pin structure having terminal pins **54** thereon arranged to fit a conventional socket such as used for a

receiving tube for convenience in electrically connecting the internal constituents of pump **50** with external power sources. As more clearly seen in FIG. 2, terminal pins **54** provide electrical communication as well as structural support for the active elements comprising getter pump **50**.

Getter pump **50** comprises a generally centrally positioned filamentary cathode **56** mounted generally coaxial within pump **50**. Filamentary cathode **56** is supported at one end by a bent portion of pin **54***a* and at the other end by a bent portion of pin **54***b*. Coaxially surrounding filamentary cathode **56** is a circular grid electrode **58**. Grid **58** is mechanically supported by mounting grid support rod **58***a* to tube pin **54***c* which also provides the electrical connection necessary. A generally U-shaped flat ribbon **60** is placed around a portion of electrodes **56** and **58** comprising the getter. Ribbon **60** comprises a band **62** of solid material such as titanium having deposited on the outer surface thereof an active alloy gettering material **64**. Getter material **64** may comprise titanium, zirconium, a zirconium-aluminum alloy, or a zirconium-titanium alloy. In a preferred ebodiment a zirconium-aluminum alloy getter is used comprising approximately 84 percent by weight zirconium to 16 percent by weight aluminum particles having a particle size of 5–100 microns, sintered onto an iron mounting ribbon to provide a large surface area for reaction to the gases to be gettered. A getter strip of the type described is commercially available as ST101 Strip Getter from Getters Electronics, Inc. Hamburg, N.Y.

In operation, filamentary cathode **56** is heated and a small electron current flows from cathode **56** to grid **58**. This electron flow ionizes any gases within tube **2** and getter pump **50**. The electron current also causes dissociation of the hydrocarbons present therein into their atomic constituents. For example, in the case of methane CH_4, the electron current causes a dissociation of the hydrocarbon molecule into carbon and H_2 gas. The carbon is deposited on the wall **52** of pump **50** while the hydrogen gas is gettered by the action of getter material **64** on getter **60**.

In addition to causing dissociation of the hydrocarbon gases, the heat from filamentary cathode **56** radiates onto getter **60** causing an elevation in the temperature of getter material **64**. Preferably, the operating temperature of filamentary cathode **56** and the spacing of getter **60** from cathode **56** is chosen to provide a surface temperature on getter **60** of about 400° C. This results in enhanced operation and efficiency of the getter material.

By way of illustration a getter ion pump was constructed in accordance with the invention comprising a cylindrical glass envelope of about 1" diameter connected to the image tube by a ½" diameter glass tube. A ½" diameter grid was coaxially mounted within the enevelope surrounding the filaments. The grid was positively biased at about 250 volts with respect to the filament to provide a 10 ma. flow of current. An 84 weight percent Zr–16 weight percent Al getter ribbon comprising approximately 20 $cm.^2$ surface was positioned about the grid in a generally U-shape configuration about ⅛" from the grid. A slight negative bias voltage of about −20 volts was applied between the getter and the filament. The pump was operated and found to pump CH_4 at about 0.3 liter per second.

Several Torr-liters of CH_4 was pumped without any indication of saturation.

Thus the invention provides an improved getter ion pump which combines sensitivity of hydrocarbon gases with an increased pumping efficiency for conventional active gases.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electron discharge device comprising an evacuated envelope having getter means therein to getter gases within said envelope including gaseous hydrocarbons said getter means comprising two electrodes at least one of which is capable of thermally emitting electrons, means for heating said electrode, and active getter material in thermal proximity to said electrodes.

2. The getter means of claim **1** wherein one of said electrodes comprises a filamentary cathode and said getter material is heated by said cathode.

3. The getter means of claim **2** wherein said getter material is positioned sufficiently close to said cathode to be heated to a temperature of about 400° C.

4. The getter means of claim **2** where said getter material comprise porous material selected from the class consisting of titanium, zirconium, alloys, of titanium and zirconium, and alloys of zirconium and aluminum.

5. The getter means of claim **4** wherein said porous material comprises a zirconium-aluminum alloy.

6. An electron discharge device comprising an evacuated envelope having getter means therein to getter gases within said envelope including gaseous hydrocarbons, said getter means comprising:

(a) a filamentary cathode providing a source of electrons and heat;

(b) a second electrode adjacent said cathode, said cathode and second electrode cooperating to provide an electron current flow therebetween; and

(c) porous getter material selected from the class consisting of titanium, zirconium, alloys of titanium and zirconium, and alloys of zirconium and aluminum positioned in sufficient thermal proximity to said cathode to be heated to a temperature of about 400° C.,

said cathode providing heat and electron emission for the dissociation and ionization of gases while simultaneously providing heat to said adjacent getter material to accelerate the gettering of dissociated gases.

7. The device of claim **6** wherein said second electrode comprises a circular grid coaxially surrounding said filamentary cathode and said getter material comprises a getter ribbon positioned about said grid in generally U-shaped configuration.

8. The device of claim **7** wherein said getter material comprises a zirconium-aluminum alloy.

References Cited

UNITED STATES PATENTS

3,214,245	10/1965	Peters, Jr.	417—51
3,221,197	11/1965	Coppola	417—51

ROBERT M. WALKER, Primary Examiner

U.S. Cl. X.R.

313—7