with connections (**3**) for the first, and (**4**) for the fourth phase of the rotational alternating voltage (the other connections are not visible in the sectional drawing), and with the RF quadrupole ion trap which is made up of an injection end cap (**5**), the ring electrode (**6**) and the final end cap (**7**). The ring electrode is supplied via the connection (**8**) with drive alternating voltage for the ion trap.

FIG. **2** shows the potential distribution p in the travelling field apparatus along the axis s at three consecutive times (a), (b) and (c). The temporal forward drive of the potential minima is apparent.

FIG. **3** shows the spatial arrangement of the travelling field apparatus (**2**) with the above described connections (**3**) and (**4**) and the ion trap with end caps (**5**, **7**) and ring electrode (**7**).

FIG. **4**, in three stacked diagrams, shows the capture intervals for a heavy and a light ion, each relative to the cycle of the drive alternating voltage.

PARTICULARLY FAVORABLE EMBODIMENTS

FIG. **1** shows a basic design of the invention. Arranged between a multipole rod system (**1**), which serves as an ion guide system, and the RF quadrupole ion trap (**5**, **6**, **7**) is the travelling field apparatus (**2**) made up of washer-like aperture diaphragms insulated from one another (insulation not shown). The aperture diaphragms are spaced half a millimeter from one another and are sequentially joined with the six phases of a 6-phase rotational alternating voltage. The leads (**3**) and (**4**) are shown for phases **1** and **4**, the other leads are not visible in the sectional diagram, but may be seen in the three-dimensional depiction in FIG. **3**.

The frequency of the travelling field, at 100 kilohertz, is exactly one tenth the frequency of the drive voltage of the ion trap. The spatial cycle length of the travelling field with six phases comprises six aperture diaphragms, and is therefore 3 millimeters long. Therefore the travelling velocity of the travelling field is 300 meters per second, and the ions captured in each potential minimum at the front end of the device are accelerated to this velocity. Singly charged ions of a mass of 100 atomic mass units thereby have an energy of 0.05 electron volts, those of 1,000 atomic mass units have an energy of 0.5 electron volts, and those of 10,000 atomic mass units have an energy of 5 electron volts. The latter can no longer be decelerated within a half cycle of drive voltage in the ion trap if this is limited to about 100 volts per centimeter at the end cap, but this will function for ions of up to approx. m/z=2,000 atomic mass units per electron charge.

In the travelling field path, however, the accelerated ions vibrate in the moving potential minima if their oscillation motions are not dampened by a collision gas. For short travelling field paths of about 6 centimeters length (about 20 cycles), the damping must be relatively high, and pressures between 1 and 100 pascal (10^{-2} to 1 millibar) are appropriate here.

The ions in the travelling field can be focused if every second aperture diaphragm is superimposed by a small positive DC voltage and the aperture diaphragms in between are superimposed by a small negative DC voltage. The superposition is simply supplied to every second phase. The aperture diaphragms then function like a series of Einzel lenses. Normal operation without a travelling field can then be attained by switching off the travelling field voltage, and the aperture diaphragms function like an ion guide system made purely of lenses, due to the spatially alternating DC voltages.

Capture of the ions is optimized by adjusting the phase relationship between the travelling field frequency and that of the ion trap. This optimization, however, only applies to ions of a certain ratio of mass to charge (m/e). Ions of other m/e ratios injected at the same time do not meet their capture interval without special measures and are therefore not continuously stored for long in the ion trap.

Collision gas pressure between the travelling field path and the injection hole in one of the end cap electrodes of the ion trap has a favorable effect on the simultaneous capture of heavier and lighter ions. Ions of a low mass are more strongly decelerated in this collision gas than those of a high mass. Therefore they arrive, as required, later in the ion trap and thereby increase their chance of capture.

A light deceleration voltage between the travelling field and end cap electrode has the same effect, although there is a bottom cutoff threshold for the ions. Ions with an energy of only 0.05 electron volts cannot overcome a potential barrier of 0.1 volts.

Delay of the lighter ions compared to the heavy ones can however also be achieved by a different design of the travelling field. If the spacings between the aperture diaphragms become smaller toward the end of the travelling field path, the ions are decelerated here. In this way, the light ions are decelerated quickly, while the heavy ones are decelerated slowly. When leaving the travelling field, the heavy ions are faster, reaching the end cap earlier as required.

I claim:

1. Method for injecting externally generated ions into an RF quadrupole ion trap through an injection hole in one of a plurality of trap electrodes, comprising the steps of

(a) creating an electrical travelling wave field in front of the trap's injection hole, the frequency of which is phase-locked to the frequency of the ion trap's RF, and the travelling direction of which is pointed towards the injection hole,

(b) filling the ions into potential minima at the front end of the electrical travelling wave field, whereby the ions are separated into ion packets, and the ion packets are transported by the travelling wave field towards the injection hole of the ion trap, and

(c) injecting the travelling ion packets into the ion trap at a selected phase angle of the RF frequency.

2. Method as in claim **1**, wherein the travelling wave field is generated by coaxial aperture diaphragms, to which the phases of a multiple phase alternating voltage are applied, and wherein the alternating voltage has a frequency which is the same as the RF drive frequency of the ion trap or is an integral fraction of the RF drive frequency.

3. Method as in claim **2**, wherein the phases of the alternating voltage are alternately superimposed with positive and negative DC voltages.

4. Method as in claim **2**, wherein spacing between aperture diaphragms decreases toward the ion trap's injection hole.

5. Method as in claim **1**, wherein a deceleration voltage for the ions is applied between the travelling wave field and the ion trap.

6. Method as in claim **1**, wherein the travelling wave field and the space between the travelling wave field and the ion trap are filled with a collision gas.

7. Method as in claim **6**, wherein the collision gas has a pressure of 0.01 to 10 pascal.