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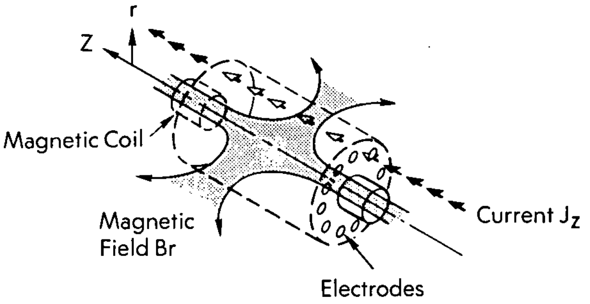
NASA TECH BRIEF
Ames Research Center

Separation of Gas Mixtures by Centrifugation

Two gases differing in molecular weight can be separated by centrifugation, but it is necessary to achieve circumferential speeds significantly larger than the speed of sound in the gas mixture, i.e., the velocity of the rotating mixture must be supersonic. When the gas mixture consists of very light components (such as hydrogen and deuterium) or heavy components at high temperature, the speed of sound in the gas mixture is so large that mechanical rotation becomes impractical; the required rotational velocity is so large that centrifugal forces exceed the structural limits of the mechanism used to rotate the mixture.



High rotational velocities in gas mixtures can be obtained in a device which may be described as a magnetohydrodynamic (MHD) centrifuge; it utilizes electric currents and magnetic fields to produce a magnetohydrodynamic force which develops supersonic rotational velocities in gas mixtures. The geometry of the magnetic and electrical fields, as shown in the diagram, is such that the greatest force acting on the gas mixture occurs near the wall of the cylindrical chamber containing the mixture.

The magnetohydrodynamic device is potentially superior to ordinary centrifuges because the rotation of gas mixtures is produced by an MHD force rather than by mechanical means; thus, the limitation in velocity imposed by stress levels in rotating parts does not exist. In particular, the performance of the MHD centrifuge is superior to any mechanical gas centrifuge in instances where the component gases in the mixture are of small molecular weights or when the mixture is hot, because the required speed of rotation is prohibitively large for the mechanical centrifuge (over 1 km/sec).

Experiments with an MHD centrifuge have indicated that with a mixture of 1.3 parts of xenon and 1 part of helium, a 3 to 1 concentration ratio of xenon to helium can be obtained at the chamber walls. Typically, the experimental device uses 16 electrodes and consumes about 134 kW of power; it operates at pressures below 26.66 MN/m^2 (200 torr), and with voltage gradients of the order of 800 V/m. The two magnet coils are axial and opposed in polarity; the radial magnetic field strength at the electrodes is about 0.2 tesla.

Reference:

Love, W. L., and Park, C.: An Experiment on the MHD-Driven Rotating Flow for Gas Core Nuclear Rocket. AIAA Journal, vol. 8, no. 8, page 1377, 1970.

Notes:

1. Several devices that have been reported previously incorporate MHD forces to produce a rotational flow in a gas; however, none have incorporated the particular geometry and features described above to provide separation of gas mixtures.
2. No additional documentation is available. Specific questions, however, may be directed to:
   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: 72-10270

(continued overleaf)

Patent status:

No patent action is contemplated by NASA.

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