

This invention relates to acoustic sensing apparatus for use in underwater applications.

In one type of device, known as a sonobuoy, for detecting acoustic vibrations underwater, an array of hydrophones for detecting incident acoustic energy is deployed beneath the surface of the water, being suspended from a float by a supporting cable to hold the array at a constant depth. Signal processing circuitry is associated with the array for producing signals representative of sensed acoustic vibrations. The float carries an antenna for transmitting the output of the hydrophone array, the supporting cable also acting as a signal transmission path between the antenna and the signal processing circuitry. The sonobuoy typically is operational for one to six hours, after which time the float is punctured in some manner and the device allowed to drop to the sea bed.

The present invention seeks to provide improved underwater acoustic sensing apparatus.

According to the invention there is provided underwater acoustic sensing apparatus comprising a float portion supporting an antenna for transmission and/or reception of signals, a hydrophone portion supporting a hydrophone arrangement and a line between the two portions providing a signal path between the arrangement and the antenna, the apparatus being such that, when deployed in water, the hydrophone portion moves downwardly during its reception period.

As it is not necessary to maintain the hydrophone portion at a fixed depth during its operational, reception period, the float portion need only have sufficient buoyancy to ensure that it reaches the surface for the antenna to transmit and/or receive signals. The float portion does not require a large enough buoyancy chamber to support the whole hydrophone portion and thus the apparatus may be made much more compact than a conventional device.

Furthermore, the line between the two portions is only necessary to provide a signal path for data transmission. It therefore does not need to be sufficiently strong to support a heavy hydrophone portion. Thus the line may be of much smaller diameter than that hitherto used and could, for example, be an optical transmission path such as an optical fibre. The volume occupied by the line may be much reduced compared to that required in a conventional device.

The hydrophone portion may move downwardly during its reception period because the apparatus as a whole has a negative buoyancy. However, preferably, the hydrophone portion has negative buoyancy and the line has insufficient tensile strength to support it. Thus, when the line is put under stress as the hydrophone portion moves downwardly, it breaks, allowing the hydrophone portion to continue towards the sea bed and transmission of the hydrophone arrangement output is terminated.

The apparatus may be a solely passive device but

also may be capable of generating acoustic vibrations, the returns of which from potential targets are then detected.

Although usually the antenna is only required for the transmission of signals, it may in some arrangements be used for the reception of an interrogating signal from a remote location, for example.

The invention may be particularly advantageously employed where the hydrophone arrangement includes at least two hydrophones contained within a housing disposed substantially orthogonally to the direction of movement during the reception period.

One way in which the invention may be performed is now described by way of example with reference to the accompanying drawings, in which:

Figure 1 schematically illustrates a sonobuoy in accordance with the invention prior to deployment;

Figure 2 shows the sonobuoy of Figure 1 in greater detail and partially in longitudinal section; Figure 3 is a schematic transverse section along the line III-III of Figure 2; and

Figure 4 illustrates the sonobuoy of Figure 1 when deployed.

With reference to Figure 1, a sonobuoy in accordance with the invention comprises two main portions, a float portion 1 and a hydrophone support structure 2, the sonobuoy being substantially cylindrical.

Referring to Figures 2 and 3, the float portion 1 includes a flotation chamber 3 within which is located an r.f. transmitter 4 and a battery 5 for powering the transmitter 4. The float portion 1 has an outer casing which includes a vaned flight stabilisation ring 6 to keep the sonobuoy substantially vertical when it is launched from an aircraft or ship prior to entry into water.

An aerial 7 is fixed to the upper surface of the float portion 1 at 8, as shown, and is connected to the transmitter 4. The aerial 7 is bent downwardly along the outer surface of the sonobuoy, being held in position at its lower end 9 by a nose cap 10 which extends across the bottom of the sonobuoy.

The hydrophone support structure 2 includes four arms 11, 12, 13 and 14, two of which 11 and 13 are shown in Figure 2. Each arm is an elongate structure having a pivot 15 and 16 at the end nearest the float portion 1 and, at its other end, a lug 17 and 18 engaging in a slot in the nose cap 10. Each arm 11, 12, 13 and 14 includes an array of hydrophones and associated electronics.

The arms 11, 12, 13 and 14 surround a water-tight casing 19 within which is located a cable pack 20 comprising a drum on which is wound a length of line 21. The line 21 is connected at one end to the battery 5 in the float portion 1 and at the other end to processing circuitry 22, which is arranged to receive the output of the hydrophones and associated circuitry and pro-

duce a signal output representative of received acoustic signals. The lower part of the casing 19 is occupied by four batteries 23, 24, 25 and 26. Two acoustic projectors 27a and 27b are positioned between the casing 19 and the nose cap 10 to provide sources of acoustic energy.

When it is wished to deploy the sonobuoy in the sea, it is ejected from an aircraft, say, at a height of 100 feet for example, and enters the water in a substantially upright orientation due to the flight stabilisation ring 6. On entering the water, the sonobuoy travels downwardly until a predetermined depth is reached, when a pressure sensitive release mechanism 28 is activated, causing the nose cap 10 to move downwardly on support rods 29. This frees the lugs 17 and 18 at the bottom of the arms 11, 12, 13 and 14 and the transducer arrays are deployed as the arms pivots about 15 and 16. As the arms move outwardly and upwardly, a latch mechanism securing the float portion 1 to the hydrophone support structure 2 at 30 and 31 is released and the two portions 1 and 2 separate. The aerial 7 is also released by the movement of the nose cap 10 relative to the remainder of the structure and the acoustic projectors 27a and 27b are deployed on the rods 29. As the float 1 moves upwardly and the hydrophone support structure 2 downwardly, the cable drum 20 unwinds so that the line 21 pays out freely, providing a data path between the processing circuitry 22 of the hydrophone support structure 2 and the aerial 7.

When the float 1 and the aerial 7 reach the surface of the sea, the hydrophone support structure 2 is still moving downwardly with its arms deployed to receive acoustic signal returns from objects insonified by the acoustic projectors 27a and 27b. The processed signals representative of received acoustic vibrations are transmitted via the aerial 7 as the hydrophone arrays move downwardly through the water.

When the line 21 reaches its greatest extent, after 5 minutes of operation, for example, it is put under tension by the weight of the hydrophone support structure 2. It is of insufficient tensile strength to support the hydrophone and projector portion and consequently, the line 21 breaks, and information transmission from the sonobuoy ceases. The hydrophone support structure 2 sinks to the bottom of the sea and the float structure 1 is left at the surface.

In an alternative embodiment of the invention, the sonobuoy is required to act solely as a passive, listening arrangement, in which case, the acoustic projectors are omitted.

Although the line 21 may be suitable for electrical signal transmission, it could alternatively be an optical fibre for carrying optical signals.

Furthermore, the invention may be used with different types of arrangements in which the hydrophone array, or arrays, is retained in the cylindrical structure

of the sonobuoy and not deployed on arms which open outwardly.

5 Claims

1. Underwater acoustic sensing apparatus comprising a float portion (1) supporting an antenna (7) for transmission and/or reception of signals, a hydrophone portion (2) supporting a hydrophone arrangement (11, 12, 13, 14), and a line (21) between the two portions (1, 2) providing a signal path between the arrangement and the antenna, the apparatus being such that, when deployed in water, the hydrophone portion (2) moves downwardly during its reception period.
2. Apparatus as claimed in claim 1 wherein the apparatus as a whole has negative buoyancy.
3. Apparatus as claimed in claim 1 wherein the hydrophone portion (2) has negative buoyancy and the line (21) has insufficient tensile strength to support it.
4. Apparatus as claimed in claim 1, 2 or 3 wherein the line is an optical transmission path (21).
5. Apparatus as claimed in any preceding claim wherein, prior to deployment, the line (21) is wound on a drum (20) carried by the hydrophone portion (2).
6. Apparatus as claimed in any preceding claim and including means (27a, 27b) for generating acoustic vibrations.
7. Apparatus as claimed in any preceding claim wherein the hydrophone arrangement includes at least two hydrophones contained within a housing (11, 12, 13, 14) which is deployed substantially orthogonally to the direction of movement of the hydrophone portion (2) during the reception period.
8. Apparatus as claimed in claim 7 and including a plurality of hydrophone arrays, each array being located within a housing (11, 12, 13, 14) which is deployed substantially orthogonal to the direction of movement of the hydrophone portion (2) during the reception period.

FIG. 1

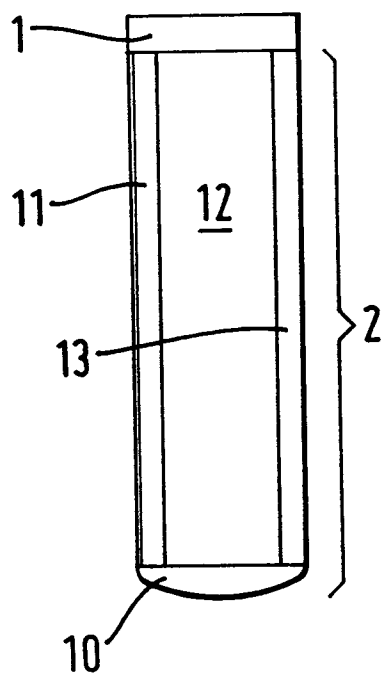


FIG. 3

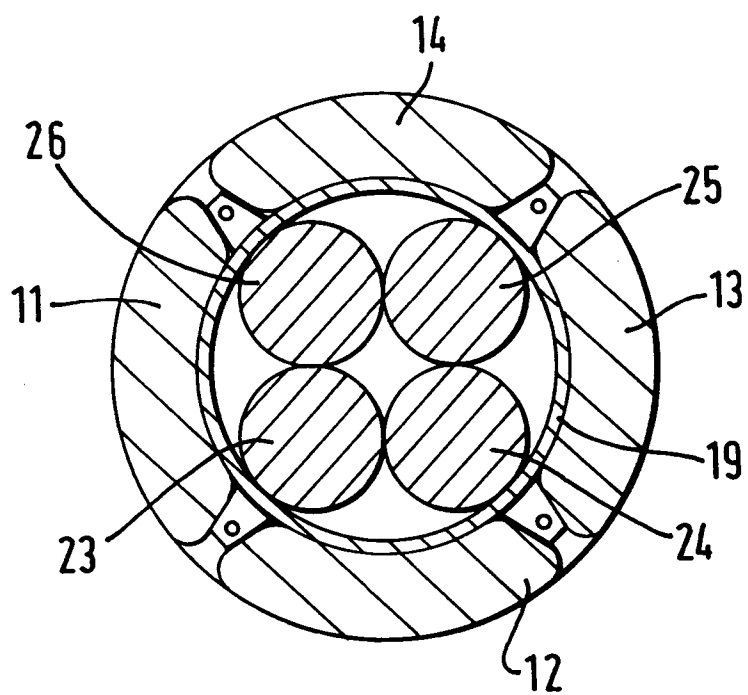
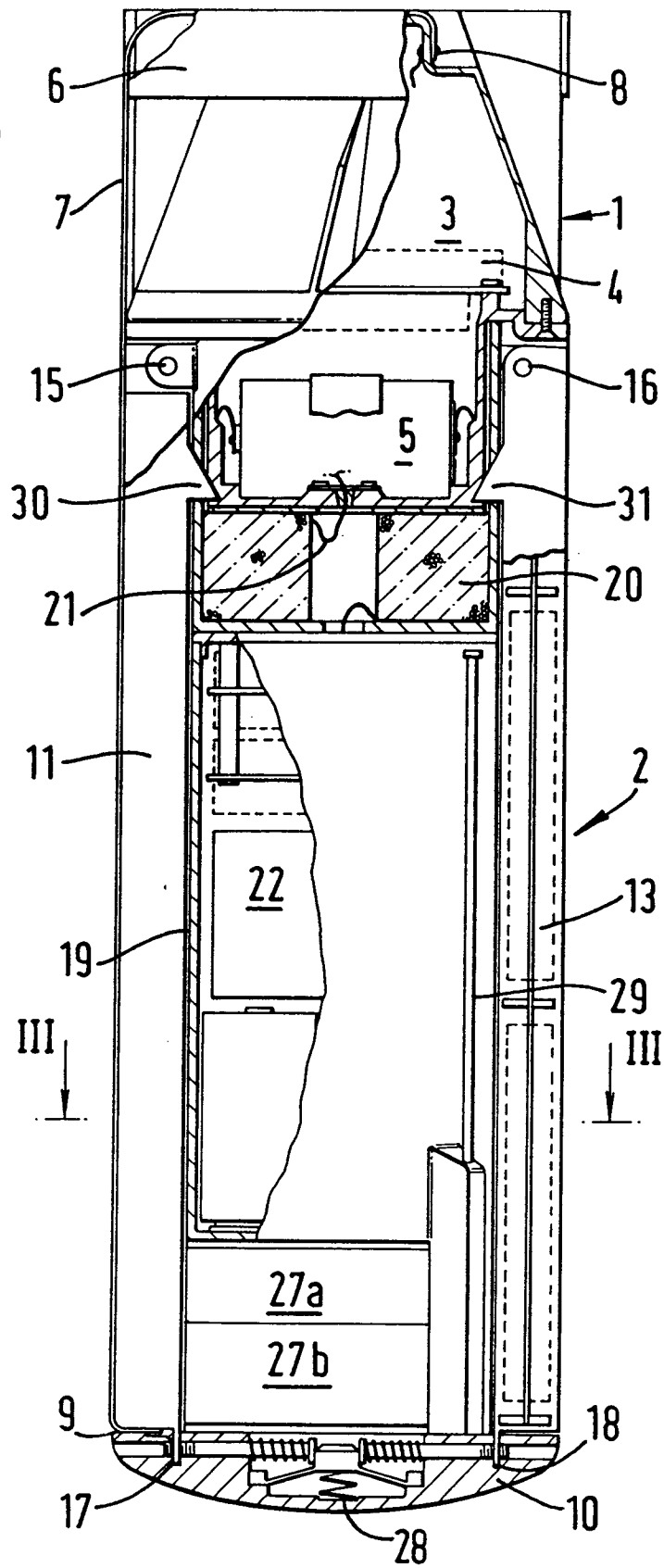
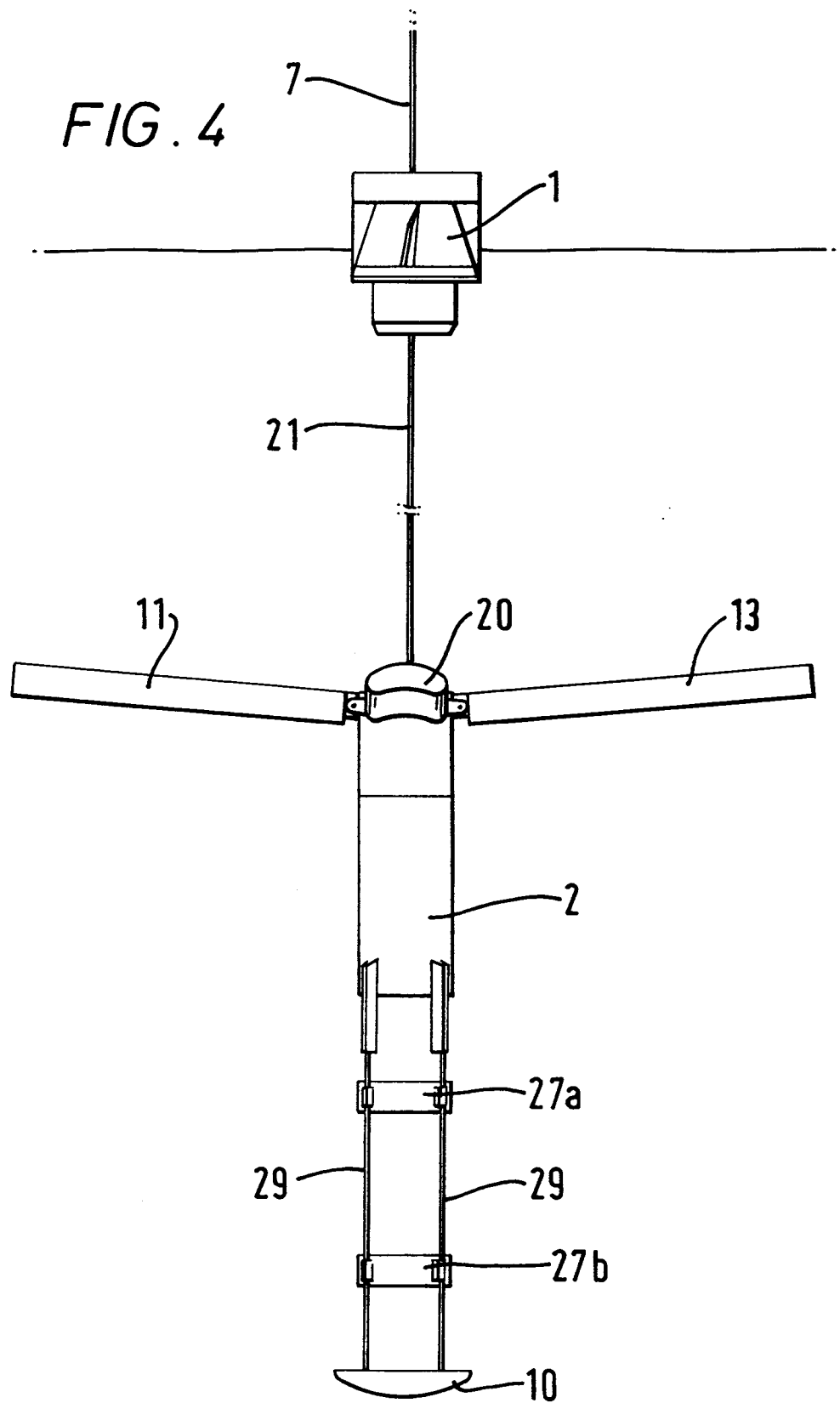


FIG. 2







European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 31 1335

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-3 936 895 (H. TALKINGTON) * claim 1; figures * ---	1, 2	B63B22/00
X	DE-A-2 051 675 (MOTOROLA INC.) * page 1 - page 2 * ---	1, 5	
A	EP-A-0 130 722 (SIPPICAN OCEAN SYSTEMS, INC.) * abstract; figure 4 * ---	1, 5	
A	US-A-3 290 642 (R. MASON) * column 4, line 30 - line 58; figures * ---	1, 7, 8	
A	FR-A-2 450 194 (COMPAGNIE INDUSTRIELLE DES TELECOMMUNICATIONS CIT-ALCATEL) * claims 1, 11; figures * -----	1, 7, 8	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B63B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 26 FEBRUARY 1992	Examiner STIERMAN E. J.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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