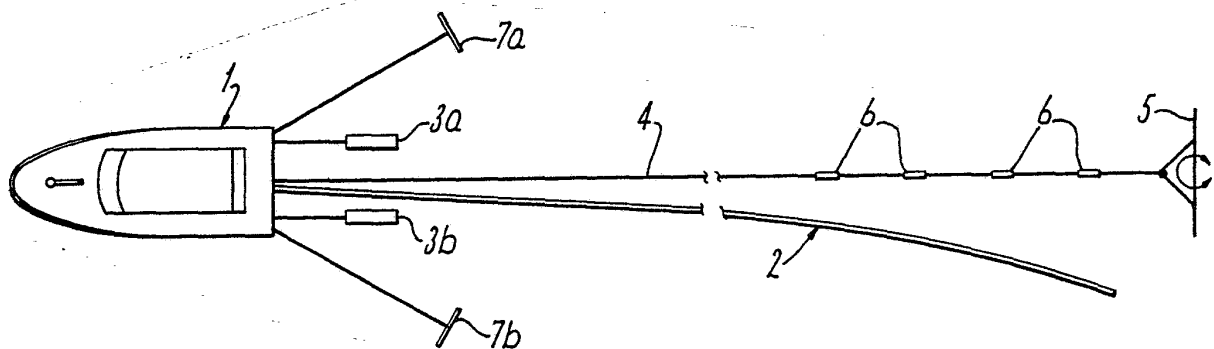


INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ³ : G01V 1/38	A1	(11) International Publication Number: WO 84/ 03153 (43) International Publication Date: 16 August 1984 (16.08.84)
<p>(21) International Application Number: PCT/NO84/00007</p> <p>(22) International Filing Date: 1 February 1984 (01.02.84)</p> <p>(31) Priority Application Number: 830358</p> <p>(32) Priority Date: 2 February 1983 (02.02.83)</p> <p>(33) Priority Country: NO</p> <p>(71) Applicant (for all designated States except US): A/S KONGSBERG VÅPENFABRIKK [NO/NO]; Kirkegaardsveien, N-3600 Kongsberg (NO).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only) : ULRICHSEN, Børre, B. [NO/NO]; Holmenkollveien 33B, N-Oslo 3 (NO).</p> <p>(74) Agent: ONSAGERS PATENTKONTOR AS; Camilla Colletts vei 4, N-Oslo 2 (NO).</p> <p>(81) Designated States: AU, BR, DE, DE (European patent), FR (European patent), GB, GB (European patent), JP, NL, NL (European patent), SU, US.</p>	<p>Published With international search report. In English translation (filed in Norwegian).</p>	

(54) Title: DEVICE IN A HYDROPHONE CABLE FOR MARINE SEISMIC SURVEYS



(57) Abstract

A device in a hydrophone cable which in connection with seismic surveys is towed through the water behind a vessel, the hydrophone cable comprising means for detecting echo signals which are reflected from the sea bed and various layers therebelow. For the purpose of improving the determination of the position of the hydrophone cable which can have a length of approx. 3000 meters, a transmission system is suggested, which comprises transmission elements arranged outside the hydrophone cable itself, the transmission elements serving to determine the position of the hydrophone cable in relation to the elements. In a simple embodiment of the device according to the invention the transmission elements are attached to or are constituted by a separate towing line (4) having a relatively small diameter, the towing line being equipped with stretching means (5) for achieving a relatively straight run. In an alternative embodiment the transmission elements can be implemented as reflectors (9a-9n) for preferably electromagnetic waves, for example in the form of light gas-filled balloons which can be attached to the hydrophone cable via thin, light lines, so that the balloons can be towed at surface position or fairly high above the water surface. The transmission elements can also be included in a conventional radio and navigation system, possibly together with the system used by the towing vessel for its positioning, in addition to determination of distance and bearing by means of the radar system of the vessel. The transmission elements can also be included as elements in an adaptive control system for combined control of vessel and hydrophone cable.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	KR	Republic of Korea
AU	Australia	LI	Liechtenstein
BE	Belgium	LK	Sri Lanka
BG	Bulgaria	LU	Luxembourg
BR	Brazil	MC	Monaco
CF	Central African Republic	MG	Madagascar
CG	Congo	MR	Mauritania
CH	Switzerland	MW	Malawi
CM	Cameroon	NL	Netherlands
DE	Germany, Federal Republic of	NO	Norway
DK	Denmark	RO	Romania
FI	Finland	SD	Sudan
FR	France	SE	Sweden
GA	Gabon	SN	Senegal
GB	United Kingdom	SU	Soviet Union
HU	Hungary	TD	Chad
JP	Japan	TG	Togo
KP	Democratic People's Republic of Korea	US	United States of America

Device in a hydrophone cable for marine seismic surveys

The present invention relates to a device in a hydrophone cable which is adapted for marine seismic surveys and is towed through the water behind a vessel, the cable comprising means for detecting echo signals from the sea bed and various layers therebelow.

Such hydrophone cables which are used in connection with seismic methods for mapping possible hydrocarbon sources below the sea bed, can be approx. 3000 meters long and be towed at a depth of approx. 10 meters. At a distance of approx. 100 meters behind the vessel there are also towed so-called air guns, the air guns firing shots according to an appropriate programme. The sound waves which are transmitted from the air guns, are reflected from the obstacles against which they may impinge below the water surface, as well as from the sea bed and various layers therebelow. The echo signals which return to the hydrophone cable, are detected by a series of hydrophones which are arranged along the cable, and which after a suitable conversion transfer the echo signals via the cable to an appropriate processing device on the towing vessel.

The seismic methods can be carried out by firing lines having a mutual distance of approx. 50 meters, and the intervals between the shots from the air guns correspond to a distance of approx. 25 meters, for thereby achieving a very fine net of squares.

Aside from comprising means for detecting echo signals from the water bottom and various layers therebelow, the hydrophone cable also comprises a plurality of compasses which indicate the form of the cable during the towing operation, and which thus constitute reference points for the line to which a sweep operation is to be referred. However, such compasses suffer from some disadvantages, the direction indication of the compasses being apt to give significant errors, since the hydrophone cable has a substantial extension.

BUREAU
OMPI

Besides, the compass section of the cable is often significantly larger in diameter than the cable itself, and will therefore in itself be prone to generate noise. Further, the compasses necessitate a substantial number of surplus connections in the cable, which in itself is unfavourable. Further, the calibrating routine for the compasses is very sophisticated, and it is not unusual that several days are used for effecting the calibration and making all of the compass sections operable. In case magnet compasses are used, these may easily be disturbed by the magnetic fields occurring during the measuring work itself.

In connection with such known magnet compass hydrophone cables no direct visual indication of the position of the cable exists other than an end buoy which is towed freely at an arbitrary position approx. 200-300 meters behind the terminal of the hydrophone cable.

Other and more reliable and stable direction references than magnet compasses have been evaluated, for example gyro compasses, but these have not been in commercial use, since it is expected that they will constitute a means which makes the hydrophone cable more expensive.

The object of the present invention is to arrive at a device in a hydrophone cable which with simpler and less expensive means can determine the position of the hydrophone cable, the detection of the hydrophone cable's position being of importance not only during the sailing of the measuring lines itself, but also during the turning programmes after a terminated line, in connection with which significant extra distances have to be sailed before a new line is entered for thereby ensuring that the cable has a shape as straight as possible.

The object is achieved according to the invention in a device which is characterized in that it comprises a transmission system which is adapted to determine the position of the hydrophone cable, and which comprises transmission elements provided outside the hydrophone cable itself.

BUREAU
OMPI

By using such a transmission system it is possible to achieve a less expensive and more direct measuring method, a fact which includes significantly reduced equipment expenses, especially compared to the type of compass sections used today. In a transmission system in which the transmission elements are provided outside the hydrophone cable itself, it is also possible to achieve a substantially greater operational safety. By means of the transmission system it is, aside from achieving better information about the position and shape of the hydrophone cable at any time, also possible to include the position signals in the manoeuvring operations of the vessel during the turning operation. Finally, the suggested transmission system can be made to co-operate with means serving to align the shape of the cable both during the line sweeping and the turning operations.

The transmission elements which are included in the proposed transmission system can either be stationarily anchored, or they may be provided on bodies floating more or less freely in the water. In the latter case the bodies carrying the transmission elements can then be connected to a continuous connection means facilitating the collection of the bodies after a measuring period.

Possibly, the transmission elements serving to transfer the position signals to or from the hydrophone cable can be provided on one or more bodies which are towed behind the vessel, the bodies being towed separately or in groups, and the bodies substantially being arranged along a straight line.

In an alternative embodiment the bodies carrying the transmission elements can be affixed to or be constituted by a separate towing line having a relatively small diameter, the towing line being provided with stretching means for achieving an approximately straight run.

The towing line with the transmission element carrying bodies can then extend at least along the overall length of the hydrophone cable.



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.