



- (51) **International Patent Classification:**
G01N 11/16 (2006.01)
- (21) **International Application Number:**
PCT/US2013/043568
- (22) **International Filing Date:**
31 May 2013 (31.05.2013)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
61/816,221 26 April 2013 (26.04.2013) US
- (71) **Applicant:** MICRO MOTION, INC. [US/US]; 7070 Winchester Circle, Boulder, Colorado 80301 (US).
- (72) **Inventors:** KRAVITZ, Andrew S.; 3045 Blue Sky Circle #18-101, Erie, Colorado 80516 (US). MCANALLY, Craig B.; 594 E. 131st Way, Thornton, Colorado 80241 (US).
- (74) **Agents:** JANSEN, Gregg L. et al.; The Ollila Law Group LLC, 2569 Park Lane, Suite 202, Lafayette, Colorado 80026 (US).
- (81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,

DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

- with international search report (Art. 21(3))

(54) **Title:** VIBRATORY SENSOR AND METHOD OF VARYING VIBRATION IN A VIBRATORY SENSOR

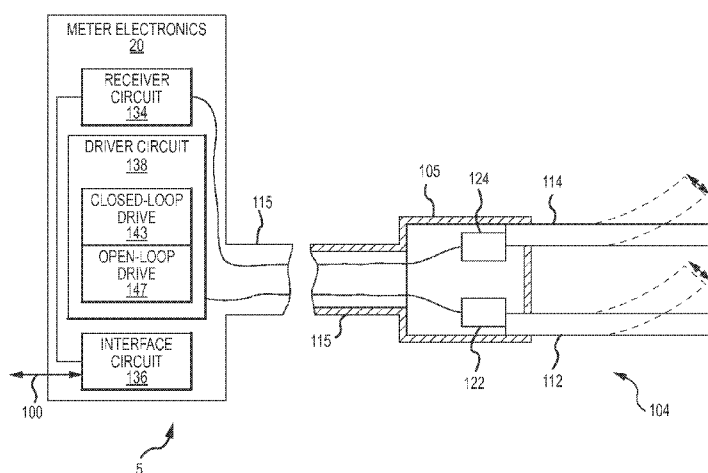


FIG.5

(57) **Abstract:** A vibratory sensor (5) includes a vibratory element (104), a receiver circuit (134) that receives a vibration signal from the vibratory element (104), and a drive circuit (138) that generates a drive signal. The drive circuit (138) includes a closed-loop drive (143) and an open-loop drive (147). The meter electronics (20) vibrates the vibratory element (104) commencing at a commanded first frequency and in an open-loop manner to achieve a first target phase difference Φ_1 for a fluid being characterized and determines a corresponding first frequency point ω_1 , vibrates the vibratory element (104) commencing at a commanded second frequency and in the open-loop manner to achieve a second target phase difference Φ_2 and determines a corresponding second frequency point ω_2 , and determines a viscosity of the fluid being characterized using the first frequency point ω_1 and the second frequency point ω_2 .