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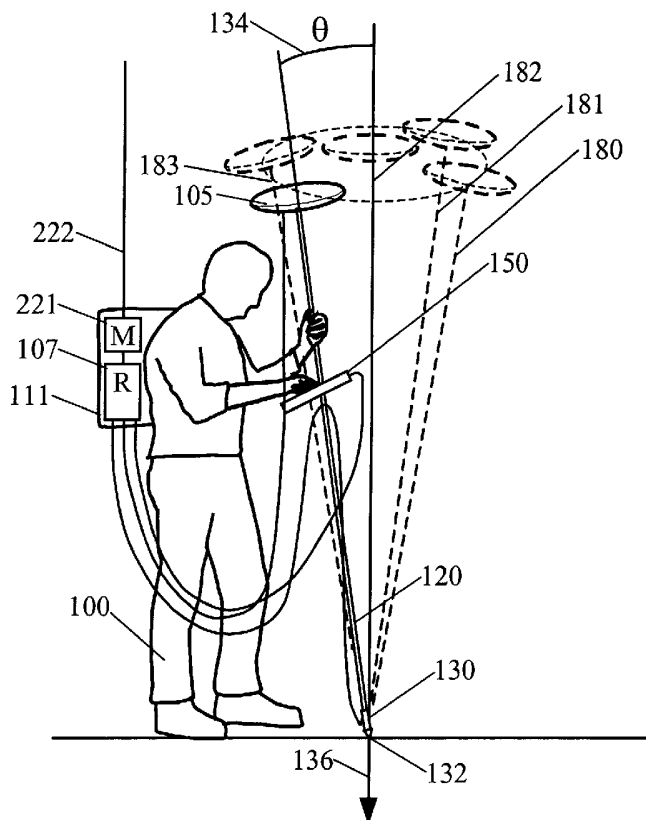
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[Continued on next page]

(54) Title: METHODS AND SYSTEMS FOR IMPROVEMENT OF MEASUREMENT EFFICIENCY IN SURVEYING



(57) Abstract: Methods and systems for measuring coordinates of a target, particularly under strong multipath conditions, are described. A satellite navigation system antenna (105) and a tilt sensor (130) are mounted on a range pole (120), with the sensor at the pole's bottom tip. Signals from the antenna and tilt sensor are provided to a receiver (107), which computes the antenna's coordinates from the antenna signals, and the pole tips position from the computed coordinates and the tilt data. The operator places the pole tip on the target and swings the pole by hand over an angle sector of 15 degrees while keeping the tip on the target. Height of the target can be computed with a single measurement set, and X-Y coordinates with just three measurement sets. The use of additional measurements reduces errors in the target's coordinates since multipath errors are uncorrelated during movement of the antenna. Vertical alignment of the pole is unnecessary.



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Published:

- *with international search report*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/26779

A. CLASSIFICATION OF SUBJECT MATTER
 IPC(7) : H04B 7/185; G01S 5/02
 US CL : 342/357.17
 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)
 U.S. : 342/357.17
 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 practicable, search terms used)

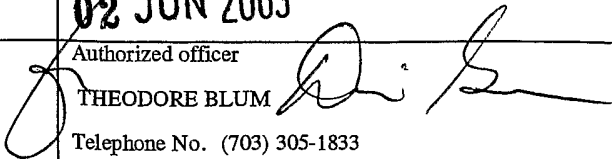
C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,052,083 A (WILSON) 18 APRIL 2000 (18/04/00), NOTE FIGURES 12 AND 5, SATELLITE ANTENNA (464), TILT METER (472), GPS RECEIVER (466), AND PROCESSOR (462).	1-60
X	US 5,929,807 A (VINEY ET AL) 27 JULY 1999 (27/07/09), NOTE FIGURE 4, SATELLITE ANTENNA (160), ANTENNA PHASE CENTER (COLUMN 7, LINE 12), TILT METER (167), AND GPS RECEIVER (100).	1-60

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"B" earlier application or patent published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

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Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer THEODORE BLUM  Telephone No. (703) 305-1833

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/26779

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

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

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

2. Claim 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. Claim 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:

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.:
- Remark on Protest** The additional search fees were accompanied by the applicant's protest.
 No protest accompanied the payment of additional search fees.