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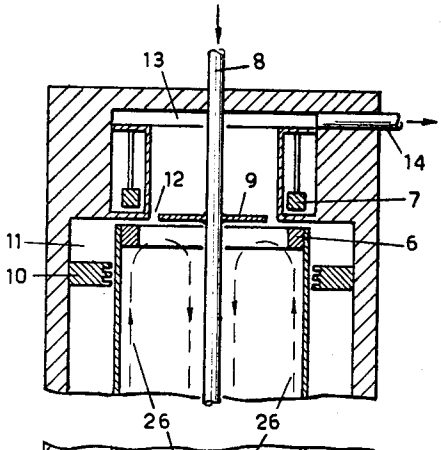
CENTRIFUGES, E.G. ULTRACENTRIFUGES FOR THE SEPARATION OF GASES

Filed March 14, 1961



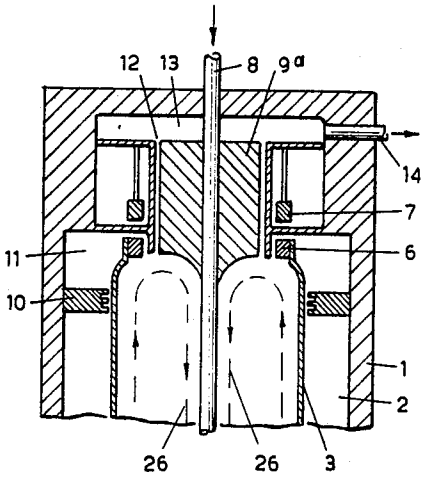


FIG. 2

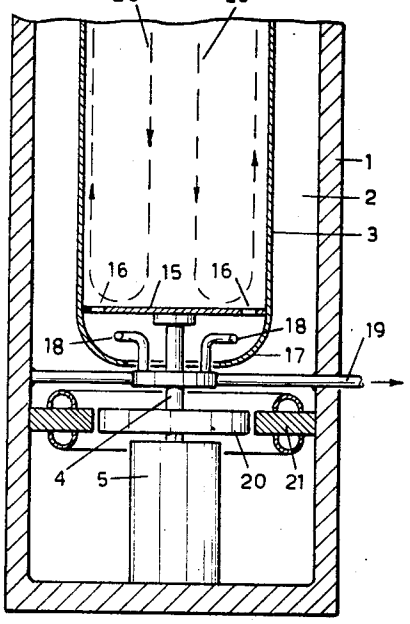


FIG. 1

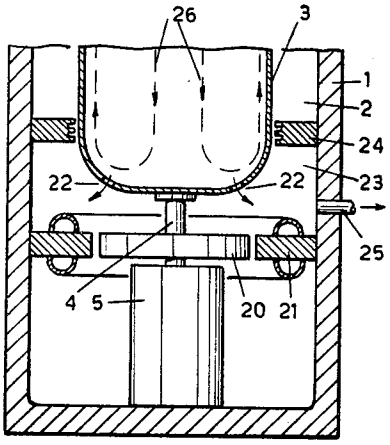


FIG. 3

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CENTRIFUGES, e.g., ULTRACENTRIFUGES FOR THE SEPARATION OF GASES

Johannes Los and Fridtjof Kelling, Amsterdam, Netherlands, assignors to Reactor Centrum Nederland, The Hague, Netherlands

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Claims priority, application Netherlands, Mar. 17, 1960, 249,508
1 Claim. (Cl. 233—27)

The invention relates to centrifuges and more particularly to ultracentrifuge for the separation of gas mixtures or mixtures of gaseous isotopes.

The centrifuges comprise a rotor mounted for rotation in a casing and means for the generation in the separating chamber of the rotor of a gas whirl transversely directed to the rotation.

The separating action of a gas centrifuge is very much improved, when in the rotor a gas whirl is produced, which is directed transversely to the rotation. For the generation of said gas whirl various means are known. A first means causes a temperature difference between the ends of the rotor. Another means uses the momentum of the mixture supplied to the rotor and the way in which the components of the mixture are discharged. According to a third means a stationary plate is placed within the closed rotor near one end thereof, said plate operating as a brake on the rotating gas, whereby the rotation of the gas in the neighborhood of said plate is considerably reduced, so that near said plate a smaller radial pressure gradient is produced and within the rotor local pressure differences occur which produce the desired whirl. All these means require special devices either for the production of a temperature gradient or for the supply of mixture and for the discharge of the separated components thereof, such devices being complicated and requiring measures difficult to realize.

The invention has for its object to provide a simple construction which is also adapted to produce the desired gas whirl and permits a simple supply of mixture and also a simple discharge of the components of said mixture. According to the invention the rotor is open at one of its ends and the separating chamber thereof is bounded at said open end by the stationary wall of said casing. In this case the wall of the casing acts as the stationary friction wall on the charge of the rotor, whereby the pressure differences required for the generation of the gas whirl are produced.

The generation of the whirl is facilitated, when the cylindrical wall of the rotor is bent towards the axis of the rotor in a marginal portion adjacent the open end of the rotor. Also the part of the casing wall bounding the separating chamber at the open end of the rotor may be given a shape adapted to the suitable shape of the whirl by means of a special profile, e.g., the shape of an annular recess.

For the discharge of one of the components of the gaseous mixture the portion of the casing wall bounding the separating chamber at the open end of the rotor may be provided with apertures.

The other end of the rotor may be closed by an end wall having apertures, through which the other component of the gaseous mixture may be discharged from the rotor. It is also possible to close the latter end of the rotor at some distance from the end of the cylindrical wall by a plate provided with apertures and to bend the marginal portion of the cylindrical wall of the rotor extending beyond said plate towards the axis of revolution. A stationary discharge conduit or stripping tube may be so arranged as to open within the space bounded by said marginal wall portion.

For the elucidation of the invention reference is made to the accompanying drawing, therein:

FIG. 1 is an elevational sectional view of a centrifuge according to the invention,

FIG. 2 is an elevational sectional view of a part of a centrifuge according to FIG. 1, having a slightly different upper part, and

FIG. 3 is an elevational sectional view of a part of a centrifuge according to FIG. 1 having a somewhat different lower part of the rotor.

In the drawing **1** is a closed casing, having a hollow cavity **2**. Mounted for rotation centrally in said casing is a rotor **3** which rests with a pintle **4** in a socket (not shown) provided in a block **5**. The rotor **3** is kept in a vertical position by an annular permanent magnet **6** attached to the upper part of the rotor and by a ring **7** of magnetic material mounted in the casing. Said ring may also be a permanent magnet. The mixture to be separated, e.g., a gas mixture or a mixture of gaseous isotopes, is supplied through a stationary tube **8** which extends into the rotor **3**. It is of only slight importance and the invention is not concerned with the location at which the tube **8** opens in the rotor **2**.

According to the invention the upper end of the rotor is open and the separating chamber of the rotor is bounded at said end by a stationary wall part **9** of the casing **1**. A screw-seal operating according to the principle of Holweck's molecular pump is designated by **10**, said seal separating the upper part **11** of the space within the casing **1** from the space **2**. The wall **9** is provided with apertures or a gap **12**, through which one of the components of the mixture to be separated may be led towards a chamber **13**, from which it is discharged at **14**.

Near the lower end of the rotor a plate **15** provided with apertures **16** is mounted in the rotor. The pintle **4** is fixed to said plate. The end portion **17** of the rotor extending beyond the plate **15** is bent towards the axis of revolution. In the annular space bounded by the bent portion **17** and the plate **15** stationary strip tubes **18** open, which are connected to a discharge tube **19**. The second component of the mixture is discharged through the latter tube. The motor for driving the rotor is designated by **20** and **21**.

The difference between the embodiment illustrated in FIG. 2 and that according to FIG. 1 is that the upper part of the cylindrical rotor wall is bent towards the axis of revolution and the wall **9***a* has a predetermined profile which in the drawing is curved.

In FIG. 3 the lower end of the rotor is closed and provided with apertures **22**. These apertures lead the relevant component of the mixture from the rotor into a chamber **23** separated from the space **2** by a screw-seal **24** operating in the manner of Holweck's molecular pump. Said component is discharged from the chamber **23** through a tube **25**.

In each of the illustrated centrifuge drums, a gas whirl **26** improving the separating action of the centrifuge is produced and maintained by the braking operation of the stationary separating plate or body **9**, **9***a*. The separating plate has a braking influence on the revolving gas such that adjacent the plate the centrifugal force on the gas will be less than at greater distances from the plate so that there will be created an axially directed pressure gradient which will generate a gas whirl in the shape of a torus which is concentric with respect to the axis of revolution of the drum. Due to the plate the gas near the wall of the drum will flow towards the plate, while the gas near the axis of the drum will flow away from the plate. As a result of the diffusion of the gas molecules due to the centrifugal force, the axial gas flow towards the braking plate will become gradually heavier and the axial gas

flow away from the plate will become gradually lighter. Consequently, the heavier gas components will be discharged at the upper end of the drum adjacent plate 9, 9*a*, and the lighter components will be discharged at the lower end of the drum. The central supply of the mixture through the tube 8 also has a favorable action on said whirl due to the momentum of the mixture. The curved shape of the upper boundary of the separating chamber of the rotor is better adapted to the shape of the whirl 26 than the plane shape thereof shown in FIG. 1.

What we claim is:

An ultracentrifuge for the continuous separation of a gas mixture into light and heavy fractions, said ultracentrifuge comprising a stationary housing, a tubular elongated rotor drum having opposite ends one of which is open over substantially the entire cross-section of the drum while the other of the ends is a closed end, means supporting the drum within said housing for rotation about a vertical axis with the open end of the drum facing upwardly, means for supplying the mixture to be separated into said drum, said stationary housing including a portion bounding said open end of the drum to close the same and exert a braking force on gas within the drum to create an axial gas whirl within the drum whereby the lighter fractions are accumulated at the lower end of the drum and the heavier fractions are accumulated at the upper end of the drum, said portion of said stationary housing defining an opening for the outflow of the gas fraction at said upper end of the drum, said drum including an inwardly curved portion at said upper end, said portion of the stationary housing which bounds the upper end of the drum including a portion with a curved surface in the shape of a portion of a torus which together with the inwardly curved portion of the drum defines a smooth inner curved surface at the upper end of the drum and means at said closed lower end of the drum for the discharge of the gas fraction accumulated thereat.

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M. CARY NELSON, *Primary Examiner.*

HERBERT L. MARTIN, HARRY B. THORNTON, *Examiners.*