

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
30 November 2006 (30.11.2006)

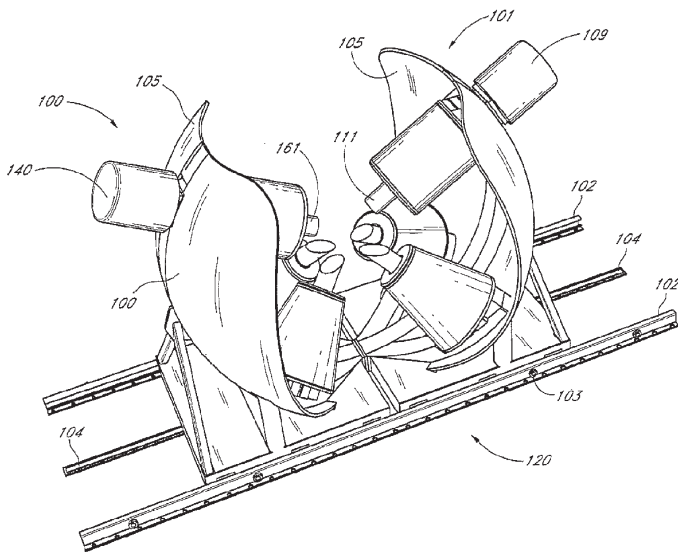
PCT

(10) International Publication Number  
WO 2006/128160 A2

- (51) **International Patent Classification:**  
A61B 19/00 (2006.01)      A61B 5/06 (2006.01)  
A61M 25/01 (2006.01)      A61B 17/22 (2006.01)
- (21) **International Application Number:**  
PCT/US2006/020895
- (22) **International Filing Date:** 25 May 2006 (25.05.2006)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
11/140,475      27 May 2005 (27.05.2005)      US
- (71) **Applicant (for all designated States except US):** MAGNETECS, INC. [US/US]; 10524 S. La Cienega Blvd., Inglewood, California 90304 (US).
- (72) **Inventor; and**
- (75) **Inventor/Applicant (for US only):** SHACHAR, Yehoshua [US/US]; 2417 22nd Street, Santa Monica, California 90405 (US).
- (74) **Agent:** DELANEY, Karoline, A.; Knobbe, Martens, Olson & Bear, LLP, 2040 Main Street, 14th Floor, Irvine, California 92614 (US).
- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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(54) **Title:** APPARATUS AND METHOD FOR SHAPED MAGNETIC FIELD CONTROL FOR CATHETER, GUIDANCE, CONTROL, AND IMAGING



(57) **Abstract:** A variable magnet system for manipulating a magnetic catheter is described. In one embodiment, a cluster of electromagnets is configured to generate a desired magnetic field. In one embodiment, one or more poles of the cluster are moveable with respect to other poles in the cluster to allow shaping of the magnetic field. In one embodiment, one or more magnetic poles can be extended or retracted to shape the magnetic field. In one embodiment, the electromagnets can be positioned to generate magnetic fields that exert a desired torque and/or movement force on the catheter, in one embodiment, the catheter guidance system includes a closed-loop servo feedback system. In one embodiment, a radar system is used to determine the location of the distal end of the catheter inside the body, thus, minimizing or eliminating the use of ionizing

radiation such as X-rays. The catheter guidance system can also be used in combination with an X-ray system (or other imaging systems) to provide additional imagery to the operator. The magnetic system used in the magnetic catheter guidance system can also be used to locate the catheter tip to provide location feedback to the operator and the control system. In one embodiment, a magnetic field source is used to create a magnetic field of sufficient strength and orientation to move a magnetically-responsive catheter tip in a desired direction by a desired amount.

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