metal electrode sheets. A system of lamellae leads to the same electric fields in front of the surface of the pole electrode system. The disadvantage of a system of lamellae is that it has a larger electrical capacitance; it therefore requires a more powerful RF generator. Its advantage is that the lamellae are easy to fix mechanically, with spacing insulators, for example. With a system of wires, on the other hand, it is a little difficult to fix the wires mechanically without creating insulating surfaces which can be charged by impinging ions.

[0039] A bipolar grid (**11**) like the one in FIG. **5** can generally be configured with the voltages $U_1=A_1 \cos(\omega_1 t)+A_3 \cos(\omega_3 t)$ and $U_2=A_2 \cos(\omega_2 t)-A_3 \cos(\omega_3 t)$. The two voltages of opposite polarity $\pm A_3 \cos(\omega_3 t)$ balance each other out completely in the near field region and thus form the dipolar near field. The quadrupole far field between the four pole electrode systems is formed by the voltage component $A_1 \cos(\omega_1 t)+A_2 \cos(\omega_2 t)$, it being preferable for the two frequencies ω_1 and ω_2 to be the same. The amplitude A_2 can also be set at zero. The frequency ω_3 for the dipole field must not be the same as the frequency of the far field. It can be favorable for the frequency ω_3 of the dipolar near field to be lower than the frequency ω_1 of the far field in order to generate a more repulsive force for heavy ions close to the pole electrode systems.

[0040] The electric field in front of the bipolar grid (**71**-**75**), which roughly corresponds to a section of the grid in FIG. **5**, is shown in FIG. **11** for a specific voltage configuration. The two voltages here are $U5=A_1 \cos(\omega_1 t)$ and $U6=-(A_1/2) \cos(\omega_1 t)$. The voltage components $\pm(A_1/2) \cos(\omega_1 t)$ from the voltages U**5** and U**6** in the dipolar near field balance each other out, while the voltage component $(A_1/2) \cos(\omega_1 t)$ from U**5** is left for the far field. A strongly inhomogeneous field is formed in front of each of the wire electrodes (**71**-**75**), said field driving back the heavy ions according to the invention.

[0041] Very similar near and far fields can be created in front of the electrode structure shown in FIG. **4**. In this case, the wire-shaped electrodes of the pole electrode grid are arranged at right angles to the axis of the ion guide. Here too, the electrode wires can be designed as electrode lamellae. A special configuration of the individual electrodes even makes it possible to superimpose an axial DC field on the RF field here, enabling the ions to be actively driven through the ion guide. An active forward drive of this type is already familiar from the above-cited U.S. Pat. No. 5,572,035 A for ring electrode systems, and from German Patent Publication DE 10 2004 048 496.1 (equivalent to British Patent Publication GB 2 422 051 A) for diaphragm stacks with non-round apertures. It is also possible to create quadrupole electric RF fields in these diaphragm stacks.

[0042] The two grid-like structural element arrays of pole electrode systems such as those shown in FIGS. **3**, **4** and **5** are relatively easy to produce if the solid rod is replaced by an electrode structure made of individual lamellar metal electrodes which are stacked in the longitudinal or transverse direction and isolated from each other. If the lamellar electrodes have smooth edges, a system of edges is formed, but if the edges are split up into individual spikes, they form a system of tips. To reduce the electrical capacitance, the lamellar metal electrodes can be arranged in a filigree structure so that only small pieces of the surface of any two electrodes are next to each other. With an electrode stack whose sheet electrodes are arranged transversely, it is also easily possible to superimpose an electric DC field in the axial direction, as indicated above.

[0043] A non-vanishing far field in front of a bipolar grid can be generated by two different amplitudes of the RF voltages so that, at a distance from the surface of the electrode structure, one of the two RF voltages predominates. It is also possible to apply two equal RF voltages of opposite polarity to the two arrays of an electrode structure if the structural elements of one array extend less far toward the surface of the electrode structure, as shown schematically in FIG. **8**. Here, as well, the field of one RF voltage predominates at a distance in front of the surface, namely the field of the RF voltage across the protruding electrode array (**51**), even if it is attenuated. It is then possible, for example, to create a relatively weak quadrupole alternating electric field with a very low lower mass limit in the interior of a system comprising four such electrode structures; but close to the surface of each electrode structure, the field increases to a strongly reflecting pseudopotential for an approaching ion. It is thus possible to construct quadrupole systems whose upper mass limit is a factor of several hundred above the lower mass limit.

[0044] In the same way, a technique whereby individual diaphragms are stacked can be used to produce a quadrupole field of the type shown in FIGS. **9** and **10**. In the four inner "pole surfaces" of the quadrupole field the sheets of one electrode array stand back; if two RF voltages of opposite polarity but the same amplitude are applied, a weak quadrupole field with very low lower cut-off mass for storing ions is created while, in the near field in front of the "pole surfaces", heavy ions are also readily driven back.

[0045] It must be expressly emphasized here that a pole electrode system of this type made of either sheet-type or wire-shaped electrodes, as shown in the FIGS. **3**, **4**, **5**, **9** and **10**, is no longer a pole rod in the literal sense of the word.

[0046] The basic idea of the invention, namely the generation of near fields with greater inhomogeneity in front of the pole rods of a multipole field, preferably a quadrupole field, can also be achieved with solid pole rods. A very simple embodiment uses solid pole rods, as in the prior art, but here their surfaces are shaped to form a field of edges or tips with enclosed indentations. This can be achieved by milling channels or grooves, for example. In this case, as well, the alternating fields which are generated in the near field region in front of the edges or tips are more inhomogeneous than those which would be the case on smooth surfaces. It is thus possible to produce quadrupole systems whose upper mass limit is 30 to 40 times the lower mass threshold. This type of structure can also be constructed of pole rods which are not solid but comprise lamellae or other structural elements with edges or tips.

What is claimed is:

1. A multipole RF ion guide comprising:

a pole rod having a surface that is formed from a plurality of electrodes, each electrode being driven by an RF voltage so that electric fields generated in a spatial region near to the pole rod surface are more inhomogeneous than electric fields generated by a pole rod having a continuous surface.