Nov. 4, 1952 H. V. NEHER 2,617,044

AUTOMATIC IONIZATION CHAMBER

Filed Sept. 1, 1950

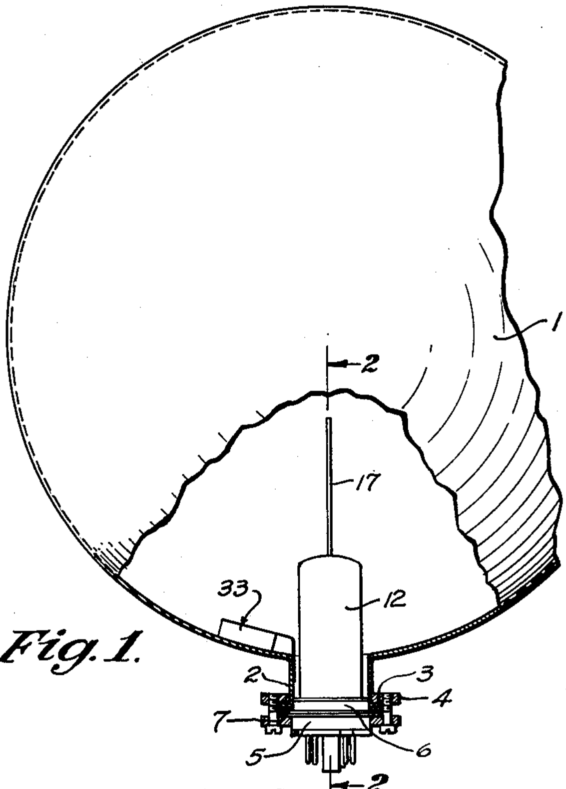

Fig. 1.

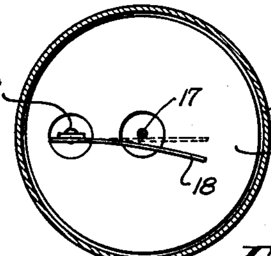

Fig. 3.

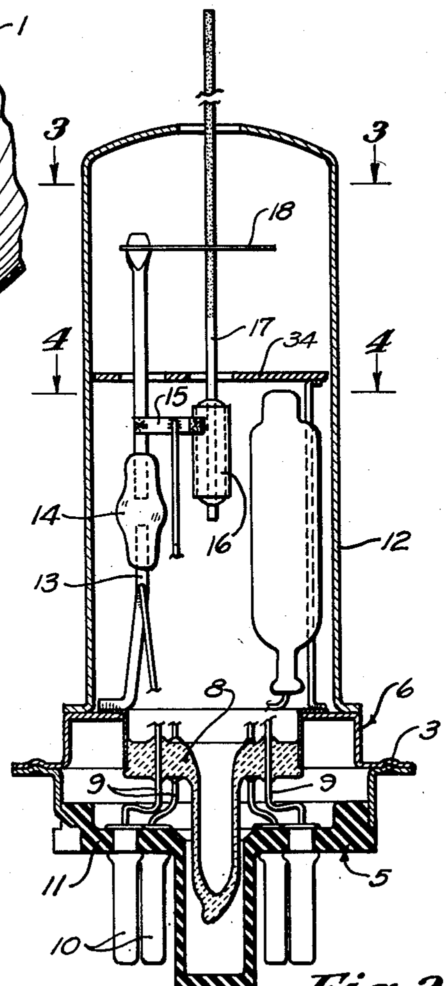

Fig. 2.

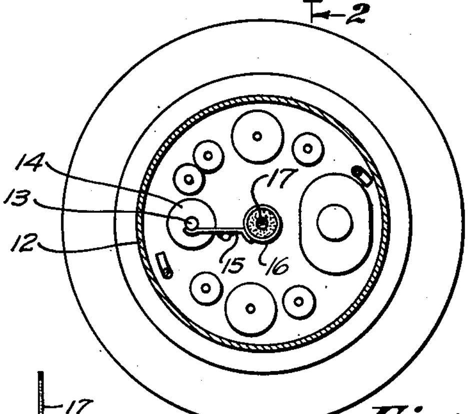

Fig. 4.

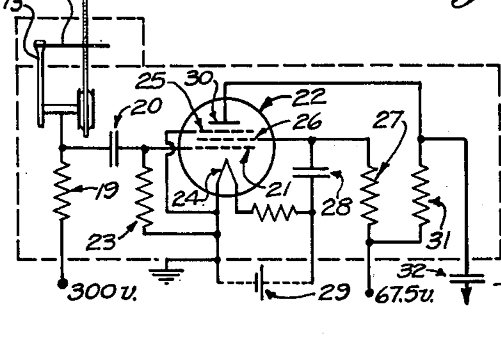

Fig. 5

INVENTOR.

Henry Victor Neher

BY Lyon & Lyon

Attorneys

Patented Nov. 4, 1952 2,617,044

UNITED STATES PATENT OFFICE

2,617,044

AUTOMATIC IONIZATION CHAMBER

Henry Victor Neher, Pasadena, Calif., assignor to California Institute Research Foundation, Pasadena, Calif., a corporation of California

Application September 1, 1950, Serial No. 182,711

6 Claims. (Cl. 250—83.6)

1

My invention relates to automatic ionization chambers and included in the objects of my invention are:

First, to provide an automatic ionization chamber which is particularly reliable for long periods of time; in fact, for periods of years.

Second, to provide an ionization chamber which is dependably rugged, yet economical to manufacture and repair.

Third, to provide an automatic ionization chamber which responds to extremely large variations in radiation; for example, a range variation from ten thousand to one or from a count each half hour to several counts per second.

Fourth, to provide an ionization chamber which is fully and completely automatic and which lends itself to remote recording in which the ionization chamber may be placed in some remote point and caused to key or operate a radio transmitter.

With the above and other objects in view as may appear hereinafter, reference is directed to the accompanying drawings in which:

Figure 1 is a fragmentary, partial elevational, partial sectional view of my automatic ionization chamber.

Figure 2 is an enlarged sectional view through 2—2 of Figure 1 showing substantially schematically the physical arrangement of some of the circuit components contained within the ionization chamber.

Figure 3 is a transverse, sectional view through 3—3 of Figure 2.

Figure 4 is a transverse, sectional view through 4—4 of Figure 2.

Figure 5 is a wiring diagram of the circuit contained within the ionization chamber.

My automatic ionization chamber is contained within a shell 1 which is preferably spherical in form and formed of metal or may be of other suitable material, metal coated. The shell is provided with a mouth 2 having a flange 3 which co-acts with a clamp ring 4 and appropriate screws to secure the margins of a terminal base 5 forming part of a mounting unit 6 which projects into the shell 1. A seal ring 7 is provided between the flange 3 and the clamper margins of the terminal base 5.

The mounting unit 6 includes a glass seal 8 in the central portion of the terminal base 5. Leads 9 extend through the seal and the outer extremities are connected to terminals 10 suitably supported in an insulating member 11, secured to the terminal base 5. The inner extremities of the leads 9 are connected to appropriate circuit components of a single stage amplifier to be described hereinafter. The amplifier which utilizes miniature circuit components is encased in a housing 12 secured to the terminal base and projecting into the spherical shell 1. The housing 12 is cylindrical. Within the housing is a mounting bracket 13 in the form of a wire interrupted by a separator of insulating material 14. The extended portion of the bracket or rod 13 is provided with a lateral support or bracket 15 which is attached to a sleeve member 16 in which is cemented an ion collector rod 17 of insulating material, preferably quartz. The ion collector rod 17 projects through an opening in the inner end of the housing 12 and is coated with a conductive material such as graphite except for a suitable insulating length near its support. The inner extremity of the bracket or rod 13 is provided with an electroscope element 18 in the form of a flexible fiber or whisker which is positioned so that it may contact the conductor coated surface of the ion collector. The fiber is formed of, or coated with, conductive material.

2

Contained within the housing 12 below a shield plate 34 are the circuit components of a preamplifier, the circuit of which is shown in Figure 5. The electroscope element 18 is connected through a resistance 19 and a terminal 10 to the ungrounded positive terminal of a suitable voltage source such as a battery, not shown. The electroscope element is also connected through a coupling condenser 20 to the main control grid of a discharge device 22.

A grid resistor 23 is connected between the grid 21 and cathode 24. The other connections with the discharge device 22 are conventional. That is, the suppressor grid 25 is connected to the cathode 24, and the screen electrode 26 is connected to an external positive ungrounded terminal of a second voltage source, not shown, through a voltage dropping resistance 27 and a terminal 10. Screen bypass condenser 28 is connected between the screen 25 and the ungrounded terminal of a filament or cathode voltage source 29 located externally, to serve the function of a conventional screen bypass condenser. The anode 30 is connected, for the flow of space current through the discharge device 22 to the positive ungrounded terminal of the second voltage source through a resistance 31. Amplified voltage appearing across resistance 31 is transferred through a coupling condenser 32 to an external recording, transmitting, or telemetering apparatus not shown.

The preamplifier is placed and sealed within the ionization chamber itself to:

(1) Reduce the capacitance of the input circuit to the tube. This is essential because of the small charge needed to recharge the collector to its original voltage (for example 300 volt) potential;

(2) To minimize the effects of external conditions such as leakage over insulators caused by humidity.

Operation of my automatic ionization chamber is as follows:

Assuming an initially charged state of the collector rod 17, the input pulses or ion charges entering the ionization chamber cumulatively reduce the potential of the collector rod. The apparatus is pre-designed to receive from 10,000 to 50,000 or more input pulses before discharging the collector rod sufficiently to cause contact by the electroscope element or fiber 18.

When the potential of the collector rod 17 drops to a value where the electroscope element or fiber 18 suddenly touches it, a current flows through a resistance 19 causing a drop in potential. This potential drop, due to the mechanical contact of the fiber and collector, occurs quite rapidly, probably in a few micro-seconds. Such small loss in time does not appreciably effect the accuracy of the apparatus. The charge that flows to recharge the collector may be in the range of 10^{-10} coulombs.

This negative pulse is passed by condenser 20 to the grid 21 of the discharge device 22. The pulse passed on by this device is positive. This output pulse is transferred through the coupling condenser 32 to operate a trigger circuit which in turn controls a recording transmitting, or telemetering apparatus, not shown.

The time interval between such pulses vary inversely as the rate of ionization in the ionization chamber, and may range from a count or pulse each half hour or so to several counts per second. By use of known sources of radioactivity the ionization chamber can be calibrated so that the number of input pulses represented by each output pulse is known.

Mounted within the ion chamber at one side of the shell 12 is a desiccating unit 33.

Having thus described certain embodiments and applications of my invention, I do not desire to be limited, but intend to claim all novelty inherent in the appended claims.

I claim:

1. An automatic ionization chamber; involving: a sealed shell; an ion collector caused to contact said ion collector after a predetermined number of input charges have been received in said shell mounted therein; a charging arm movable to and from contact with said ion collector; means for applying a predetermined potential to said charging arm to repel said arm from said ion collector; means for receiving and amplifying for transmission an output impulse representing numerically the total of said predetermined input charges occasioned by engagement of said arm and ion collector.

2. An automatic ionization chamber; involving: a sealed shell forming an ionization chamber; a shield extending into said shell; an ion collector mounted in said shield and extending therefrom into said shell; and by the cumulative effect of ion impulses in said chamber to bleed its charge a charging arm within said shield; a source of electrical potential connected therewith; said charging arm movable away from said ion collector when said ion collector and charging arm are similarly charged and toward said ion collector as its charge is bled into said ionization chamber, said charging arm adapted on discharge of said ion collector to make electrical contact therewith, and thereby simultaneously recharge said ion collector and produce an electrical signal; representing numerically said plurality of ion pulses and means for transmitting said electrical signal.

3. An automatic ionization chamber, involving: a sealed shell forming an ionization chamber; a shield extending into said shell; an ion collector mounted in said shield and extending therefrom into said ionization chamber and by the cumulative effect of ion pulses in said ionization chamber to bleed its charge; a charging arm within said shield and connected with a source of electrical potential; said charging arm movable away from said ion collector when said ion collector and charging arm are similarly charged and toward said ion collector as its charge is bled into said ionization chamber, said charging arm adapted on discharge of said ion collector to make electrical contact therewith, and thereby simultaneously recharge said ion collector and produce an electrical signal representing numerically the total of said ion impulses; an amplifier circuit, within said shield and shell for receiving and transmitting said signal.

4. An automatic ionization chamber; involving: a shell forming an ionization chamber and having an opening therein; a shield structure projecting into said ionization chamber removably sealing said opening; an ion collector rod mounted in said shield insulated therefrom and protruding into said ionization chamber and by the cumulative effect of ion pulses in said ionization chamber to bleed its charge; a charging arm within said shield; a source of electrical potential for said charging arm; said charging arm adapted to make electrical contact with and charge said ion collector whereupon said charging arm is repelled from said ion collector until dissipation of its charge; and means within said shell for producing and amplifying a signal operable upon each contact between said charging arm and ion collector, said signal being numerically representative of the total of pulses occurring between contacts of said charging arm with said ion collector rod.

5. An automatic ionization chamber, involving: a shell forming an ionization chamber and having an opening therein; a removable shield structure sealing said opening and projecting into said shell; an ion collector rod mounted in said shield insulated therefrom and protruding into said ionization chamber and by the cumulative effect of ion pulses in said ionization chamber to bleed its charge; a charging arm within said shield, movable to and from electrical contact with said ion collector; a source of electrical potential for said charging arm externally of said shell; said charging arm adapted on making electrical contact with said ion collector to charge the same and repel therefrom; means within said shell operable on contact between said charging arm and ion collector to produce an electrical impulse; and an amplifier circuit, within said shield for transmitting said impulse, said electrical impulse being numerically representative of the total of pulses occurring between contacts of said charging arm with said ion collector rod.

6. An automatic ionization chamber, involving: a shell forming an ionization chamber and having an access opening; a shield including a terminal base removably sealed in said opening;

a preamplifier unit mounted within said shield and subjected to the conditions within said ionization chamber, said preamplifier being connectable through said terminal base to a power supply and signal receiving means; an ion collector mounted in said shield and protruding into said ionization chamber and by the cumulative effect of ion pulses in said ionization chamber to bleed its charge; a charging element movable to and from electrical contact with said ion collector and connected with a source of electrical potential to charge said ion collector on contact therewith, said charging element adapted on charging said ion collector to repel therefrom; and means operable on contact between said charging element and ion collector to produce a signal for transmission through said preamplifier, said signal being numerically representative

of the total of pulses occurring between contacts of said charging arm with said ion collector rod.

HENRY VICTOR NEHER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,933,063	Kolhorster	Oct. 31, 1933
2,265,966	Gebauer	Dec. 9, 1941
2,403,603	Korn	July 9, 1946
2,465,886	Landsverk et al.	Mar. 29, 1949
2,474,773	Baker	June 28, 1949

FOREIGN PATENTS

Number	Country	Date
18,827	Great Britain	Dec. 11, 1913