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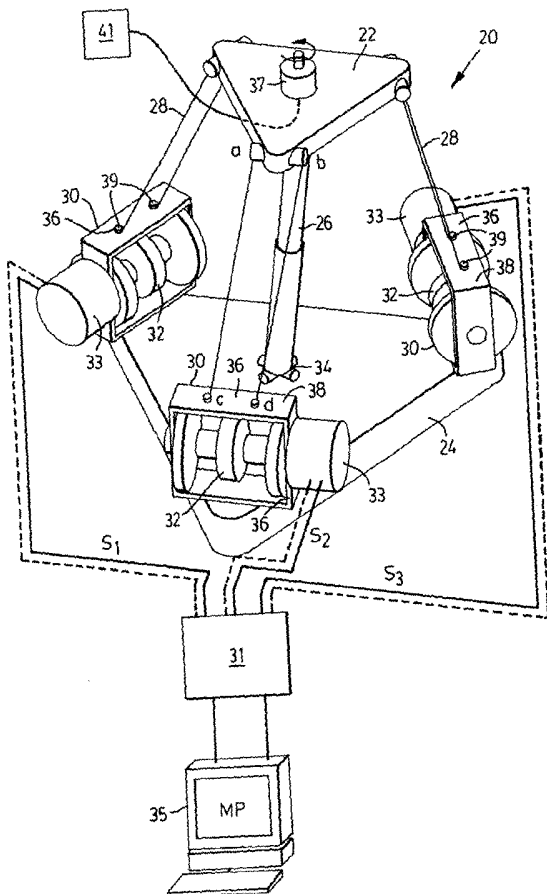
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- (71) Applicants and
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[Continued on next page]

(54) Title: LIGHT WEIGHT PARALLEL MANIPULATORS USING ACTIVE/PASSIVE CABLES



(57) Abstract: The present invention provides parallel, cable based robotic manipulators, for use in different applications such as ultra high-speed robots or positioning devices with between three to six degrees of freedom. The manipulators provide more options for the number of degrees of freedom and also more simplicity compared to the current cable-based robots. The general structure of these manipulators includes a base platform (24), a moving platform or end effector (22), an extensible or telescoping central post (26) connecting the base (24) to moving platform (22) to apply a pushing force to the platforms. The central post (26) can apply the force by an actuator (active), or spring or air pressure (passive) using telescoping cylinders. The robotic manipulators use a combination of active (28) and passive tensile (cable) members, and collapsible and rigid links to maximize the benefits of both pure cable and conventional parallel mechanisms. Different embodiments of the robotic manipulators use either active cables only, passive cables only, or combinations of active and passive cables. An active cable is one whose length is varied by means of a winch (30). A passive cable is one whose length is constant and which is used to provide a mechanical constraint. These mechanisms reduce the moving inertia significantly to enhance the operational speed of the robots. They also provide a simpler, more cost effective way to manufacture parallel mechanisms for use in robotic applications.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 03/00987

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B25J17/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B25J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 666 362 A (SHERIDAN THOMAS B ET AL) 19 May 1987 (1987-05-19) cited in the application abstract; figures 1-4 column 3, line 54 - column 4, line 11 column 2, line 54 - line 55 column 5, line 35 - line 38 -----	1,3,9,42
X	US 5 313 854 A (AKEEL HADI A) 24 May 1994 (1994-05-24) cited in the application abstract; figure 1 column 5, line 41 - column 6, line 4 column 5, line 35 - line 40 column 3, line 17 - line 18 ----- -/--	1,8,9

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

11 November 2003

Date of mailing of the international search report

12 03. 2004

Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA 03/00987

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6:4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-10, 42

Remark on Protest:

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10,42

Parallel manipulator using at least three cables, especially three degree of freedom parallel manipulator using active or passive cables

2. claims: 11-24

Five or six degree of freedom parallel manipulator using cables, especially passive cables

3. claims: 25-41,43-47

Planar parallel manipulator using active or passive cables

4. claims: 48-53

Parallel manipulator using both active and passive cables or only active cables, wherein the translational and rotational motions of the end effector are independent

INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 03/00987

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 08, 30 June 1999 (1999-06-30) -& JP 11 077577 A (TOSHIBA MACH CO LTD), 23 March 1999 (1999-03-23) abstract; figures 1,5 -----	1,8
A	MAEDA K ET AL: "On design of a redundant wire-driven parallel robot WARP manipulator" ROBOTICS AND AUTOMATION, 1999. PROCEEDINGS. 1999 IEEE INTERNATIONAL CONFERENCE ON DETROIT, MI, USA 10-15 MAY 1999, PISCATAWAY, NJ, USA, IEEE, US, 10 May 1999 (1999-05-10), pages 895-900, XP010336867 ISBN: 0-7803-5180-0 figures 2,3 -----	4,5
A	US 4 976 582 A (CLAVEL REYMOND) 11 December 1990 (1990-12-11) cited in the application abstract; figures 1,2,5 -----	4-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CA 03/00987

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4666362	A	19-05-1987	NONE	
US 5313854	A	24-05-1994	JP 7503188 T WO 9315452 A1	06-04-1995 05-08-1993
JP 11077577	A	23-03-1999	NONE	
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