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[54] **FAST-RESPONSE IONIZATION CHAMBER FOR  
 DETECTING IONIZING RADIATION FROM 0.1 TO  
 60 ANGSTROMS**  
**4 Claims, 2 Drawing Figs.**

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 250/83.6, 313/101  
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 H01j 39/28  
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 101; 250/83.6

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**ABSTRACT:** This invention is directed to an ionization chamber having a rectangular housing including therein spaced anode plates with a centrally located cathode. This ionization chamber has a fast response for detection of ionizing radiation in various bands from 0.1 to 60A depending on the gas filling and window material (for example 0.5–3.0A uses a 50-mil-thick beryllium window and 2 atm. of krypton) with a fast recovery. Fast response is brought about by the relationship of the cathode to the anodes in which the spacing and electric field is uniform along the length of and on opposite sides of the cathode. The chamber is filled with a gaseous filling selected from one of the following, nitrogen, carbon tetrachloride, xenon, nitrogen, krypton or argon and is provided with a removable beryllium, Mylar or aluminum window through which the ionizing radiation enters the chamber.

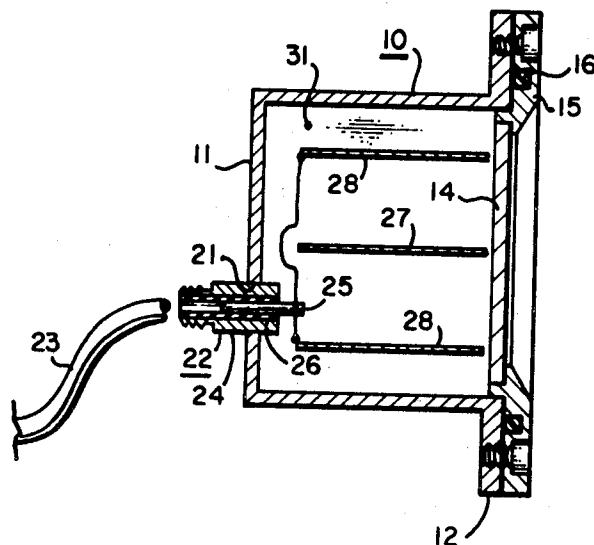


FIG. 1

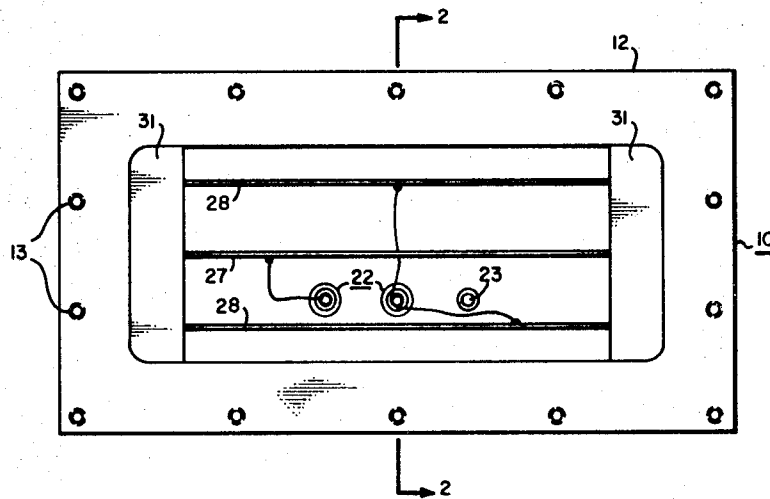
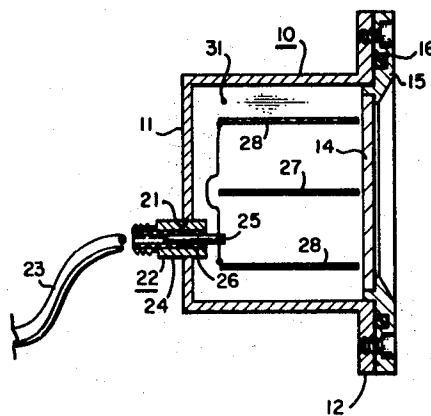


FIG. 2



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# FAST-RESPONSE IONIZATION CHAMBER FOR DETECTING IONIZING RADIATION FROM 0.1 TO 60 ANGSTROMS

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

## BACKGROUND OF THE INVENTION

The present invention relates to ionization chambers and more particularly to an improved ionization chamber usable on an earth orbiting vehicle.

In general, conventional ionization chambers comprise two electrodes in a surrounding of a desired gas at a desired pressure. Radiation entering the ionization chamber ionizes the gas molecules therein to produce ions. The negatively charged ions produced will travel to the anode whereas the positively charged ions travel in the opposite direction to the cathode. The resulting output of the tube is a measure of the intensity of the ionizing radiation which enters into the ionization chamber.

Heretofore, ionization chambers have been used in a stationary environment and also mounted upon rotating rockets or satellites and fired into the atmosphere. Ionization chambers fired into the atmosphere on a rotating rocket or satellite responds to incident radiation each revolution of the rocket should respond sufficiently fast that the peak signal of one event is recorded or telemetered to a ground station prior to a response from any succeeding event due to radiation excitation. Ionization chambers used heretofore are slow in their response time and therefore when mounted on a rotating rocket, the signal of one event is superimposed on the output of the succeeding event thereby giving a false signal. Normally, satellites in order to obtain desired stability, rotate at a revolution of from 2 to 3 revolutions per second. The prior art ionization tubes operate satisfactorily at about 1 revolution per second. Thus, for good operation of the prior art tube the rocket spinning rate must be reduced to at least 1 revolution per second or lower; however, at 1 revolution per second the rocket misbehaves and does not follow the intended flight pattern.

## SUMMARY OF THE INVENTION

The ionization tube of the present invention is of light weight being made of aluminum. It has an easily removable window and is rectangular, which presents a large area to the ionization particles to be detected. This ionization chamber operates satisfactorily with a vehicular rotation which is sufficient to prevent flight misbehavior.

It is therefore an object of the present invention to provide an ionization chamber which has a quick response time in a vehicle having a stable rotational movement.

Another object is to provide an ionization chamber which is not affected by a nearby magnetic field that guides the ionizing particles into the ionization chamber.

Still another object is to provide an ionization chamber which is of simple construction resulting in reduced fabrication time and cost.

Other objects and advantages will be apparent to those skilled in the art upon the consideration of the following description and the attached drawings.

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a view looking into the chamber from the top.

FIG. 2 is a cross-sectional view of the tube illustrating the relative parts.

## DESCRIPTION OF THE EMBODIMENT

Now referring to the drawing wherein like reference characters represent like parts throughout the drawing there is illustrated an ionization chamber made in accordance with the teaching of the present invention. As shown, FIG. 1 illustrates

a rectangular boxlike aluminum housing 10 having an integral bottom 11 with an open top. The top is provided with an outwardly extending flange 12 which is provided with threaded holes 13 therein for the purpose of securing a window 14 over the open end of the housing. The window 14 is made of a radiation permeable material such as beryllium, aluminum, Mylar, or any other suitable material, through which the radiation passes into the chamber. The window is secured to a frame 15 and the frame is secured to the flange of the housing by suitable screws. Gas leakage is prevented by the use of any suitable seal such as an O-ring 16. The window frame may be provided with cross-supports in order to support the window to prevent rupture thereof if needed.

The bottom of the housing is provided with three spaced apertures 21, two of which have a "microdot" connector 22 therein, one a voltage input connector and the other a signal output connector. The other aperture is provided for evacuating the chamber and adding gas into the chamber through a suitable tube 23 connected to the bottom. The "microdot" connectors as shown, include an outer metal housing 24 which is secured at one end to the aperture wall in the bottom of the chamber and is threaded on the outer end for connection to an electrical line by a connector. The center of the connector is provided with a conductor 25 which is separated from the connector housing by a Teflon insulator 26. Thus, the center conductor is insulated from the chamber housing by the Teflon insulator.

The inside of the chamber is provided with three plate type electrodes 27 and 28. Plate 27 is a collector plate and is electrically connected with the signal output "microdot" connector and the plates 28 are positioned on opposite sides of the collector plate 27 in a parallel arrangement and connected electrically to the voltage input connector. The parallel plates 27 and 28 are spaced from the bottom of the chamber housing and extend upwardly to a close spacing from the window. Each end of plates 27 and 28 are secured in a Teflon insulator block 31, to hold the plates in a parallel position relative to each other and the side walls of the housing 10 and to insulate the plates from the chamber housing. Each of the plates 28 are connected to the same voltage input connector in parallel so the same voltage is applied to each of the plates.

For detection of radiation having a range of about 0.50 to about 3.0 angstrom units, the gas filling in the tube should be krypton. The tube is evacuated to a pressure of about 10 millimeters of mercury and a gas filling of krypton is injected through the tube to a pressure of about 1,520 millimeters of mercury at 0° centigrade. For such a tube the beryllium window would have a thickness of 50 mils. In order to make an ionization chamber for detection of radiation in a range between about 2.0 and about 8.0 angstrom units, the chamber is evacuated and filled with argon gas at a pressure of 760 millimeters of mercury at 0° centigrade. For the latter tube, the window is formed of a 5-mil beryllium sheet.

As noted, the filling pressures are determined on the basis of temperature of 0° centigrade, therefore the filling pressure should be correspondingly adjusted when filling the tube at room temperature. The formula for this adjustment is as follows:

$$AP = \frac{(LP)(273 + RT)}{273}$$

where

AP = adjusted pressure

LP = list pressure given for tube filling at 0° centigrade

RT = room temperature in degrees centigrade.

For example, the above ionization chamber may be made of aluminum with the following dimensions:

outside length 3.8 inches; width 1.6 inches; height 1.375 inches.

inside length 3.7 inches; width 1.5 inches; height 1.25 inches.

each of the aluminum conductor plates have a length of 3.2 inches with a width of 1.0 inches. Each of the plastic insulators have a thickness of about three-eighth inch therefore the length of the exposed portions of the conductor plates is approximately 3 inches by 1 inch in height.

The plates are separated by about one-half inch (on center) with the conductors 28 positioned approximately one-quarter inch from the sides. The above dimensions are suitable for carrying out the invention and are set forth as an example only.

In operation of the ionization chamber to detect solar X-rays, the device is secured aboard an earth's orbiting vehicle or a rocket which is fired into the upper atmosphere. In securing the ionization chamber aboard a vehicle, a "circular" magnet having an elongated opening therethrough is positioned in front of the window to permit only desired radiation to pass through the opening to the ionization chamber. The elongated opening in the magnet is aligned linearly with the elongated axis of the rectangular ionization chamber. The ionization chamber is connected into an electronic circuitry such that a positive voltage of about 50 volts is applied to the two outer parallel plates and the collector electrode is electrically connected to a signal amplification and telemetering or recording circuitry depending upon the vehicle upon which the ionization chamber is assembled.

Application of +50 volts to the outer parallel plates sets up uniform electric field lines between the outer two parallel plates and the center collector plate. Solar X-rays passing through the magnetic field in front of the ionization chamber passes through the window of the chamber into the gaseous filling. On passing into the gaseous filling, the ionizing radiation ionizes the gas, developing positive ions, negative ions and/or electrons. The positive ions are attracted to the collector plate and the negative ions and/or electrons are attracted to each of the parallel positive plates. The ions collected by the plates produces a voltage output signal which is amplified and recorded or telemetered to ground depending on the vehicle used and the electronic equipment used. The output signals are then evaluated to determine the amount of ionization radiation detected by the ionization chamber.

The parallel plates create a uniform electric field along the entire length of the parallel plates, thus, any ionizing radiation penetrating the window will have substantially the same electrical forces applied thereto regardless of the point in which it penetrates the window of the ionization chamber. The device is made of aluminum, therefore, it is of light weight and the window is easily removable for performing any necessary repairs.

The operation has been described using a +50 volts connected with the two outer plates, it is obvious that the system will work just as effectively if a negative voltage is applied to the center plate. The important thing is that the center plate be negative with respect to the outer sideplates.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the ap-

pended claims the invention may be practiced otherwise than as specifically described.

What is claimed and desired to be secured by Letters Patent of the United States is:

- 5 1. An ionization chamber for detecting solar X-ray, which comprises:
  - a housing,
  - said housing having sidewalls, a closed and an open end,
  - three equally spaced electrodes secured within said housing,
  - said electrodes being insulated from said housing and extending perpendicular to said closed end surface and said open end, and parallel to said side walls and to each other with one electrode centrally positioned,
  - 15 a pair of spaced electrical connectors secured to said closed end,
  - each of said electrical connectors including an electrical conductor insulated from said closed end and passing therethrough,
  - the center electrode of said three electrodes electrically connected with the electrical conductor in one of said electrical connectors,
  - 20 the outer two electrodes of said three electrodes connected electrically in parallel and connected to the electrical conductor of the other of said pair of electrical connectors,
  - a window through which ionizing radiation enters said ionization chamber,
  - said window selected from a group consisting of beryllium, mylar or aluminum,
  - 30 said window enclosing said open end of said housing, and an ionizable gas filling in said enclosed housing,
  - said gas selected from a group consisting of nitrogen, carbon tetrachloride, xenon, nitrogen, krypton or argon, whereby said ionization chamber operates for detection of radiation in a range from about 0.1 to 60A.
2. An ionization chamber as claimed in claim 1, wherein said electrodes are thin plates extending along the length of said housing and having a height substantially the height of the inside height of said housing.
3. An ionization chamber as claimed in claim 1; wherein, said gas filling is krypton at a pressure of about 1,520 millimeters of mercury at 0° centigrade in an evacuated environment of about 10<sup>4</sup> millimeters and said window is beryllium having a thickness of about 50 mils, whereby the radiation detected has a range between about 0.50 to about 3.0 angstrom units.
4. An ionization chamber as claimed in claim 1; wherein, said gas filling is argon at a pressure of 760 millimeters of mercury at 0° centigrade in an evacuated environment, said window is a thin sheet of beryllium having a thickness of about 5 mils, whereby the radiation detected is in a range between about 2.0 and about 8.0 angstrom units.

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