Oct. 11, 1966 W. DOBNER 3,277,637

APPARATUS FOR THE SEPARATION OF GASEOUS ISOTOPES

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FIG.1

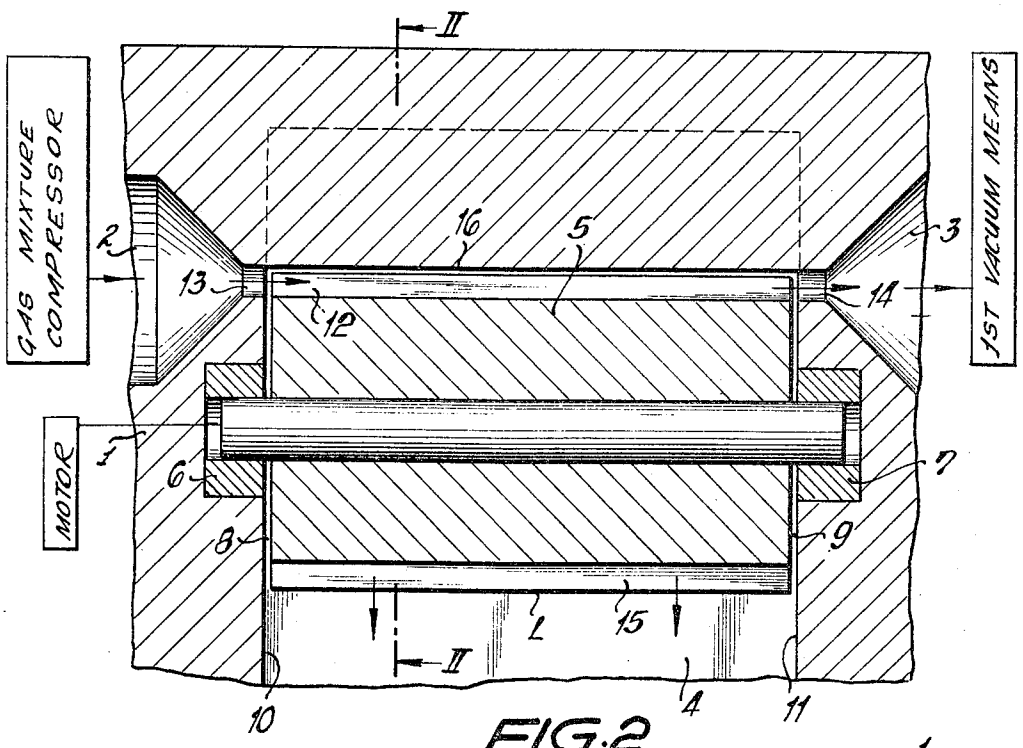
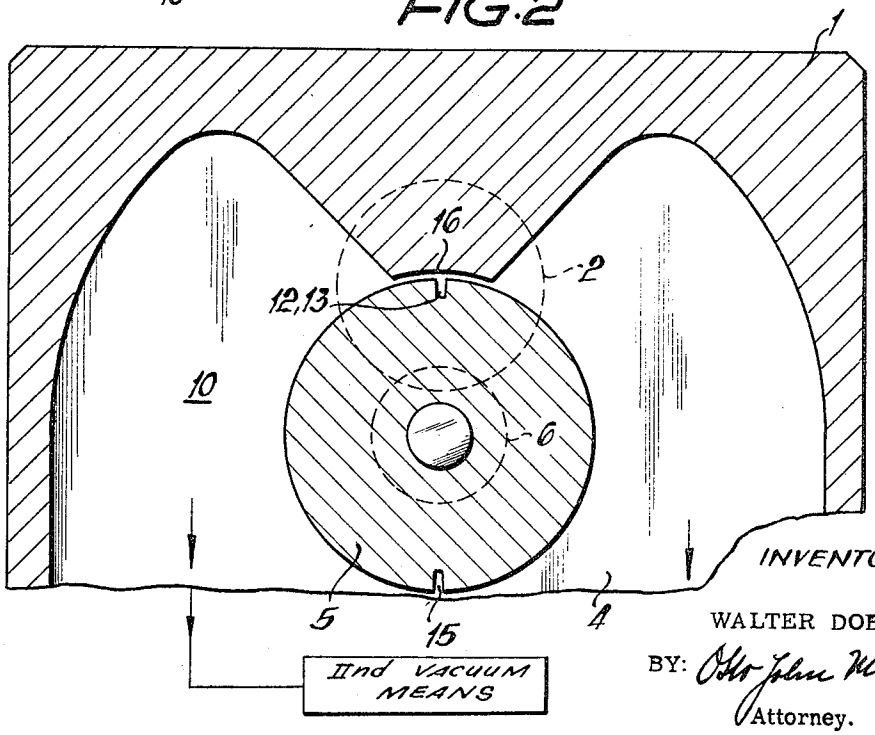


FIG.2



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APPARATUS FOR THE SEPARATION OF GASEOUS ISOTOPES

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The invention relates to an apparatus for the separation of gaseous isotopes.

The primary object of the invention is to utilize the molecular velocity of isotopes to be separated in an isotope trap in the shape of a groove, the length and width of which can be determined by the product of the ratio thereof with the velocity imparted to the isotopes.

Another object of the invention is to provide such a groove of a minute width and of a length excessive in proportion thereto.

Yet another object of the invention is to interpose between the inlet and outlet orifices of a diffusion separator a cylinder provided with one or more groove traps, mentioned hereinabove, and rotating it in either direction at high speeds calculated to just allow sufficient time for the light isotopes to pass through the groove into a collector, and immediately thereafter automatically closing the groove to permit collection of the heavy isotopes in a subsequent stage of operation.

Still another object of the invention is to elongate the groove to such an extent that even the speediest molecules have no time sufficient to reach the outlet port when the entrance port is being closed, and because of the longer time of diffusion to give the speedier molecules an opportunity to outdistance the slower molecules. In this case the outlet port must be widened in the sense of rotation of the duct.

Still another object of the invention and utilizing its above principles is to impart to the gas mixture to be separated an initial pressure, considerably higher than employed in the conventional apparata of the prior art, and thus also to increase the output and reduce the expense of the operation.

The nature of the present invention as well as other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawing in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 shows a longitudinal section of the apparatus of the invention in direction of the axis of a rotary cylinder,

FIG. 2 is a cross section on line II—II of FIG. 1.

In the drawings a housing **1** is shown in a side wall **10** provided with an inlet orifice **2** connected with a compressor of an isotope mixture operable on a controllable pressure of for instance 10 atm. abs. A second orifice **3** in the opposite wall **11** is kept under a pressure of about 0.0001 atm. abs. by a first vacuum pump of conventional construction. A space **4** is kept evacuated at a low pressure of i.e. 0.0001 atm. abs. by means of a second vacuum pump.

The space **4** is provided with a rotatable right circular cylinder **5** supported on bushings **6, 7** and its speed is variably controllable at between 1000 and 10,000 r.p.m. The side walls **8** and **9** of the cylinder **5** are in alignment with the inside walls **10, 11** of space **4** with the lowest possible amount of play between them. A narrow, longitudinal groove **12** on the lateral surface of cylinder **5** and parallel to its axis connects, in the position shown in FIGURE 1, an inlet orifice **2** and a stationary stop port **13** in axial alignment with the outlet orifice **3** and stationary stop port **14**. The inlet orifice **2** and the outlet orifice **3** are shown in a preferred embodiment in shapes of frustum cones having tapers toward the inlet and from the outlet of the groove respectively. The narrow cylindrical ports **13** and **14** have diameters approximating the depth of the groove.

The two plane surfaces bounding the right circular cylinder form with its lateral surface two coaxial parallel circles, the radius of which determines the distance of the two ports **13** and **14** from the axis of the cylinder.

According to the present invention, however, the longitudinal axial alignment of the two orifices **2** and **3** and ports **13** and **14**, respectively, is shown in FIGURE 1 by way of example. In this embodiment, when the groove becomes aligned with the two orifices on an appropriate rotation of the cylinder in either direction, the compressed mixture is blown through, until by the continuing rotation of the cylinder, the groove is moved past the two ports and thus becomes entirely closed off. During the high speed flow through the groove the gas mixture becomes separated and the lighter and speedier molecules escape through the outlet orifice before the subsequent rotation closes off the heavier and slower residue.

In another embodiment of the invention, the inlet and outlet orifices, while still distanced equally from the shaft of the cylinder in alignment with the periphery of the circles, are not in axial alignment with each other but slightly displaced radially relative to each other. Thereby a rotation of the cylinder brings the groove first into alignment with the inlet orifice **2**, thus permitting a blow of compressed gas mixture thereinto. The outlet of the groove is out of alignment with the outlet orifice **3** at that moment. Immediately thereupon, the continuing rotation of the cylinder brings the groove out of alignment with the inlet orifice **2**, its port **13** thus being closed by the cylinder wall **8**, adjacent to the inlet of the groove, and simultaneously the outlet of the groove gets into alignment with the outlet port **14** for a fraction of a second during the rotation of the cylinder.

In conjunction with these features the elongation of the groove itself and of the rotational speed of the cylinder are calculated by known equations with consideration of the speed of flow of the mixture and of the molecular velocity of the isotopes under separation, to close off the inlet flow in time before the speediest molecules reached the outlet port of the groove. Thus the speedier molecules, because of the longer time of diffusion, are permitted to out-distance the slower heavier molecules, which become retained in the groove trap after closing of the outlet port. Collection of the residue, as shown in FIGURE 1 is obtained when the groove has reached position **15** as soon as the cylinder has turned for instance through 180°. In the position shown in the drawing the longitudinal side L of duct **15** is in its whole circumference connected with excess space **4** under vacuum so that the residue may be collected from the groove with the greatest possible efficiency by a very speedy rotation of cylinder **5**. In order to turn the groove into a closed conduit when in alignment with the orifices the third wall of the airtight chamber **4** has a projection **16** concavely surrounding airtight a minimum lateral surface area of the cylinder in a width of a small excess of the width of the groove just sufficient to cover the groove for the duration of the alignment with the orifices. The collection of the residue isotopes from the groove when in position, shown in FIGURE 1 as **15**, may be accomplished by an arrangement of a second set of inlet and outlet orifices such as shown for the introduction and collection of the lighter isotopes. In the preferred embodiment, however, shown in FIGURE 2, the total space surrounding the exposed lateral surface of the cylinder, which is not covered by the concave area **16**, is enlarged to excess, so that the slow speed gas portion which remains in groove **12** after the

escape of the high-speed gas portion expands in the excess space 4 during the subsequent rotation of cylinder 5 in the vacuum created by the second vacuum pump, which also collects the residue.

While the invention is clearly operable with a single groove on the lateral surface of the cylinder, and while two grooves are shown in the drawings, it is obvious that a greater amount of grooves spaced in parallel over the lateral surface of the cylinder substitutes for any desirable increase in the rotational speed thereof. This permits a decrease in the width of the grooves making a more efficient collection of the isotopes in the excess space feasible, and allowing also for an efficient increase of the speed of flow of the initial gas mixture.

Thus the invention offers a greater efficiency and economy over the prior art.

It should be understood that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purposes of this disclosure, which do not constitute departures from the spirit and scope thereof.

What I claim is:

1. An apparatus for separating gaseous isotopes comprising a chamber having spaced parallel end walls and a concave wall defined by a segment of a cylinder between and joining the end walls, a cylinder rotatably mounted in said chamber with the ends thereof in sealing engagement with the parallel end walls and the surface thereof in sealing engagement with the concave wall, ports in each of the parallel end walls adjacent the junction thereof with the concave wall, at least one linear groove in the surface of the cylinder parallel with the axis of the cylinder and coextensive with the length of the cylinder, and means for rotating the cylinder, means connecting one port to a source of compressed gas, means connecting the other port to a first source of vacuum, and means connecting the chamber to a second source of vacuum.

2. An apparatus for separating gaseous isotopes of various molecular weights from a mixture comprising an airtight chamber, an elongated right circular cylinder mounted therein for rotation along its longitudinal axis, the two plane surfaces bounding the cylinder adjoining in alignment two parallel walls of said chamber, said cylinder provided with at least one longitudinal groove on its lateral surface parallel with said axis, an inlet and an outlet orifice one in each of said parallel walls of said chamber respectively, and at least one of said orifices at a time temporarily in longitudinal alignment with one end of said groove during a rotation of said cylinder, a third wall of said chamber having a concave portion adjoining in an airtight alignment an area of the lateral surface of said cylinder between the inlet and outlet orifices, having a length and a radius of concavity same as said cylinder, and having a lateral width in excess of that of said groove, means to direct a stream of a gas mixture under pressure into said inlet orifice, vacuum means connected with said outlet orifice, means to rotate said cylinder,

and other vacuum means connected with said groove for exhaustion of the residue isotopes after it passed said orifices.

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