

Sept. 4, 1951

C. A. TOBIAS

2,566,684

SEGMENTED IONIZATION CHAMBER

Filed Nov. 2, 1950

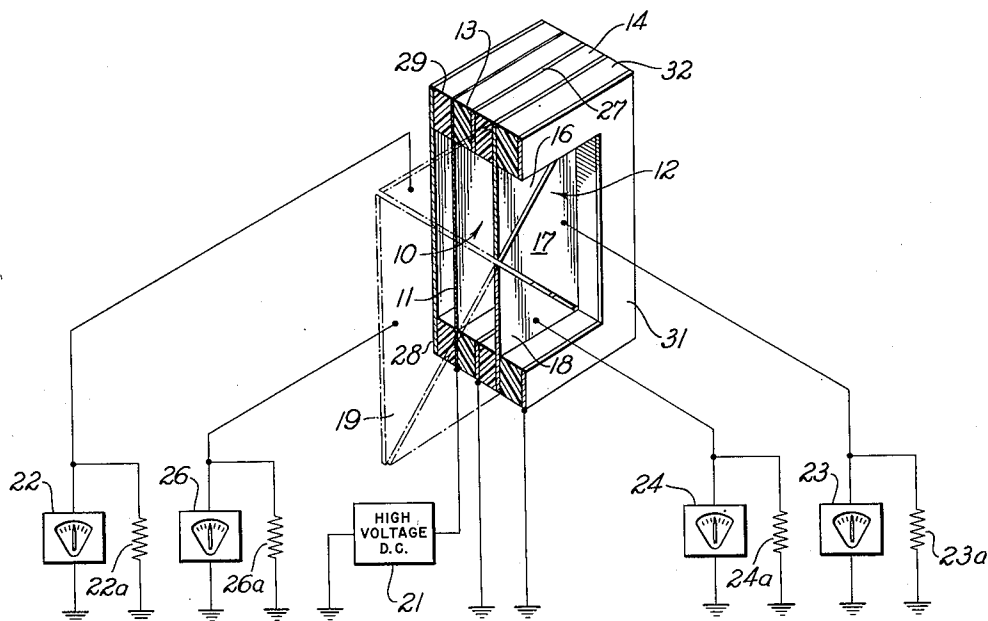


Fig. 1.

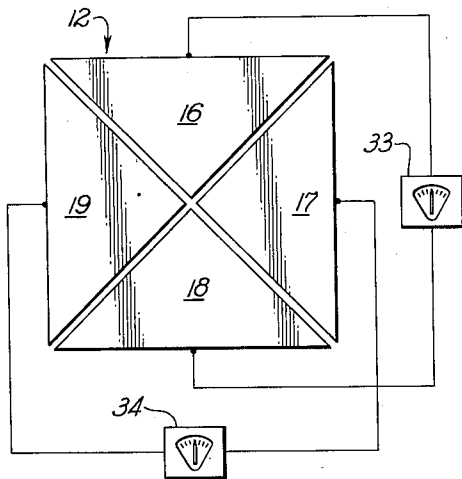


Fig. 2.

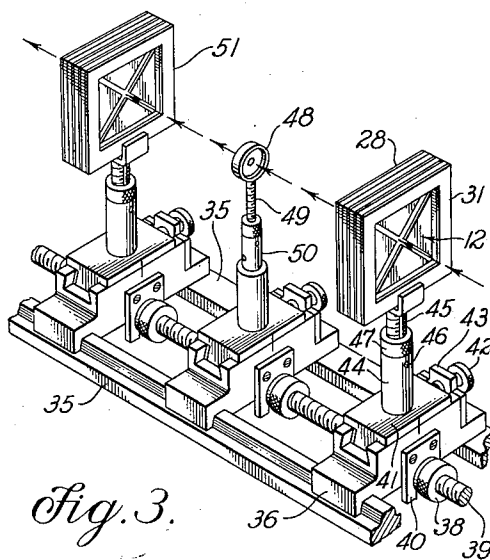


Fig. 3.

INVENTOR.
CORNELIUS A. TOBIAS

BY

Roland A. Anderson

ATTORNEY.

UNITED STATES PATENT OFFICE

2,566,684

SEGMENTED IONIZATION CHAMBER

Cornelius A. Tobias, Walnut Creek, Calif., assignor to United States of America as represented by the United States Atomic Energy Commission

Application November 2, 1950, Serial No. 193,614

6 Claims. (Cl. 250—83.6)

1

This application relates to ionization chambers and particularly to their utilization for ascertaining the direction of a beam of ionized particles and the center of such beam. The principle of the ionization chamber is well known and its adaptability to various embodiments demonstrated by the range of instruments which have been evolved for particular purposes. So far as I am aware, ionization chambers of the prior art, however, are not especially helpful when the problem of quickly locating the center of a collimated beam of ionized particles is presented. When the cross-section of such a beam is non-uniform with reference to particle density, the performance of certain laboratory operations, such for example, as the precise irradiation of a small-area target is difficult and uncertain.

Accordingly, it is an object of the present invention to provide an ionization chamber which may be employed to locate rapidly and accurately the center of a beam of ionized particles.

Another object of this invention is to provide a means and method of quickly ascertaining the direction of the central axis of such beam.

Another object of the invention is to provide an ionization chamber of unique type and effectiveness for scanning the cross section of a beam of ionized particles and thereby indicating the relative density of the various portions of such cross section.

Another object of the invention is to provide an ionization chamber adapted to indicate simultaneously the density of two or more closely adjacent areas of an ion beam cross section and thereby locate the center of such beam.

A further object of the invention is to provide an improved apparatus for locating the axis of symmetry of a collimated beam of charged particles for impingement upon a suitable target area.

Further objects and advantages of the invention will be apparent from the following specification and from the accompanying drawing wherein:

Figure 1 is a sectional perspective view of the ionization chamber of this invention together with a schematic representation of the energizing circuits therefor,

Fig. 2 is a schematic representation of the ionization chamber in plan and employing a different circuit arrangement, and

Fig. 3 is a perspective view of a pair of spaced ionization chambers of this invention and an interposed target for the ion beam, the various

2

relative adjustments of the beam interrupting components being facilitated through manipulation of the carriage depicted in this figure.

The principle of my invention in its broadest aspects is that of scanning the cross-section of a beam of charged particles, that is, traversing the area of such cross section in a direction generally normal to that of the beam through use of a density indicator, such as an ionization chamber, and observing the value of the ionization at a number of spaced locations across such cross section. It will be appreciated, however, that a somewhat complicated traversing mechanism must be provided if a large number of readings are needed; furthermore, if the beam cross section is relatively small the ionization chamber also must be small. Obviously, the minute detail of such procedure is time-consuming since the beam must be maintained through many readings and the practical accuracy of such technique in a given series of readings may be open to question.

Instead of moving a single beam intercepting element to scan an entire cross-sectional area of the beam, I have found that the necessary movement is greatly reduced and much time saved through the provision of a plurality of beam intercepting elements arranged to indicate beam intensity of the respective intercepted areas. If such elements are symmetrical in area outline with respect to either a horizontal axis or a vertical axis of the beam cross section and are congruent, a line including the center of the beam may be located, while if both horizontal and vertical symmetry are provided, the precise center point of the beam on such line may be ascertained. It is the latter concept which finds utilization in a preferred form of the invention and now to be described.

Reference is now made to the drawing and to Fig. 1 thereof, wherein an inner chamber 10 may be defined by suitable wall structure such, for example, as a high voltage electrode 11 in the form of a thin aluminum foil sheet spaced from a divided or segmented aluminum sheet 12 by means of rectangular insulator rings 13 and 14. It will be observed that the sheet 12, preferably, is square shaped and is narrowly separated (e. g. $\frac{1}{8}$ inch) along diagonals to provide triangular segments indicated at 16, 17, 18, and 19, respectively. The customary high voltage D. C. source 21 connected between high voltage electrode 11 and ground is provided as is well known in the art, while a plurality of grounded electrometers 22, 23, 24, and 26 corresponding, respec-

3

tively, to the segments 16, 17, 18, and 19 serve to indicate the polarity and value of the electrical current flowing between plate 11 and those segments of plate 12 which are in intercepting relation to the beam. High resistances 22a, 23a, 24a, and 26a are shunted across the respective electrometers to serve as a discharge path thereacross when ionization of the air in chamber 10 has ceased.

It will be noted from Fig. 1 that a conductive rectangular ring 27 is interposed between insulator rings 13 and 14 and is connected to ground to prevent the passage of any leakage current from plate 11 to the segments of plate 12 by way of the surfaces of said insulating rings. Also, it is desirable to incorporate an aluminum or other suitable guard plate 28 as a rear wall for the device and separated from plate 11 by a rectangular insulating ring 29 to prevent accidental contact by an operator with the high potential of plate 11. Forwardly of the segmented plate 12 is provided a rectangular ring 31 spaced from plate 12 by a suitable rectangular insulator ring 32. Ring 31 may be suitably grounded as indicated and may also with guard plate 28 serve as a mechanical connection to a suitably positioned type of support from below and as described hereinafter. The assembly of the foregoing components of my invention is easily accomplished since the chamber contains air at atmospheric pressure; ordinary adhesive materials such as are used in cabinet making or cement, insulated screws, etc., as is well known to the art are entirely satisfactory for the purpose.

The operation of the just described apparatus is believed to be virtually self-evident from the foregoing. When segment plate 12 is located so as to intercept a collimated beam of ionized particles having a cross-sectional diameter of the order of one inch, electrometers 22, 23, 24, or 26 will register an indication corresponding to the respective impact area of such beam on said segments. When the center of a symmetrical beam strikes the center of segmented plate 12, ionization of the air in chamber 10 between electrode 11 and the respective segments 16, 17, 18, and 19 will be equal and produce equal electrometer readings, while if the beam is displaced to the right, for example, increased ionization in this region would be indicated by electrometer 23. Similarly, vertical or diagonal displacement of the beam would be indicated, requiring corresponding corrective movement of the ionization chamber or re-orientation of the beam source.

Since a beam of accelerated particles may not always be of constant intensity, variations therein will produce undesirable proportional oscillations of the electrometer indications. Such random oscillation may make difficult the necessary adjustment of the beam or the ionization chamber. This problem is overcome in the embodiment of the invention shown in Fig. 2 wherein vertical segments 16 and 18 are bridged by electrometer 33 while horizontal segments 17 and 19 are bridged by electrometer 34. The bridge circuits are inherently balanced so that the meters thereof read zero when no ionization current flows through either of the interconnected and opposed segments. Since each electrometer indicates the difference in current flow between the opposite segments of plate 12, the varying ionization currents due to variations in beam intensity are equal in opposite segments and, accordingly, cancel.

Any desired mounting of the ionization cham-

4

ber to provide the necessary adjustments may be employed. It has been found convenient, however, to provide conveniently adjustable translating apparatus for moving the ionization chamber assembly vertically and also horizontally so that positioning of the latter wherein the electrometers read identically may be readily achieved. Such apparatus for thus centralizing the beam in the intersection of the separating diagonals between the segments 16, 17, 18, and 19 and also for orienting the direction of such beam will now be described.

In Fig. 3 is shown a pair of spaced and parallel rails 35 having a block 36 provided with similarly spaced grooves adapted to rest on said rails for guided, longitudinal movement therealong, according to the position of a knurled and peripherally grooved nut 38 threaded on a suitably mounted, fixed rod 39 disposed in parallelism with said rails and therebetween. Nut 38 is straddled by a forked plate 40 secured to block 36 for producing longitudinal movement of the latter along rails 35 upon rotation of said nut as will be understood.

Lateral movement of my ionization chamber is facilitated by the provision of an upper block 41 slidable transversely in block 36 along mating, dovetailed surfaces, any desired relative positioning thereof being obtained through movement of a thumb screw 42 threaded through an extension 43 of block 36 and rotatable therein, as by a ball and socket joint (not shown), for example.

Centrally of upper block 41 and integral therewith rises a post 44 having an inner bore for guiding a vertical stud 45 which may be longitudinally slotted to receive the end of guide screw 46 threaded into post 44. Stud 45 terminates upwardly in a U-shaped clamp for resiliently gripping the ionization chamber between its guard plate 23 and the forward rectangular ring 31. Vertical positioning of the ionization chamber is effected through rotation of screw 47 which rests on post 44 and is threaded on stud 45, alignment of the ionization chamber normal to the rails 35 being insured by the guide screw 46 and cooperating slot in stud 45.

Target holder 48, shown as ring-shaped although it may be of any desired conformation, includes an integral stud 49 which is vertically adjustable in post 50 in a manner similar to the adjustment of stud 45. Through the addition of suitable scales and indicators on the relatively movable parts the ionization chamber may be aligned with the collimated beam and similarly the center of the target in holder 48 may be aligned with the chamber. The latter operation is facilitated through the provision of a second ionization chamber 51 similarly mounted on rails 35 and in use, adjusted to centrally intercept the beam, after which target holder 48 is moved to a position in which its center lies on the axis of symmetry of the two ionization chambers and hence of the beam.

It will be apparent that the rectangular ionization chamber shown is but one form of my invention and that variations thereof will readily occur to one skilled in the art, such for example, as one utilizing a circular segmented plate which is symmetrical about the center of the ionization chamber. Accordingly, it is desired that the invention not be limited to the preferred embodiment but only by the terms of the following claims.

What is claimed is:

1. Apparatus for ascertaining the center of

5

a collimated beam of ionized particles comprising a high potential plane surface, a surface constituted of a plurality of mutually insulated, co-planar segments of material pervious to said beam disposed symmetrically about an axis normal thereto and in spaced parallelism with said first surface, a peripheral, insulating wall uniting said first surface to said segments to form an ionization chamber, a protective rear wall disposed in spaced and insulated relation to said surface and a peripheral, grounded surface disposed forwardly of said segments, and electrometer means connected between each of said segments and said first surface for indicating the ionization in the segment-defined areas of said chamber.

2. Apparatus for ascertaining the center of a collimated beam of ionized particles comprising a high potential plane surface, a surface constituted of a plurality of mutually insulated, co-planar, triangular segments of material pervious to said beam disposed symmetrically about an axis normal thereto and in spaced parallelism with said first surface and a peripheral, insulating wall uniting said first surface to said segments to form an ionization chamber and electrometer means connected between each of said segments and said first surface for indicating the ionization in the segment-defined areas of said chamber.

3. Apparatus as described in claim 2 wherein said insulating wall includes an electrically conductive and grounded peripheral portion for eliminating leakage currents from said first surface to said segments.

4. An ionization chamber comprising a plane

6

surface adapted to receive a high electrical potential, an insulating ring mounted on the periphery of said surface, a conductor ring mounted on said insulating ring and adapted to be connected to ground, a second insulating ring mounted on said conductor ring, and a surface constituted of a plurality of congruent and mutually insulated, co-planar, triangular segments of material pervious to said beam and united to said second insulating ring.

5. Apparatus as described in claim 4 including an elongated support, means for mounting said ionization chamber thereon in longitudinally, laterally and vertically adjustable position, and an identical ionization chamber similarly mounted on said supporting means in spaced relation to said first chamber for centering a beam of collimated particles passing through said chambers.

6. Apparatus as described in claim 4 including an elongated support, means for mounting said ionization chamber thereon, an identical ionization chamber mounted on said support in spaced relation to said first chamber and a target holder disposed between said chambers.

CORNELIUS A. TOBIAS.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,195,098	Skellett	Mar. 26, 1940
2,459,724	Selgin	Jan. 18, 1949