



US007107693B2

(12) **United States Patent**
Nesch et al.

(10) **Patent No.:** **US 7,107,693 B2**
(45) **Date of Patent:** **Sep. 19, 2006**

(54) **APPARATUS AND METHOD FOR PRECISE ANGULAR POSITIONING**

(75) Inventors: **Ivan N. Nesch**, Crown Point, IN (US);
Timothy I. Morrison, Darien, IL (US)

(73) Assignee: **Illinois Institute of Technology**,
Chicago, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

4,805,543 A *	2/1989	Schwab et al.	108/20
4,887,804 A *	12/1989	Ohtsuka	269/73
4,991,309 A *	2/1991	Nagasawa et al.	33/568
5,217,214 A *	6/1993	Takei	269/73
5,329,825 A	7/1994	Askins	
5,334,892 A	8/1994	Chitayat	
5,622,078 A	4/1997	Mattson	
5,657,523 A	8/1997	Lin et al.	
6,016,607 A	1/2000	Morimoto et al.	
6,028,376 A	2/2000	Osanai et al.	

(Continued)

(21) Appl. No.: **11/036,811**

FOREIGN PATENT DOCUMENTS

(22) Filed: **Jan. 14, 2005**

JP 02312148 A * 12/1990

(65) **Prior Publication Data**

US 2006/0156556 A1 Jul. 20, 2006

(Continued)

(51) **Int. Cl.**
B23Q 3/18 (2006.01)

Primary Examiner—R. Alexander Smith
(74) *Attorney, Agent, or Firm*—Pauley Peterson & Erickson

(52) **U.S. Cl.** **33/1 N; 33/568; 33/1 M; 248/424**

(57) **ABSTRACT**

(58) **Field of Classification Search** **33/1 M, 33/1 N, 568, 569, 573; 269/58, 71, 73; 248/419, 424, 425; 29/281.4; 359/391, 359/392, 393**

An apparatus and method for precise angular positioning of an object. A first pivot arm and a second pivot arm each is pivotally mounted with respect to a base. A pivot base flex member is operatively connected to the first pivot arm and allows the first pivot arm to pivot with respect to the base, within a particular plane. A second pivot base flex member is operatively connected to the second pivot arm and allows the second pivot arm to pivot with respect to the base, and also within either the same plane or a different plane as the plane within which the first pivot arm pivots. Support structures maintain each of the first pivot arm and the second pivot arm within the particular plane or planes. An interconnect flex member connects the first pivot arm and the second pivot arm. With a relatively small base and thus overall apparatus, an input movement, such as a linear input of about 10 mm can be translated into an output movement of about 7200 radians.

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,864,983 A	2/1975	Jacobsen	
3,952,604 A	4/1976	Baudler	
3,973,445 A	8/1976	Ballard	
4,078,441 A	3/1978	Mazur	
4,225,110 A	9/1980	Akkerman et al.	
4,320,943 A *	3/1982	Link	353/27 R
4,351,197 A	9/1982	Carson	
4,559,717 A *	12/1985	Scire et al.	33/568
4,559,843 A	12/1985	Nilsson	
4,667,139 A	5/1987	Hirai et al.	
4,667,415 A *	5/1987	Barsky	33/568
4,711,157 A	12/1987	Kayyod et al.	

27 Claims, 3 Drawing Sheets

