Sept. 29, 1959 W. O. BRUNK 2,906,876

CALUTRON RECEIVER

Filed Jan. 30, 1950 2 Sheets-Sheet 1

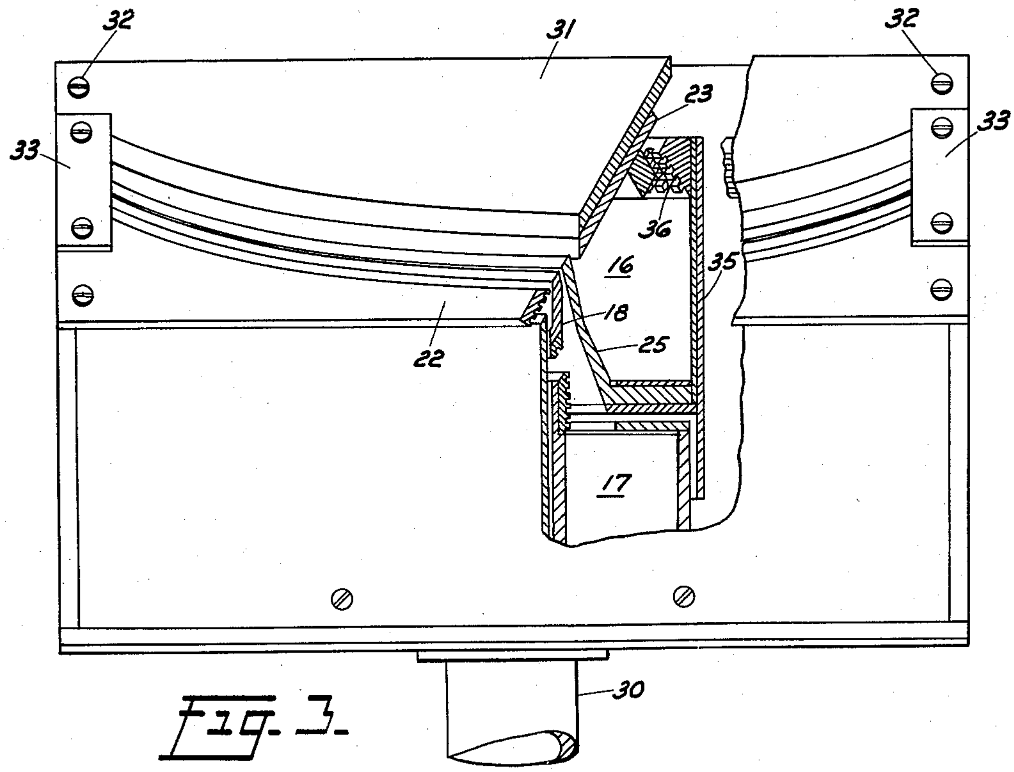

Fig. 3.

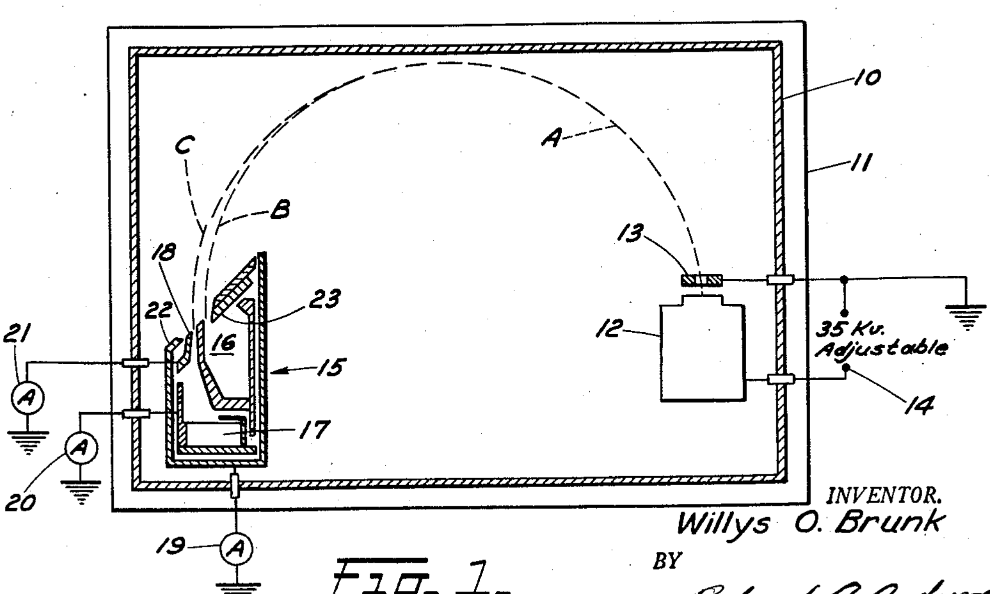

Fig. 1.

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Filed Jan. 30, 1950 2 Sheets-Sheet 2

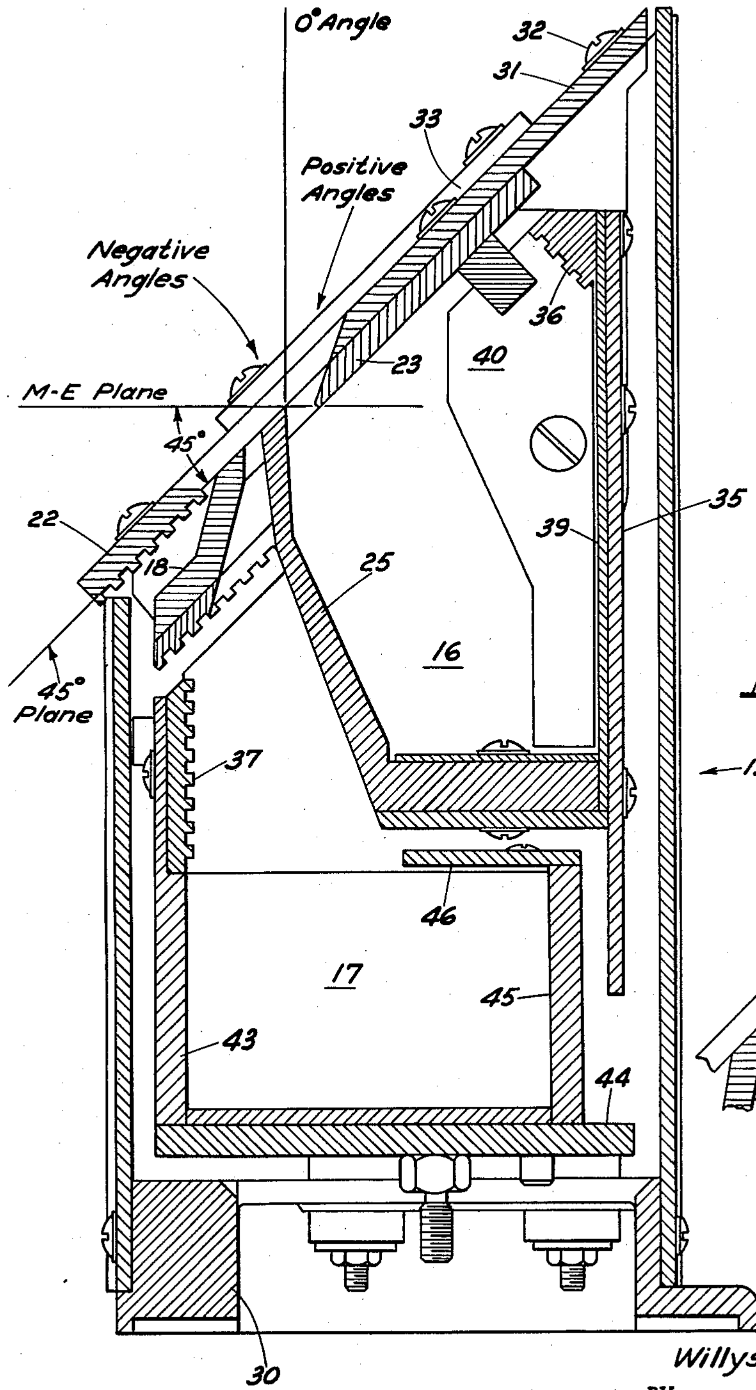

Fig. 2.

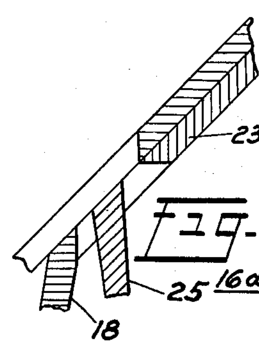

Fig. 4.

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CALUTRON RECEIVER

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Application January 30, 1950, Serial No. 141,219

4 Claims. (Cl. 250—41.9)

The present invention relates generally to isotope separating appartus of the electromagnetic type, commonly referred to as a calutron, and more particualrly to an improvement in the receiving unit for more efficiently collecting the different isotopes after they have been separated into distinct ion beams in such apparatus. The invention is particularly concerned with the collection of the separated isotopes with a reduced amount of contamination than has previously been possible.

The invention is not limited to the separation of the isotopes of any particular element but may be employed in the separation of isotopes of any of various elements, the separation of isotopes of many different elements having already been successfully accomplished.

In a calutron, as is now well known, a beam of positive ions of the element to be separated is formed and projected at a uniform velocity into an evacuated region traversed by a substantially uniform magnetic field, the ions being projected at right angles to the direction of the field. As a result, each particular ion is caused to describe a circular path having a radius proportional to the square root of its mass. In this way, the original single ion beam is divided into two or more fairly discrete component beams, each of which consists primarily of individual isotopes of the material. Because of a geometrical and magnetic focusing action, the various beams are most distinctly resolved after the completion of 180 degrees of their circular path; the various isotopes, that is, the beams, diverge from each other dependently on their separate masses, and the beams may be individually collected in a receiver located at the focal point.

It is desired, of course, that the collected isotopes be as free as possible from contamination by adjacent beams or foreign material and it has long been an objective in the art to contrive a receiver capable of achieving increased production without increased contamination. This objective, however, has been extremely difficult of attainment prior to the present invention. Receivers, as built in the past, have customarily employed a face plate positioned at a substantial angle to the direction of the incoming ion beams with slots formed therein to receive the individual beams. In the past, the actual plane of the opening receiving the particularly desired isotope has coincided with the plane of the face plate of the receiver. In the present invention, the plane of this opening is substantially perpendicular as respects the entering ion beams. In this way, the actual opening through which the more desired isotope can be received is widened, while at the same time, the actual area of the opening through which foreign material, contamination, and scattered material may enter is reduced.

In accordance with the foregoing, the primary object of the invention is to provide a calutron receiver having a slot or opening so formed and positioned as to increase the effective area through which the desired material may enter the receiver and at the same time reduce the effective area through which contaminating material may enter the receiver.

Another object of the invention is to provide a calutron receiver having a face plate lying at an angle to the direction of the entering ion beams but having an opening the plane of which is in a substantially perpendicular plane as respects the entering ion beams.

Further objects and numerous advantages of the invention will become apparent from the following detailed description and annexed drawings, wherein:

Fig. 1 is a diagrammatic view partly in section showing isotope separating apparatus embodying the receiver of the invention.

Fig. 2 is a cross sectional view of the receiver of the present invention.

Fig. 3 is a front view partially broken away of the structure of Fig. 2.

Fig. 4 is a fragmentary detailed view showing the arrangement of the prior art which has been improved upon.

Referring to Fig. 1 of the drawings, there is shown an electromagnetic type isotope separating apparatus comprising a closed vessel **10** positioned in a substantially uniform transverse magnetic field provided by a magnet, one pole piece **11** of which is shown. The vessel **10** provides a space within which electromagnetic separation of ions may take place and is highly evacuated, although the presence of a small amount of gas is desirable under some circumstances to avoid so called "space charge" effects.

Within the closed vessel **10** and also within the region of influence of the magnetic field, there is provided a source **12** of positive ions of an element, the isotopes of which it is desired to separate. An accelerating electrode **13** projects the ions emitted by source **12** in a direction normal to the magnetic field and in the form of a discrete stream or beam A of ions having a uniform velocity. The accelerating electrode **13** is made negative with respect to the ion source **12** from any suitable direct current supply **14** which is preferably adjustable.

As is known, the ion beam A projected by the accelerating electrode **13** will follow a substantially circular orbit, as indicated, and after 180 degrees of travel, the different isotopes will attain maximum separation. It is at this point that the receiver unit is positioned with its entrance slots coinciding as nearly as possible with the best foci of the isotope beams. As shown, there are two entrance slots, adapted to separately collect the isotopes identified as "B" and "C," respectively. Ordinarily it is desired to collect and retain one of the isotopes in particular, and it will be herein assumed the "B" isotope is such isotope. "B" and "C" might, for example, represent Fe–54 and Fe–56, respectively, or Cu–63 and Cu–65, respectively.

As will be described in detail in connection with Figs. 2 and 3, the receiver **15** has two separate pockets **16** and **17** and auxiliary electrode **18** all of which are electrically isolated and connected through meters **19**, **20**, and **21**, respectively, so that the magnitude of their respective deionizing currents may be known for control and other purposes. The entrance slots to the receiver **15** are defined in part by face plates **22** and **23**, as will be described.

Referring now to Figs. 2 and 3, the receiver unit is shown in greater detail and as shown embodies the construction of the invention whereby more of the particularly desired beam, that is the beam of "B" ions, may be collected with less contamination than heretofore. As will be seen in Fig. 2, the face plate member **25** forms a partition between the pockets **16** and **17**, and the line extending upwardly from the top edge of this member, identified as 0° angle, defines the dividing line between ions approaching at positive angles and negative angles. It will be noted that the lower edge of the defining plate **23** terminates on a plane perpendicular to the 0° angle identified as the M—E plane, so that the actual opening into pocket **16** lies in a plane perpendicular to the direction of the incoming ion beam. Thus, any contaminating or scattering material, or other foreign material moving generally transversely to the vertical 0° angle line "sees" no opening into pocket **16**. Fig. 4 shows the conventional structure of the prior art, showing the shape of the face plate member **23***a* which does not have the depending or extending edge and which results in the opening into the pocket **16***a* lying in a 45 degree plane, rather than in the M—E plane. The lower extending edge of plate **23** may take the form of a depending lip of material, resulting in the receiver being described as of the "dip-lip" type.

As observed, also in Fig. 2, the ions entering at positive angles actually "see" a wider opening with the arrangement shown in Fig. 2 than with the previous arrangement, as shown in Fig. 4. That is, the positive angle ions in Fig. 2 "see" an opening which is that lying in the M—E plane of Fig. 2.

The remaining construction of the receiver is conventional, the receiver itself being attached to a base as shown at **30**. The face plate **31** overlies the defining plate **23**, as shown, and is attached to the receiver by screws **32** and by end plates **33**. The under side of the defining carbon **22** is "waffled," as shown, to prevent peeling of long strips of deposited material which would cause electrical shorts between plate **22** and electrode **18**.

The auxiliary electrode **18** is also waffled on its under side, this electrode being for monitoring purposes through the meter **21**. Pocket **16** is formed from member **25** and back plates **35** and **39**, attached by screws as shown, and inside of this pocket is an additional waffled surface, as shown at **36**. Pocket **16** is supported on insulators which are located immediately in back of plate **40**. The pocket **17** is built up from plates **43**, **44**, **45**, and **46**, as shown, and it also has a "waffled" surface at **37**.

From the foregoing, those skilled in the art will observe that I have provided a form of calutron receiver wherein the capabilities of the receiver to collect an individual isotope in its pure state are enhanced and the susceptibility of the device to permitting the entry of contaminating material is substantially reduced. The general construction of the apparatus as a whole may be varied considerably, of course, the invention lying primarily in the geometry, that is, the shape and positioning of the entrance slot into the receiver. The foregoing disclosure is primarily illustrative, and it is intended that the scope of the invention be determined in accordance with the claims appended hereto.

I claim:

1. A calutron receiver having at least one pocket adapted to receive an ion beam of particular isotopic content, face plate means forming a cover for said receiver and lying generally in a plane forming an acute angle with the incoming ion beam, said face plate means having an elongated slot therein for the entrance of ions into said pocket, said slot being formed by two facing surfaces comprising the two sides of said slot, the outer edge of one of said surfaces and the inner edge of the other of said surfaces both lying in a plane which is substantially normal to the incoming ion beam.

2. A calutron receiver having at least one pocket adapted to receive an ion beam of particular isotopic content, face plate means forming a cover for said receiver and lying generally in a plane forming an acute angle with the incoming ion beam, said face plate means having an elongated slot therein for the entrance of ions into said pocket, said slot being formed by two facing surfaces comprising the two sides of said slot, said surfaces converging toward each other in the direction of the incoming ion beam, the outer edge of one of said surfaces and the inner edge of the other of said surfaces lying in a plane which is substantially normal to the incoming ion beam.

3. A calutron receiver having at least one pocket adapted to receive an ion beam of particular isotopic content, face plate means forming a cover for said receiver and lying generally in a plane forming an acute angle with the incoming ion beam, said face plate means having an elongated slot therein for the entrance of ions into said pocket, said slot being formed by two facing surfaces comprising the two sides of said slot, the first of said surfaces lying in a first plane which is parallel to the incoming ion beam, and the second of said surfaces lying in a second plane which intersects said first plane at an acute angle on the receiver side of said face plate means.

4. A calutron receiver having at least one pocket adapted to receive an ion beam of particular isotopic content, face plate means forming a cover for said receiver and lying generally in a plane forming an acute angle with the incoming ion beam, said face plate means having an elongated slot therein for the entrance of ions into said pocket, said slot being formed by two facing surfaces comprising the two sides of said slot, the first of said surfaces lying in a first plane which is parallel to the incoming ion beam, and the second of said surfaces lying in a second plane which intersects said first plane at an acute angle on the receiver side of said face plate means, the outer edge of the first of said surfaces and the inner edge of the second of said surfaces both lying in a plane which is substantially normal to the incoming ion beam.

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