

[54] **METHOD FOR DETERMINING THE POSITION OF SEISMIC STREAMERS IN A REFLECTION SEISMIC MEASURING SYSTEM**

[75] **Inventors:** Jan-Åge Langeland, Garnes; Stein ÅSheim; Bjorn Nordmoen, both of Oslo; Erik Vigen, Drammen, all of Norway

[73] **Assignee:** Geco A.S., Sandvika, Norway

[21] **Appl. No.:** 460,146

[22] **PCT Filed:** Jun. 6, 1989

[86] **PCT No.:** PCT/NO89/00055

§ 371 Date: Jan. 30, 1990

§ 102(e) Date: Jan. 30, 1990

[87] **PCT Pub. No.:** WO89/12236

PCT Pub. Date: Dec. 14, 1989

[30] **Foreign Application Priority Data**

Jun. 6, 1988 [NO] Norway ..... 882495

[51] **Int. Cl.<sup>5</sup>** ..... G01V 1/38

[52] **U.S. Cl.** ..... 367/19

[58] **Field of Search** ..... 367/6, 19, 129, 130

[56] **References Cited**

**U.S. PATENT DOCUMENTS**

4,532,637	7/1985	Baeckel et al.	367/19
4,660,185	4/1987	French	367/19
4,669,067	5/1987	Roberts	367/19
4,845,686	7/1989	Brac	367/19

**FOREIGN PATENT DOCUMENTS**

2393320	12/1978	France .
2620536	3/1989	France .
0831513	5/1984	Norway .

WO07732 12/1987 World Int. Prop. O. .

**OTHER PUBLICATIONS**

Sonerdyne Limited Publication, "A Hydro-Acoustic System for Precision Tracking of Twin Seismic Hydrophone Streamers," 7/87.

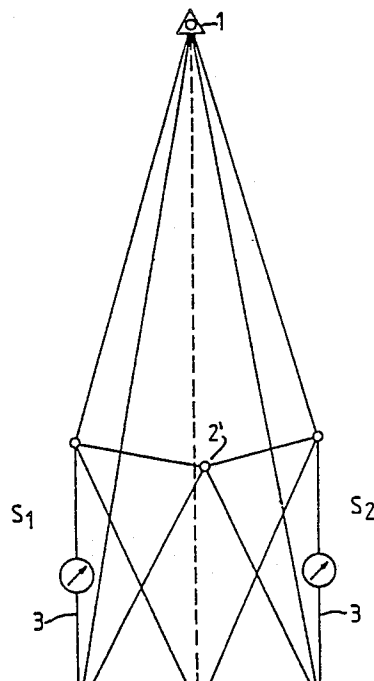
"Improving the Accuracy of Merile 3D Seismic Surveys," Ocean Industry, Jan. 1987.

*Primary Examiner*—Ian J. Lobo  
*Attorney, Agent, or Firm*—Fleit, Jacobson, Cohn, Price, Holman & Stern

[57] **ABSTRACT**

A method for determining the position of at least two seismic streamers (S<sub>1</sub>, S<sub>2</sub>) in a reflection seismic measuring system, wherein hydroacoustic distance measurements are used which are taken by means of acoustic transceivers provided in vessels (1), buoys (8), floats (5), seismic sources (2) and in the seismic streamers (S<sub>1</sub>, S<sub>2</sub>). Absolute reference positions are determined by position determining equipment provided in at least two locations, for instance, on a vessel (1) or a float (5). The acoustic transceivers and the position determining equipment form a three-dimensional structure. The position determination takes place by trilateration between the acoustic transceivers and the determination of at least two reference positions so that there is no dependency on compass bearings or optical visibility, and high redundancy is obtained. The method is particularly suited for application in connection with three-dimensional marine seismic surveys. The method may be integrated with suitable surface navigation systems in order to find the reference positions and provide absolute positions at any point within a marginal error of 5 to 10 m.

**18 Claims, 5 Drawing Sheets**



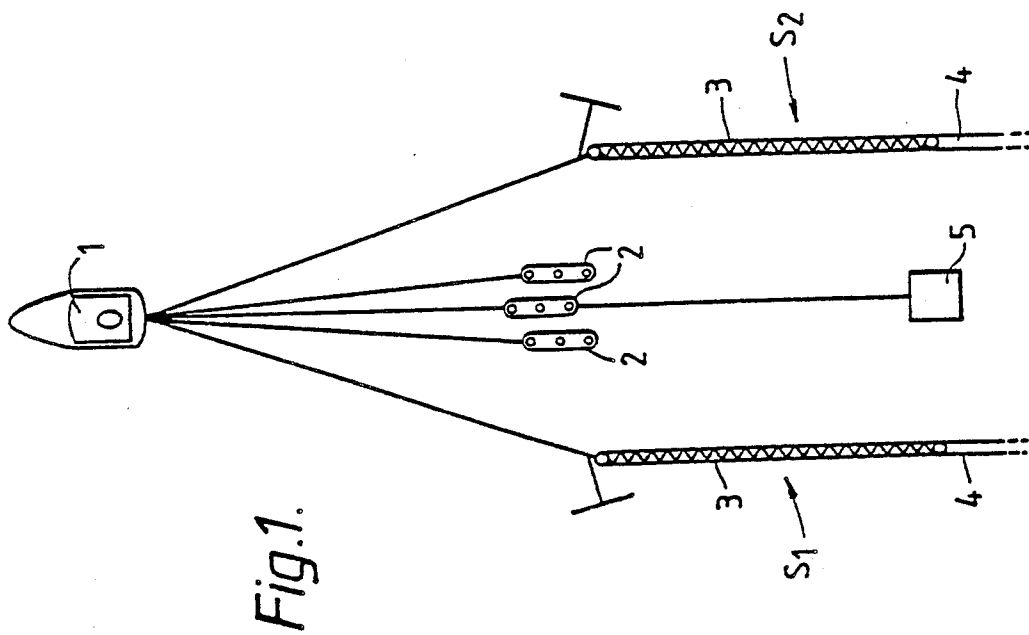


Fig. 1.

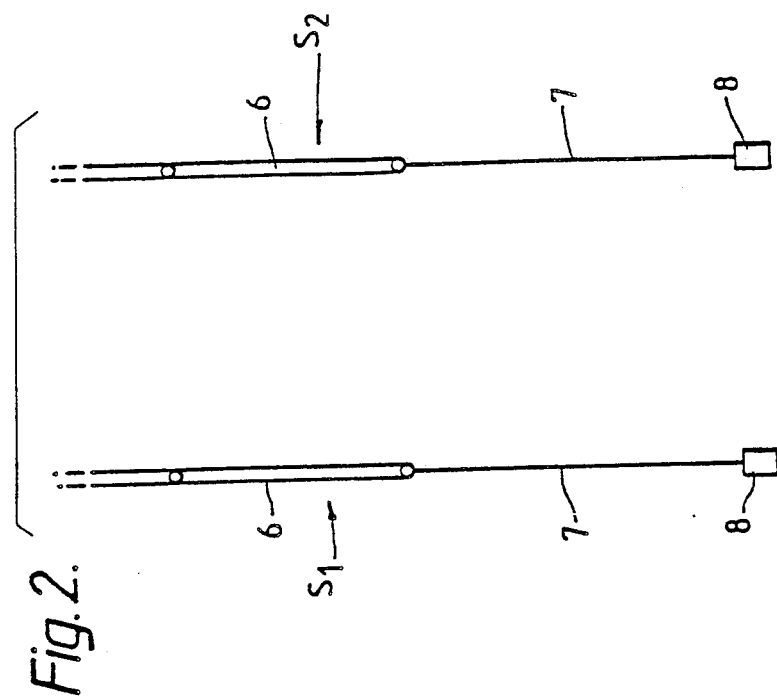
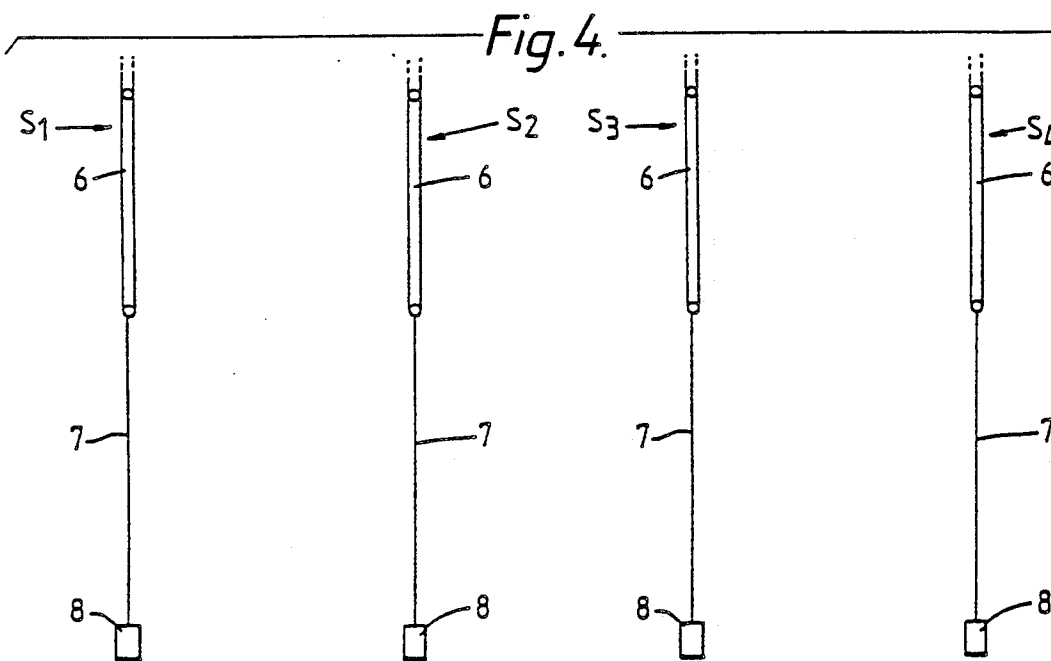
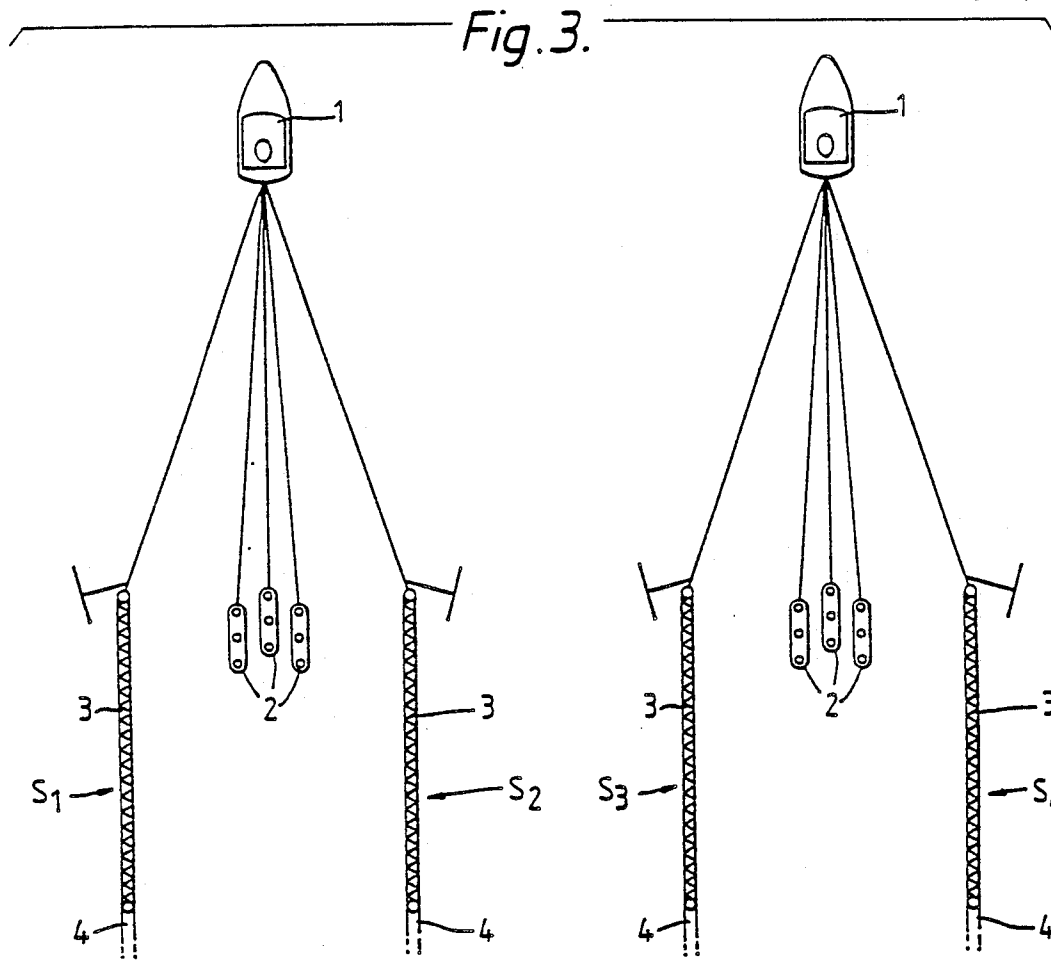


Fig. 2.



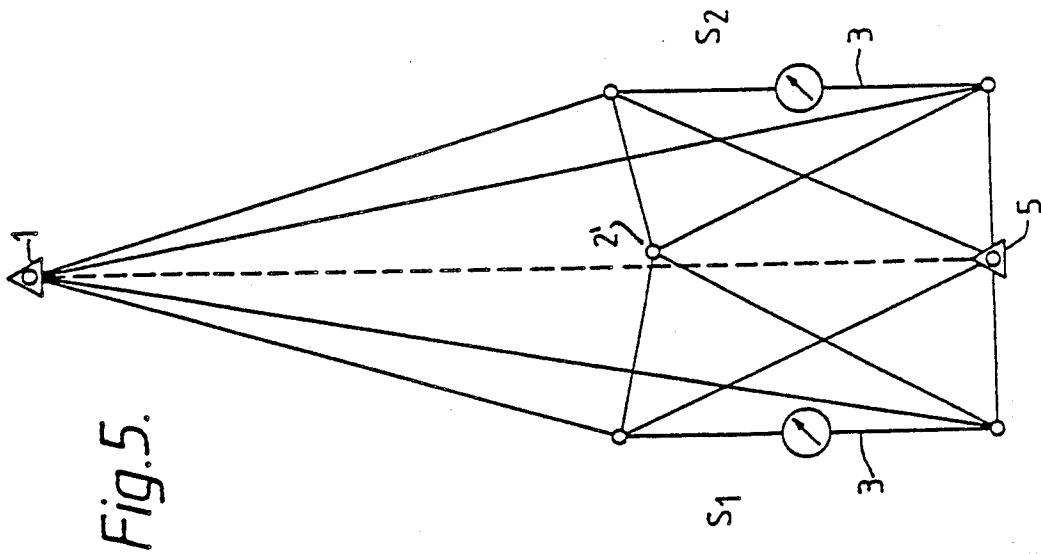


Fig. 5.

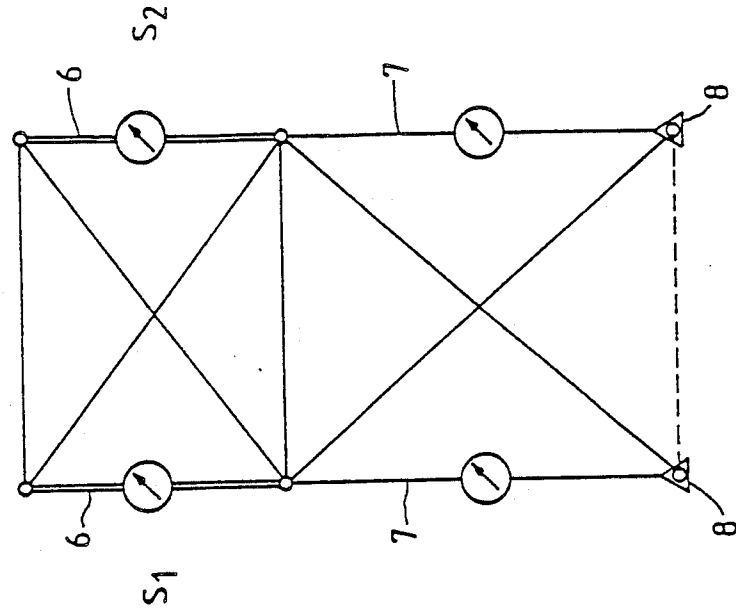


Fig. 6.

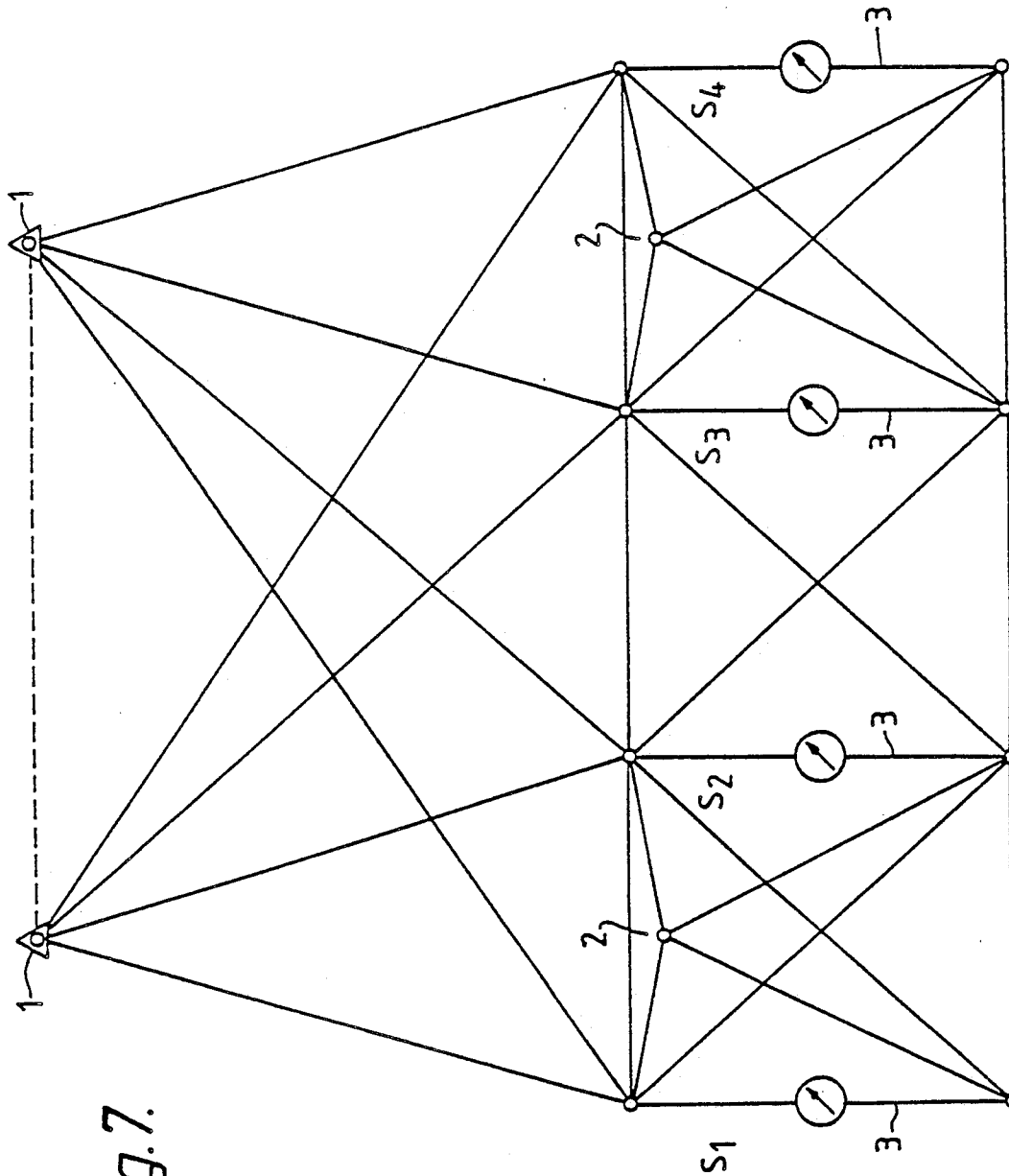


Fig. 7.

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.