(**6**). The gas pressure in chamber (**7**) should be still high enough to create the gas jet (**27**) by expansion through nozzle (**6**) into the vacuum of chamber (**10**). The gas jet (**27**) from the nozzle (**6**) passes a ring electrode (**28**) which provides the field barrier by a suitable voltage between ring electrode (**28**) and nozzle (**6**). Here also the field barrier should be formed directly at the exit of nozzle (**6**) so that all ions are pushed against the field barrier. Ions (**34**) passing the field barrier are accelerated by several kilovolts towards the conversion electrode (**35**), and the secondary electrons (**36**) generated here by impinging ions are measured by the channel plate detector (**21**).

[0051] A somewhat more elaborated version of the same principle is schematically shown in FIG. **8**, applying two ion guides to catch and guide the ions, but not between jet forming nozzle and field barrier. The primary gas stream (**26**) from the entrance capillary is directed towards a Laval nozzle (**6**) surrounded by a skimmer. For the sake of clarity, the Laval nozzle in FIG. **8** is shown somewhat enlarged out of scale. The ions within the primary gas flow (**26**) from the entrance capillary (**3**) are caught and guided towards the center of the Laval nozzle (**6**) by an RF quadrupole ion guide (**29**). The Laval nozzle is operated by the back-up pressure of the gas stream (**26**). The gas jet (**27**) formed by the Laval nozzle (**6**) passes the ring electrode (**28**) which creates the field barrier by suitable voltages. Also here it is favorable to generate the field barrier directly at the exit of nozzle (**6**), by a suitable choice of size and shape of the electrode (**28**) and its distance from the nozzle (**6**). The passing ions are then collected by a second ion funnel (**8**), separating the ions from the gas and guiding them, by a DC voltage gradient, towards the ion detector (**21**) in a separate pumping chamber (**10**) which is pumped by pump (**24**). The ions are highly accelerated by several kilovolts towards the ion detector (**21**).

[0052] Although the electrode (**28**) in FIG. **8** allows creation of a favorable shape of the field barrier, for some applications it is still more favorable to simply use grids (**30**) to create the field barrier, as shown in FIG. **9**. The field barrier can be created by voltages between the two grids (**30**), or even, more favorable, between the first grid and the nozzle (**6**), creating the field barrier directly at the exit of the nozzle (**6**). In FIG. **9**, the ions are caught and guided in chamber (**4**) by an ion funnel **5**, instead of the quadrupole rod arrangement in FIG. **8**.

[0053] In FIGS. **6**, **7**, **8** and **9**, the field barrier is located most favorably directly in front of the nozzle (**6**). During adiabatic expansion, the gas cools down to low temperatures and forms a jet in which all molecules have about the same velocity across the jet. As long as the ions are transported within this jet to the field barrier, high mobility resolution can be achieved. Therefore, it is highly preferable to generate the field barrier directly at the exit of the nozzle (**6**).

[0054] If the gas jet arrives at the field barrier in a short distance from the nozzle, some of the ions already will leave the jet in radial direction driven by space charge. These ions can no longer be pushed over the field barrier; they are lost for any measurement. If the field barrier is located in some distance from nozzle (**6**), the ions have to be strongly canalized in order to not let them escape radially.

[0055] To canalize the ions within the gas jet to the field barrier, an ion guide can be used which, however, should be designed in such a way that it does not disturb the gas jet. Restrictions or reflections of the gas flow outside the gas jet brought about by the ion guide, which could disturb the gas jet, must be avoided. In the absence of electric guiding fields, the ions would leave the gas jet driven by space charge forces in all directions. However, the radial reverse acceleration forces of the pseudopotential of the ion guide have the effect that the ions are held in the central flow region of the slightly diverging gas jet, and canalized therein up to the field barrier.

[0056] The ion guides can be multipole rod systems (as shown in FIG. **10**), stacked ring electrode systems, or ion funnels (like ion funnel (**8**) in FIG. **1**), which must, however, be designed so that they do not hinder the lateral outflow of the gas jet. The lateral outflow of the gas jet is mainly caused by friction of the gas jet with residual gas. The pole rods of the multipole rod system should therefore be kept very thin. Instead of round pole rods, the rod systems may be built, as shown for a quadrupole system in FIG. **9**, by wing-shaped pole electrodes (**41-44**) with wide gaps for the outflow of the gas. The rounded edges of the wings then replace the pole rods; the smaller summit radius must be compensated for by higher RF voltages. The diaphragms of the ring diaphragm systems and the ion funnels can be equipped with gas skimmers which conduct the impinging gas flow to the outside, as is shown in FIG. **1** for the gas flow (**27**) in the ion funnel (**8**).

[0057] In all applications, the shape of the field barrier is essential for mobility resolution. Field barriers can be generated in different ways, for example by voltages on ring electrodes or simple apertured diaphragms or ion-optical lens systems consisting of several apertured diaphragms. The spatial potential distributions of such field barriers usually have the shape of potential saddles. However, the mobility separation does not depend on the potential saddle, but on the axial component of the electric field generated by the potential distribution. On the positive slope toward the potential saddle, the strength of the axial component of the electric field initially increases, then crosses a field maximum in the steepest portion of the positive slope before again reaching the zero value in the saddle point of the potential barrier.

[0058] While the potential obeys Laplace's equations and can only ever assume a spatial potential saddle, but never a spatial maximum or minimum, the area around the field maximum in the radial direction can assume different forms. If the axial field component in the field maximum decreases with radial distance from the axis, the field maximum in the cross-section forms a mountain peak. If it increases, however, a saddle is formed, i.e. a mountain pass. If it remains constant regardless of the radial distance from the axis, it forms, figuratively speaking, a transverse mountain ridge which can be crossed by the ions in the gas flow everywhere with the same chance because the gas flow has a homogenous velocity distribution in the vicinity of the ridge-like field maximum. It is, therefore, most favorable for achieving a high mobility resolution if the field maximum is formed as a mountain ridge where the field maximum has a radially constant height, because then the separation of the ions according to their mobility is achieved everywhere at the same mobility threshold regardless of their distance from the axis. This form of a radially extended field barrier which has the same height everywhere can, in approximation, be generated by an arrangement of several ring diaphragms with corresponding DC voltages.

[0059] In the case of such a mountain ridge, the ions are not focused toward the axis by the field in the vicinity of the field maximum. They therefore have to be prevented from escaping radially by the ion guide. To achieve this, the ion guide must extend to the field maximum. With a weak field saddle,