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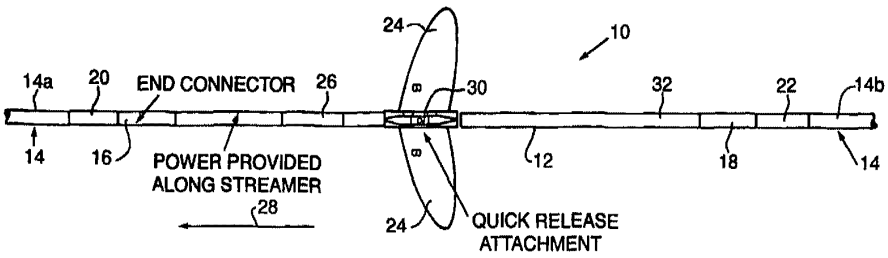

(57) Abstract

A control device (10) (or "bird") for controlling the position of a marine seismic streamer is provided with an elongate, partly flexible, body (12) which is designed to be connected electrically and mechanically in series with the streamer (14). In its preferred form, the bird has two opposed wings (24), which are independently controllable in order to control the streamers lateral position, as well as its depth.

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CONTROL DEVICES FOR CONTROLLING THE POSITION OF A MARINE SEISMIC STREAMER

This invention relates to control devices for controlling the position of a marine seismic streamer.

A marine seismic streamer is an elongate cable-like structure, typically up to several thousand metres long, which contains arrays of hydrophones and associated electronic equipment along its length, and which is used in marine seismic surveying. In order to perform a 3D marine seismic survey, a plurality of such streamers are towed at about 5 knots behind a seismic survey vessel, which also tows one or more seismic sources, typically air guns. Acoustic signals produced by the seismic sources are directed down through the water into the earth beneath, where they are reflected from the various strata. The reflected signals are received by the hydrophones, and then digitised and processed to build up a representation of the earth strata in the area being surveyed.

The streamers are typically towed at a constant depth of about ten metres, in order to facilitate the removal of undesired "ghost" reflections from the surface of the water. To keep the streamers at this constant depth, control devices known as "birds", attached to each streamer at intervals of 200 to 300 metres, are used.

Current designs of birds are battery-powered, and comprise a relatively heavy body which is suspended beneath the streamer, and which has a pair of laterally projecting wings (hence the name "bird"), one on each side. The combination of streamer and birds is arranged to be neutrally buoyant, and the angle of attack of both wings is adjusted in unison from time to time to control the depth of the streamer.

Birds in accordance with these current designs suffer from a number of disadvantages. Because they are battery-powered, the batteries can run out before the survey is completed, necessitating either retrieval of the streamer for battery replacement, or deployment of a work boat to replace the battery in the water. The former operation is very time consuming, while

the latter can be hazardous. Further, because the birds hang beneath the streamer, they produce considerable noise as they are towed through the water, which noise interferes with the reflected signals detected by the hydrophones in the streamers. The hanging of the birds from the streamers also means that the birds need to be detached each time the streamer is retrieved and re-attached each time it is re-deployed, which is again rather time consuming.

During the seismic survey, the streamers are intended to remain straight, parallel to each other and equally spaced. However, after deploying the streamers, it is typically necessary for the vessel to cruise in a straight line for at least three streamer lengths before the streamer distribution approximates to this ideal arrangement and the survey can begin. This increases the time taken to carry out the survey, and therefore increases the cost of the survey. But because of sea currents, the streamers frequently fail to accurately follow the path of the seismic survey vessel, sometimes deviating from this path by an angle, known as the feathering angle, of up to 10°. This can adversely affect the coverage of the survey, frequently requiring that certain parts of the survey be repeated. In really bad circumstances, the streamers can actually become entangled, which though rare, causes great damage and considerable financial loss. Current designs of birds can do nothing to alleviate any of these lateral streamer positioning problems.

It is therefore an object of the present invention to provide novel streamer control devices which alleviate at least some of the disadvantages of the current designs, and/or which possess more functionality than the current designs.

According to the present invention, there is provided a control device for controlling the position of a marine seismic streamer, the device comprising a body mechanically connected in series between two adjacent sections of the streamer, sensor means in the body for determining its angular position in a plane perpendicular to the longitudinal axis of the streamer, two opposed control surfaces projecting outwardly from the body, each control surface being rotatable about an axis which in use extends transversely of the streamer, and control means responsive to control signals and the sensor means for independently adjusting the respective angular positions of said two control surfaces so as to control the lateral position of the streamer as well as its depth.

In a preferred embodiment of the invention, for use with a multi-section streamer which includes an electric power line, the control means is at least partly electrical and arranged in use to receive electric power from said electric power line.

When the streamer also includes a control line, the control means is preferably arranged in use to receive control signals from the control line.

The control means preferably includes at least one electrical motor, and may also include means for sensing the respective angular positions of the two control surfaces.

Conveniently, said two control surfaces rotate about a common axis.

Advantageously, each of the two control surfaces comprises a respective wing-like member which is swept back with respect to the direction of tow of the streamer.

Preferably, said control surfaces are releasably secured to the body, which may be adapted to be non-rotatably coupled to the streamer.

The invention will now be described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 is a somewhat schematic representation of a preferred embodiment of a streamer control device in accordance with the present invention;

Figure 2 is a simple schematic of a control system forming part of the streamer control device of Figure 1; and

Figures 3 to 5 illustrate the operation of the streamer control device of Figure 1.

The streamer control device, or "bird", of Figure 1 is indicated generally at 10, and comprises an elongate streamlined body 12 adapted to be mechanically and electrically connected in series in a multi-section marine seismic streamer 14 of the kind which is towed by

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