with a thermally cured inert material (such as a phenolic or a Teflon layer) to prevent decay due to chemical attack.

A ceramic magnet was chosen because it produces a much stronger field than the common permanent magnets that are typically used in magnetic stirring applications, and it can be used to much higher temperatures. The increased field strength allows the tube **102** and base disk **112** to be operated inside of stainless steel pressure vessels without appreciable loss of flux. Stronger magnets (such as samarium-cobalt) were deemed unsuitable because the much higher field of these magnets would cause an unfavorable increase in friction at the base of the rotor.

It will further be appreciated that the invention could be embodied in a version having three small studs added to the flat bottom of the disk base **112**, positioned 120 degrees apart and equidistant from the rotational axis of the disk **112**, each projecting sufficiently to cause a separation between the bottom of the disk and the floor of the containment vessel, thus forming a support that decreases friction between the disk **112** and the containment vessel. It will further be appreciated that the invention could be embodied in versions comprising three nylon screws in place of the three small studs.

A magnetic stirring motor **304** is closely positioned under the containment vessel **302** such that a magnetic flux coupling is achieved with the magnet disposed within the disk component **112** of the base. The magnetic stirring motor may be selected from the common laboratory variety of the submersible variety, electric or pneumatic.

Operation of the magnetic stirring motor **304** spins the rotor with increasing angular velocity, gradually developing a liquid vortex in the liquid phase. Speed of the rotor is controlled such that the lowest surface of the vortex forms at the plane of the sidewall holes. As the mixing continues, the external screw thread **104** generates turbulence at the surface of the liquid near the rotor and ambient vapor is entrained into the liquid. The threads also draw vapor into the liquid from above the tube **102**. This vapor is thus urged into intimate contact with the turbulent, droplet-forming liquid. Circulation then develops whereby the vapor that is pulled into the liquid enters the holes **108** in the sidewall of the tube, rises through the liquid in the longitudinal bore **106**, and exits the open top end **118**.

This circulation promotes the rapid approach to chemical equilibrium and mass transfer that is vital in many measurement and chemical reaction procedures. This circulation can be demonstrated by operating the rotor in a beaker of water with a magnetic stirring motor. As the turbulent entrainment region is formed by the external right-hand screw threads, bubbles are visible rising in the water in the longitudinal bore. This vapor circulation can be made very clear by slowly adding water into the longitudinal bore during the rotation, and observing the rapidly rising air bubbles.

The holes in the tube of the apparatus upon which the initial testing was performed were drilled approximately perpendicular to the longitudinal axis of the tube. In cases in which the gas viscosity is relatively high, it may be desirable to drill the holes at an oblique angle, thus forming an angle of attack that would be an aid in drawing vapor into the longitudinal bore.

The device can be constructed from many common polymeric materials such as Teflon, glass-filled Teflon or Delrin, ceramics, or other nonmagnetic metals such as titanium or some stainless steels. The choice depends upon the fluids present in the mixing application as well as the mixing conditions under consideration.

The present invention therefore provides a unique system for mixing liquids and entrainment mixing of vapor into liquids. The present invention provides a superior method of entrainment and mixing that has not hereto for been achievable in magnetically coupled mixers. The present invention provides robust mixing of a liquid that can be achieved within a containment vessel with the simultaneous entrainment of vapor into the liquid that has not been provided by prior art devices. The present invention is simple and easy to implement and provides superior results.

The foregoing description of the invention has been presented for purposes of illustration and description, It is not intended to be exclusive or to limit the invention to the precise form disclosed, and other modifications and variations may be possible in light of the above teachings. For example, the screw threads can be made to be either right-side or left-side screw threads and the device can be rotated accordingly. Further, the relative dimensions can be modified dependent on scaling factors, liquid viscosity, vapor density, etc. without extending beyond the spirit and scope of the present invention. The embodiment was chosen and described in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and various modifications as are suited to the particular use contemplated. It is intended that the appended claims be construed to include other alternative embodiments of the invention except insofar as limited by the prior art.

The invention claimed is:

1. An apparatus for mixing liquid and for entrainment mixing of vapors in liquid comprising:

a freestanding tube having an open top end and a longitudinal bore extending into said tube from an open top end to a closed bottom end, said closed bottom end forming a floor within said longitudinal bore, said tube also having an exterior bottom end, said tube further having an exterior axial surface between said open top end and said exterior bottom end, said exterior axial surface having at least one helix in the form an external screw thread, said tube also having a sidewall between said exterior axial surface and said longitudinal bore, said sidewall also defining at least one aperture for circulation of vapor.

2. An apparatus as recited in claim **1** wherein said aperture is located centrally between two flanking surfaces of said screw thread.

3. An apparatus as recited in claim **1** wherein said aperture is a circular bore.

4. An apparatus as recited in claim **3** wherein said circular bore is located centrally between two flanking surfaces of said screw thread.

5. An apparatus as recited in claim **3** wherein said circular bore is located centrally between two flanking surfaces of said screw thread.

6. An apparatus as recited in claim **1** wherein the height of said external screw thread, measured from a crest of said external screw thread to a lowest adjacent point between flanking surfaces of said screw thread is at least equal to a radius of said tube measured from a longitudinal axis of said tube to said exterior axial surface of said tube at said lowest point between flanking surfaces of said screw thread.

7. An apparatus as recited in claim **1** further comprising:

a base comprising:

a disk having a top surface and a substantially flat bottom surface, said top surface having an area greater than an area of a bottom end of said tube, said