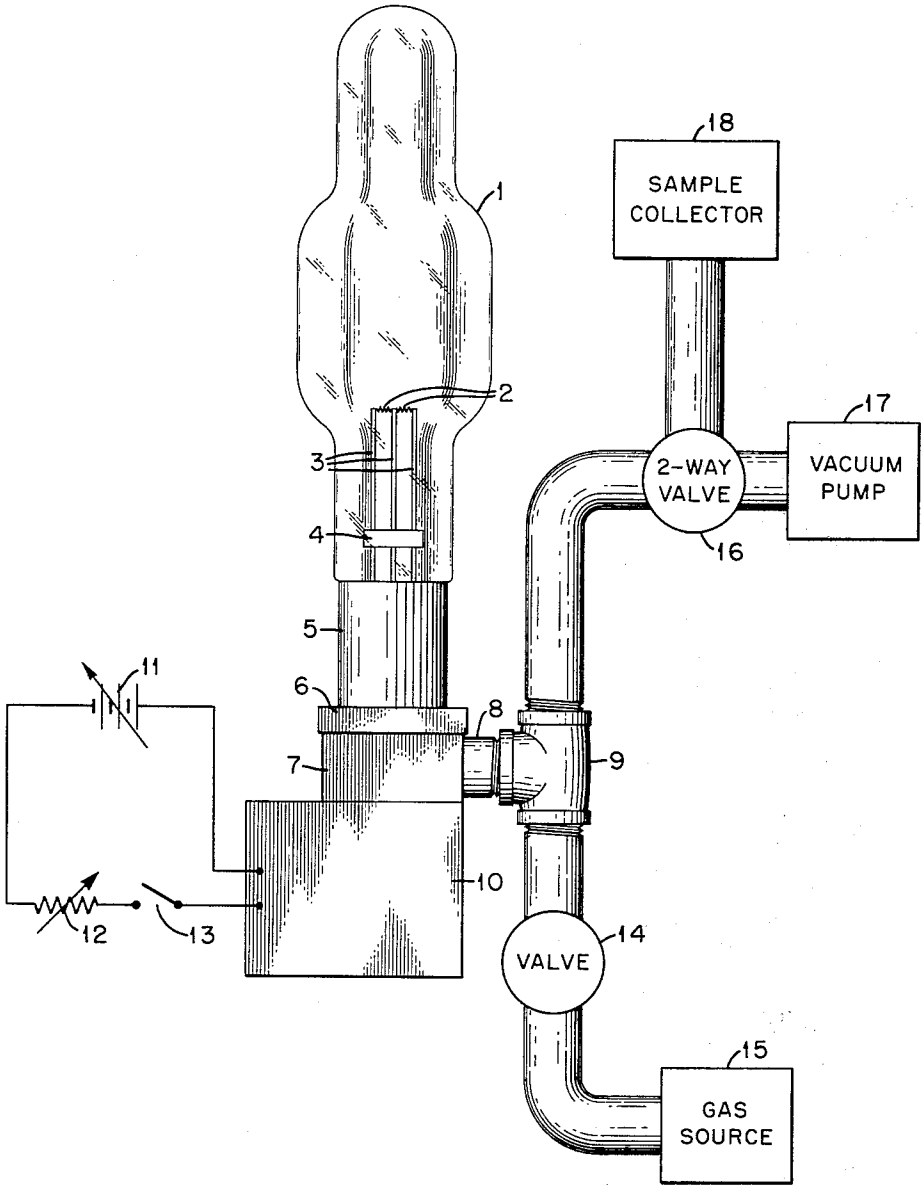
July 26, 1966 G. W. KEILHOLTZ ETAL 3,262,756

METHOD FOR ANALYZING INERT GAS FOR PRESENCE OF OXYGEN OR WATER VAPOR

Filed Dec. 18, 1962



INVENTORS.
Gerald W. Keilholtz
Curtis C. Webster

BY

ATTORNEY.

United States Patent Office 3,262,756 Patented July 26, 1966

3,262,756

METHOD FOR ANALYZING INERT GAS FOR PRESENCE OF OXYGEN OR WATER VAPOR

Gerald W. Keilholtz, Knoxville, and Curtis C. Webster, Oak Ridge, Tenn., assignors to the United States of America as represented by the United States Atomic Energy Commission

Filed Dec. 18, 1962, Ser. No. 245,952
1 Claim. (Cl. 23—232)

The present invention relates to a device for detecting the presence of oxygen or water vapor in any inert gas atmosphere.

In certain laboratories argon, helium and other inert gases are used in various projects and experiments. For example, these gases may be used in welding devices and in gas cooled nuclear reactors. In order to prevent undesirable oxidation and corrosion in the operation of these and other devices that use inert gases, it is desirable that no oxygen or water vapor be present in these gases. Thus, it is desirable to analyze inert gases, prior to their use, for any possible content of oxygen or water vapor contained therein.

Accordingly, it is a primary object of this invention to provide a device for detecting the presence of oxygen or water vapor in any inert gas atmosphere.

It is another object of this invention to provide a device which is easily fabricated and can be used repeatedly for analyzing inert gases for the presence of oxygen or water vapor.

These and other objects and advantages of this invention will become apparent upon a consideration of the following detailed specification and the accompanying drawing wherein:

The single figure illustrates one embodiment in which the principles of this invention may be carried out.

The above objects have been accomplished in the present invention by providing a transparent glass bulb in which are disposed a plurality of metallic filaments. After the glass bulb is evacuated, electrical power is supplied to one or more of the filaments in the bulb and a portion of the gas to be analyzed caused to flow into the glass bulb. If the gas in the bulb contains either oxygen or water vapor, a black coating will form over the filament when it is heated to a low temperature; subsequent heating of the filament to a high temperature results in a white smoke being given off from the filament and deposited on the interior of the bulb, leaving the filament clean.

In the drawing, a clear glass bulb **1** is rigidly attached to a metal-to-glass seal **5** which in turn is rigidly attached to a stand plate **6** and sealed from the atmosphere. The stand plate **6** is removably attached to a gas inlet box **7** and the joint therebetween is sealed from the atmosphere by an O-ring seal, not shown. A gas inlet pipe **8** is rigidly attached to and sealed within the gas inlet box **7**, and this inlet pipe **8** threadably engages with and is sealed to a pipe T **9**. A plurality of metallic filaments **2** are disposed within the glass bulb **1** and are rigidly attached to metal conductors **3** which are held in place by a spacer insulator **4**. The filaments **2** may be made of tungsten, for example, and the metal conductors **3** may be made of copper, for example. It should be understood that more than two filaments may be used, only two being shown for the sake of clarity in the drawing.

An electrical junction box **10** is removably attached to the gas inlet box **7**. The metal conductors **3** that extend through the members **5**, **6** and **7** pass through insulators (not shown) in the wall of the gas inlet box **7** and are affixed to suitable terminals within the box **10**. Electrical power is furnished to one or more of the filaments **2**, as desired, by means of a battery **11**, a variable resistor **12** and a switch **13** which are connected to the appropriate terminals within the junction box **10** depending upon which desired filament or filaments are to be energized. The voltage across any filament **2** may be varied from about 10 volts to about 90 volts depending upon which type of operation is desired as discussed below, the lower voltage being preferred to prolong the life of the filament.

The pipe T **9** is connected by means of a gas inlet line and a valve **14** to a source of inert gas **15** to be analyzed for any possible oxygen or water vapor content. A gas outlet line connects the other side of the pipe T **9** to either a vacuum pump **17** or a gas sample collector **18** by means of a two-way valve **16**.

Before the gas analyzer can be used, the bulb **1** and the rest of the analyzing system (members **5**, **7**, **8**, **9**) must be evacuated to remove the air and any water vapor that might be present. This is accomplished by connecting the vacuum pump **17** by means of valve **16** to the interior of the analyzing system, and closing the valve **14** after gas from source **15** purges the line between the valve **14** and source **15** of any air therein. Thus any air or water vapor present in the bulb **1** and connecting lines may be removed therefrom by the vacuum pump **17**. After evacuation, gas is allowed to flow through the analyzer by opening valve **14**. The vacuum pump is then disconnected and the gas is directed to the collector **18** by proper operation of valve **16**. If gas is allowed to flow through the line at a fast rate, then the turbulence set up by the gas passing through the T **9** will channel a portion of the gas up into the bulb **1**. If the gas is allowed to flow at a low rate, some of the gas will naturally flow up into the bulb **1**. In either event, a sufficient sample of the gas will enter the bulb **1** so that any oxygen or water vapor present may be detected by allowing a flash of current through one of the tungsten filaments **2**. It has been found that if the gas in the bulb **1** contains either oxygen or water vapor, a black coating will form over the filament when it is heated to a low temperature, whereas a white smoke will be detected at a high filament temperature and be deposited on the interior of the bulb **1**.

It may become necessary to clean the interior of the bulb **1** after prolonged use. This may be done by detaching and removing the stand plate **6** from the gas inlet box **7**. Any suitable solvent may be used for cleaning the bulb **1**, for example, acetone. The provision of more than one filament is desirable in the above described device since in the event one filament should fail, the others could be used.

It has been determined that for the size filament being used when about ten volts is applied to the filament it will be heated to a dull glow, and if oxygen or water vapor are present the filament changes to a black color. Larger or smaller filaments may necessitate larger or smaller voltages, respectively, to achieve the minimum temperature for producing a dull red color. Time-color calibrations may then be used, if desired, to determine the amount of oxygen or water vapor present. If the voltage applied to a filament is raised to about 90 volts, for example, the filament is heated to nearly incandescent temperature and the presences of small quantities of oxygen or water vapor in the gas being analyzed will be indicated by the flash-off of white smoke from the filament.

It should be noted that when the analyzer is operated at a low voltage and if the filament acquires a black coating, this coating may be removed by momentarily increasing the voltage applied across the filament and the coating will be flashed off. The analyzer filament will then be clean and in condition for making a subsequent low volt-

age analysis of an inert gas sample. When the interior of the bulb becomes too cloudy with depositions of the white smoke thereon, it may be cleaned in the manner indicated above and the device reassembled for a subsequent use.

The inert gas analyzer described above may be used as a "go-no-go" moisture gage for gases to be used in a gas-cooled nuclear reactor, if desired. Also, the analyzer may be used in certain welding operations and other applications of inert gases which require assurance that oxygen or water vapor are not present.

This invention has been described by way of illustration rather than limitation and it should be apparent that this invention is equally applicable in fields other than those described.

What is claimed is:

A method of qualitatively analyzing an inert gas for the possible presence of oxygen or water vapor therein comprising the steps of evacuating a transparent glass bulb containing a tungsten filament therein, flowing an inert gas sample through said bulb, connecting a first selected voltage across said filament for a short time interval to heat said filament to a dull red color, said filament turning black to provide a first indication of the presence of any oxygen or water vapor that may be present in said inert gas sample, and connecting a second selected voltage across said filament for a second short time interval to heat said filament to near incandescence, said filament flashing off a white cloud to provide a second indication of the presence of any oxygen or water vapor that may be present in said inert gas sample.

References Cited by the Examiner

UNITED STATES PATENTS

1,240,700	9/1917	Friederich	313—233 X
1,859,029	5/1932	Boer et al.	313—180 X
3,147,083	9/1964	Steverding et al.	23—254 X

OTHER REFERENCES

Slowter et al.: "Metal Progress," vol. 38, pp. 566 and 569 (1940).

MORRIS O. WOLK, *Primary Examiner.*

H. A. BIRENBAUM, *Assistant Examiner.*