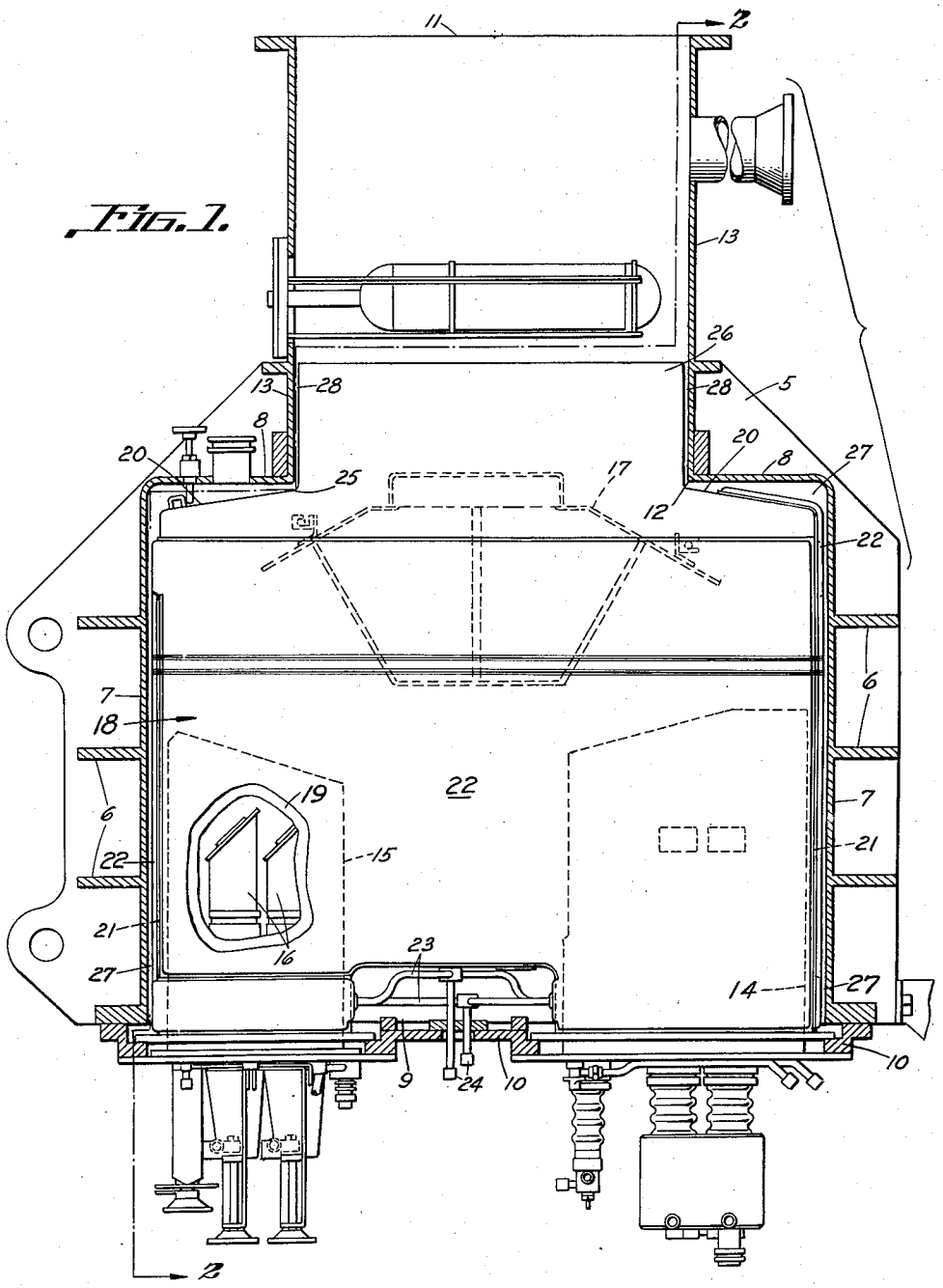
Aug. 25, 1959 L. R. LUDWIG ET AL 2,901,618

CALUTRON

Filed June 28, 1946 2 Sheets-Sheet 1

Fig. 1.



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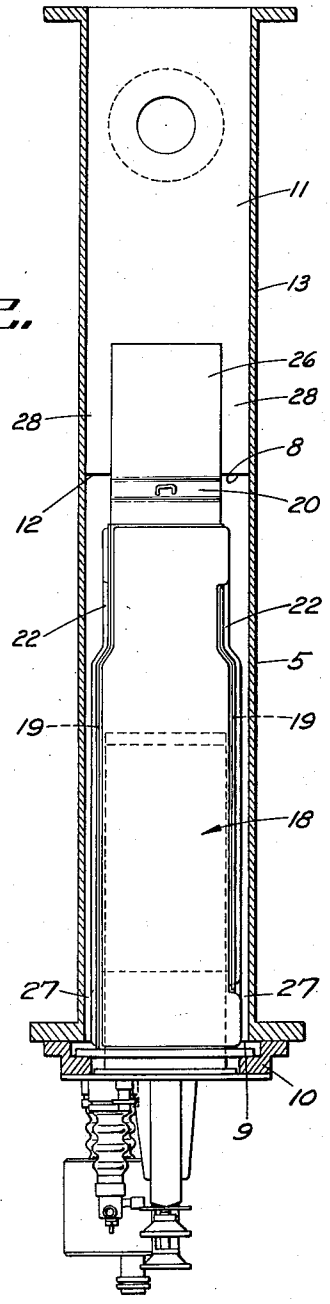
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CALUTRON

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Fig. 2.



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CALUTRON

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4 Claims. (Cl. 250—41.9)

This invention relates to calutrons and particularly to a tank and liner assembly that encloses the operating elements of apparatus of this kind.

By the term "calutron" is meant apparatus for separation on a practical scale of different isotopes of a material, or separation of such material into components that are respectively enriched and impoverished in their contents of a given isotope, such separation or concentration being accomplished by means of a beam of accelerated gaseous ions projected through a magnetic and/or an electric field, whereby ions of different masses are caused to follow curved paths of different radii and respectively come to a focus at predetermined spaced positions so as to permit collection of the respective components at these positions and thereby effect separation.

Such apparatus includes a tank that encloses a highly evacuated operating chamber, means for projecting one or more beams through the chamber, magnet for setting up a field that extends through the chamber in a direction normal to that in which the ions are projected, and a collector for separating and retaining the portion of each beam that contains the greatest concentration of the desired isotopic component, and de-ionizing the charged particles that make up the collected portion of the beam.

Due to the tendency of the ions forming the beam to scatter, and also due to sputtering of de-ionized material from the collecting apparatus, and also due to condensation of unionized gas, material is deposited on the surfaces enclosing the apparatus, making it necessary to clean the surfaces of the structure enclosing the operating system. The material obtained by such cleaning is reprocessed in the apparatus. There is a tendency for gas adsorbed by the tank walls to be released during operation, by reason of the relatively high operating temperature, the high vacuum maintained in the tank during operation, and bombardment by scattered ions, which gas tends to interfere with the orderly travel of the ions and may contaminate the product. Such considerations render it desirable to provide a liner, arranged inside the tank, enclosing a processing space that is separated from the inner surfaces of the tank and wherein the operating elements of the system are arranged, and that is readily removable to provide easy access to its interior for cleaning of its interior surfaces.

One object of the invention is the provision of a novel arrangement of an assembly of a tank and liner, which separates a processing space enclosed by the liner from exposure to the inner surfaces of the tank walls, and which provides for removal of gas molecules released from the inner surfaces of the tank walls by direct paths that communicate with a vacuum system arranged outside the tank, thereby substantially eliminating the possibility of such molecules entering the processing space and preventing their interference with the ion beam.

Another object is the provision of an assembly of this kind arranged to permit removal of the liner by a simple withdrawing movement.

Still another object is the provision in a calutron of an arrangement of tank and liner which provides both for ready removal of the liner, and for establishment of separate paths of communication between a single pump-out connection to a vacuum system and spaces that are respectively inside the liner and between the outer surfaces of the liner and the inner surfaces of the tank.

In the accompanying drawings:

Fig. 1 is a sectional elevation of a calutron tank assembly arranged in accordance with the present invention.

Fig. 2 is a sectional view on line 2—2 of Fig. 1.

Describing the drawings in detail, a calutron tank is illustrated diagrammatically as comprising side walls **5** that are parallel and spaced apart by an intermediate structure including spacing struts **6**, opposed walls **7** defining edges of the chamber, and an end wall **8**. These walls cooperate to enclose an operating chamber having an open end **9**. The open end **9** is closed by a face plate structure **10** that is sealed to the tank and on which the operating elements of the system are mounted, so that they may be removed from the tank as a unit with the face plate. The end wall **8** is provided with a pump-out connection **11**, which is a tubular structure opening into the operating chamber at **12** and the walls **13** of which join the end wall **8**.

The operating system of the calutron is diagrammatically illustrated as comprising a casing **14** that encloses sources for projecting beams of accelerated ions, and a second casing **15** that encloses receivers **16** for separately collecting and de-ionizing the desired components of the respective ion beams, such beams being curved through 180° in their passage through the operating chamber by a powerful magnetic field that extends between the side walls **5** and is therefore normal to the direction in which the beams are projected. A baffle structure **17** is arranged across the opening **25** to shield it from the beam.

The operating system is enclosed within a processing space set off from the tank walls by a liner **18**, which is slidably mounted in the tank for removal through the open end **9**, and comprising walls that respectively correspond to each of the walls of the tank. These walls include two side walls **19**, two side walls **21** and end wall **20**. The side walls **19**, **21** are jacketed by walls **22** intermediate the sides **19**, **21** and tank walls **5** and **7**. The end of the liner adjacent the open side of the tank is closed by the face plate **10**. The internal surfaces of the walls **19**, **20** and **21** are smooth planes, permitting ready cleaning to reclaim the material that collects on such surfaces during operation. Heat transfer jackets **22** are applied to the external surfaces of the walls, and connected to a temperature-regulating fluid system by headers **23** respectively connected to supply and exhaust pipes **24** that extend through the face plate **10**.

The end wall **20** of the liner is interrupted to provide an aperture **25** that registers with the opening **12** of the pump-out connection. This aperture **25** is surrounded by a tubular extension **26** of the liner that projects into the pump-out connection **11** to a point beyond the end wall **8** of the tank.

Each of the walls of the liner **18** is spaced inward from the corresponding wall of the surrounding tank, so that spaces **27** lie between the outer surfaces of the liner walls and the inner surfaces of the adjacent tank walls. Similarly, the outer surfaces of the tubular extension **26** are spaced inward, transversely of the extension, from the inner surfaces of the pump-out connection **11**, providing passages **28** that open at one end into the pump-out connection and at the other into the spaces **27**. By this arrangement, separate paths of communication are provided, one of which connects directly between the pump-out connection and the processing space enclosed by the liner,

the other connecting directly between the pump-out connection and the spaces **27**. This provides a low impedance path to the pump-out connection for gas molecules released from the inner surfaces of the tank walls, while high impedance is presented by the liner walls to the passage of such molecules to the processing space. The arrangement also provides an entirely separate low impedance path from the processing space to the pump-out connection.

Preferably the liner walls are made of a metal that is non-magnetic and that presents smooth, non-porous surfaces having low gas adsorbing properties, and permitting ready cleaning of material deposited either by deionization or condensation. Stainless steel is a suitable material, since it may be easily cleaned, may be given a smooth surface and readily releases gas molecules during evacuation of the tank. Release of gas from the liner walls may be accelerated by passing a current of hot fluid through the jackets **22** during evacuation, instead of the cooling fluid that is normally used during operation.

The described arrangement of a liner is peculiarly advantageous because it solves the problem presented by interference with the ion beam by molecules released from the tank walls during operation of the calutron. Removal of gas from the thin stainless steel walls, which can readily be heated, is quite easily accomplished. The tank walls, however, are not as readily cleaned of adsorbed gases, particularly the side walls **5**. These walls are ordinarily made of magnetic material to enable them to act as pole pieces between which the magnetic field is established. They are also of thick cross section, so that it is impractical to heat them during evacuation of the tank to drive off gas molecules. Since tanks of this kind are usually very narrow in the direction extending between the side walls, they are inaccessible and it is also difficult to clean the inner wall surfaces. The arrangement described above provides for removal of gas molecules released from all of the tank walls, and additionally of gas that may leak into the tank, in such a way as to practically eliminate the possibility of interference with the ions or contamination of the product.

It is to be noted that the extension **26** of the liner projects in the direction in which the liner is moved during its insertion into the tank, so that the assembly of the liner and its extension with the tank and tubular pump-out connection is made telescopically by a straight line movement of the liner into the tank. This arrangement permits the accomplishment of the desired results, namely the provision of a direct low impedance path between spaces outside the liner and the pump-out connection, which paths are separated by the extension **26** from the processing space to a point well beyond the limits of the processing space, without requiring the use of detachable fittings.

We claim:

1. In a calutron assembly including a tank enclosing an operating chamber and provided with a pump-out connection opening into such chamber for evacuating it; a liner arranged within the tank to surround a processing space, said liner having its outer surfaces spaced inward from the inner surfaces of the tank, and the space between the said surfaces of the liner and tank opening directly into the pump-out connection to provide a low impedance path for gas molecules released from said surfaces during evacuation of the tank.

2. In a calutron assembly comprising a tank enclosing an operating chamber and provided with a tubular pump-out connection opening into said chamber for evacuating it; a liner arranged within the tank to surround a processing space, said liner comprising walls that are spaced inward from the tank walls and having a tubular extension projecting into the pump-out connection of the tank, said extension opening into the processing space surrounded by the liner and its outer surfaces being spaced inward from the walls of the pump-out connection to establish separate communication paths that respectively connect the interior of the pump-out connection with the processing space and with the space between the tank walls.

3. In a calutron assembly comprising a tank formed of walls that enclose an operating chamber, and a tubular pump-out connection opening through one of the walls; a liner arranged in the operating chamber and comprising walls that respectively correspond to each of the tank walls, said walls enclosing a processing space and each being spaced inward from the corresponding tank wall, said liner having a tubular extension projection into the pump-out connection and beyond the wall through which said connection opens, said extension providing internal direct communication between the pump-out connection and the processing space, and its outer surfaces being spaced inward from the inner surfaces of said connection to provide direct external communication between the connection and the space between the walls of the liner and tank.

4. A calutron assembly comprising a tank structure that encloses an operating chamber, said tank structure having an open end adapted to be closed by a face plate and an end wall opposite said open end, a tubular pump-out connection opening through said end wall and projecting outwardly from it, a liner slidably mounted in the operating chamber for removal through the open side, said liner comprising walls enclosing a processing space and that are spaced inward from the inner surfaces of the tank structure, said liner having a tubular extension opening into the processing space and projecting into the pump-out connection, said extension having its outer surfaces spaced inward from the inner surfaces of said connection, providing passages within the connection that are separated from the processing space and that communicate with the spaces between the liner and tank structure.

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