



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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| <b>(21) International Application Number:</b> PCT/JP00/01287<br><b>(22) International Filing Date:</b> 3 March 2000 (03.03.00)<br><b>(30) Priority Data:</b><br>11/55634 3 March 1999 (03.03.99) JP<br><b>(71) Applicant (for all designated States except US):</b> TOKIN CORPORATION [JP/JP]; 7-1, Koriyama 6-chome, Taihaku-ku, Sendai-shi, Miyagi 982-8510 (JP).<br><b>(72) Inventor; and</b><br><b>(75) Inventor/Applicant (for US only):</b> KUMAGAI, Toru [JP/JP]; Tokin Corporation, 7-1, Koriyama 6-chome, Taihaku-ku, Sendai-shi, Miyagi 982-8510 (JP).<br><b>(74) Agents:</b> GOTO, Yosuke et al.; The Third Mori Building 4-10, Nishishinbashi 1-chome, Minato-ku, Tokyo 105-0003 (JP). |           | <b>(81) Designated States:</b> CA, CN, KR, NO, SG, US, VN, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).<br><br><b>Published</b><br><i>With international search report.</i><br><i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> |

**(54) Title:** VIBRATION ACTUATOR HAVING MAGNETIC CIRCUIT ELASTICALLY SUPPORTED BY A SPIRAL DAMPER WITH INCREASED COMPLIANCE

**(57) Abstract**

A vibration actuator includes an electro-mechanical transducer having a magnetic circuit (1-4) and a driving coil (5), a support frame (9), and a damper (270) elastically supporting the magnetic circuit onto the support frame to flexibly damp the vibration of the magnetic circuit when a driving AC current is supplied to the coil (5). The damper (270) comprises an inner and an outer ring portions (271, 272) and a plurality of spiral spring portions (273) determined by a plurality of spiral slits (274, 275) formed in the damper. In order to reduce the spiral spring portion determined by the adjacent two spiral slits in its compliance, each of the spiral spring portions has an effective spring length determined by an effective angle ( $\theta$ ) which is determined as an angle (by angular degree) from an inner end of the inner spiral slit to an outer end of the outer spiral slit of thereof around a center of the damper. The effective angle is 55 angular degree or more. In a preferable example, the effective spring length is determined by a product ( $r\theta$ ) of an average radius ( $r$ ) value by the unit of "mm" and the effective angle ( $\theta$ ) value by unit of the angular degree. The effective spring length is selected of 320 or more, preferably, 400 or more.

