

SONAR ANTENNA MODULE WHOSE INTERNAL PRESSURE CAN BE
REGULATED FOR WATER SEALING

5

The invention relates to an antenna module for a sonar device which is installed on board a marine vessel, as claimed in the precharacterizing clause of claim 1.

10 An antenna module such as this, referred to as an antenna extension appliance, is located on mine hunting vessels, which are equipped with mine hunting sonars, underneath the marine vessel hull and, when not in use, can be completely retracted through an opening, which
15 is provided in the bottom of the hull, into a shaft that is formed inside the hull. For this purpose, the antenna mount is designed such that it can be moved vertically, and the antenna housing is held on the antenna mount such that it can be pivoted about a
20 horizontally aligned axis, such that the underwater antenna can be moved to a vertical alignment for retraction of the module. A further underwater antenna, which is likewise accommodated in a housing, a so-called vertical antenna, is also attached to the
25 antenna mount, can be pivoted in the vertical direction on the antenna mount, and its housing interior is likewise connected to the cavity in the antenna mount. Signal amplifiers connected to the transducer outputs, and further electronic components, are accommodated in
30 the hollow housing interior of the underwater antennas. Electrical signal lines which run in the interior of the antenna mount provide an electrical connection between the underwater antennas and the sonar cabinet installed in the marine vessel.

35

It has been found, in particular as a result of aging, that there is a risk of water ingress through seals between the antenna mount and the housing of the

- 2 -

underwater antennas. If the ingress of water is not identified as soon as it starts, the water which has entered leads to considerable damage to the electronic and electroacoustic components of the underwater antenna, which may even result in irreparable failure of the underwater antenna.

The invention is based on the object of countering the risk of water ingress in the case of an antenna module of the type described initially, by identifying leaks in the antenna module even before water enters, and by preventing water from entering until the leaks have been rectified.

According to the invention, the object is achieved by the features of claim 1.

The antenna module according to the invention has the advantage that, by producing a gas pressure in the module interior which is greater, including a safety margin, than the hydrostatic pressure at the operating depth of the antenna module, the gas, for example air, will emerge from the antenna module if any leaks occur, thus preventing the ingress of water. At the same time, the pressure in the module interior falls, and this can be identified by the pressure sensor. The pressure drop clearly indicates the leak in the antenna module, so that the latter can be removed from the water even before water has entered the module interior, causing damage.

Expedient embodiments of the antenna module according to the invention together with advantageous developments and refinements of the invention are specified in the further claims.

According to one advantageous embodiment of the invention, a compressed-gas reservoir is connected via

- 3 -

a metering valve to the antenna mount, and the metering valve can be controlled by means of the pressure sensor. The metering valve is controlled in such a way that, if the pressure in the module interior as measured by the pressure sensor falls below a preset value, the metering valve is opened, and pressurized gas flows out of the compressed-gas reservoir into the antenna mount. This has the advantage that, if major leaks which would lead to the pressure in the module interior falling below the hydrostatic pressure at the operating depth of the antenna module were to occur suddenly, compressed gas would be supplied to the module interior again, so that a minimum pressure to prevent the ingress of water into the antenna module can be maintained over a relatively long time period in the module interior. This extended time period, in which the ingress of water is prevented despite the leak, provides sufficient freedom to remove the antenna module from the water before water ingress.

20

The invention will be described in more detail in the following text with reference to one exemplary embodiment, which is illustrated in the drawing. In this case, the drawing shows an antenna module with an apparatus for protection against water ingress.

25

The antenna module, which is illustrated in perspective form in the drawing, for a sonar device which is installed on board a mine hunting vessel has an antenna mount 11, a horizontal antenna 12 and a vertical antenna 13, which are held on a mounting section 111 that is formed at the lower end of the antenna mount 11. In a known manner, each of the two antennas 12, 13 has a respective housing 14 or 15, in which a respective transducer arrangement 16 or 17 is accommodated, with a transmitting and/or receiving direction pointing away from the antenna mount 11. The transducer arrangements 16, 17 are in the form of a

30

35

- 4 -

line array and/or an area array. The internal areas of the housings 14, 15 are connected to the internal area of the hollow antenna mount 211. The internal areas of the housings 14, 15 contain signal amplifiers, which
5 are connected to the outputs of the transducers of the transducer arrangements 16, 17, and further electronic assemblies which are connected via signal lines to the components of the sonar device installed in the marine vessel. The signal lines are routed in the interior of
10 the hollow antenna mount 11.

In order to retract the antenna module into the marine vessel hull, and to extend it from the hull, through an opening which is provided in the marine vessel hull,
15 the antenna mount 11 has an extension section 112, which continues from the mounting section 111 towards the marine vessel and is guided in the marine vessel hull such that it can be moved axially. The housing 14 of the horizontal antenna 12 is held on the mounting
20 section 111 such that it can pivot about a horizontal axis, such that it can be rotated to a vertically aligned retraction position, before retraction of the antenna mount 11. The housing 15 of the vertical antenna 13 is held on the mounting section 111 via a
25 joint such that it can pivot vertically. In order to retract the antenna module, the vertical antenna 13 is likewise moved to a vertical alignment, such that the vertical antenna 13 and the horizontal antenna 12, which is pivoted in front of the vertical antenna 13,
30 are aligned approximately parallel, and lie within the outline of the extension section 112.

The antenna mount 11 and the housings 14, 15 are designed to be pressure-tight, and the connection
35 points of the housings 14, 15 to the antenna mount 11, through which the signal lines are also passed, are sealed by means of seals, such that water cannot enter the hollow interior of the antenna mount 11 and

- 5 -

housings 14, 15 of the horizontal and vertical antennas 12, 13 either via the housings 14, 15 or via the connection points.

5 In order to prevent water ingress at the connection points or other points on the antenna mount 11 and horizontal and vertical antennas 12, 13, as is possible for example as a result of aging of the seals at the connection points between the antenna mount 11 and the
10 horizontal and vertical antennas 12, 13, the antenna mount 11 is connected to a protective apparatus 20, which is illustrated in the form of a block diagram in the drawing. The protective apparatus 20 has a compressed-air reservoir 22, a compressed-air pump 23,
15 a pressure sensor 24, a metering valve 25 and control electronics 26. As illustrated in the exemplary embodiment, the metering valve 25 may be in the form of a 2/2-way solenoid valve with spring resetting, which is driven by the control electronics 26. The
20 compressed-air reservoir 22 is connected via the metering valve 25 to that end of the antenna mount 11 which is sealed such that it is pressure-tight. The pneumatic pressure input of the pressure sensor 24 is likewise connected to the end of the antenna mount 11,
25 and its electrical signal output is connected to the control electronics 26. The compressed-air reservoir 22 can be filled via a shut-off valve 21 by means of the compressed-air pump 23. The shut-off valve 21 which, for example, may be in the form of a 2/2-way solenoid
30 valve with spring resetting, is likewise controlled by the control electronics 26.

Furthermore, a warning indication 27 and a signaling unit 28 are connected to the control electronics 26.

35

The hollow interior of the antenna mount 11, the horizontal antenna 12 and the vertical antenna 13 are filled with compressed air from the compressed-air

reservoir 22 with the metering valve 25 open, until the pressure sensor 24 senses a pressure in the module interior which corresponds to a predetermined pressure threshold. The pressure threshold is greater than the water pressure at the operating depth of the antenna module. In order to prevent false alarms, temperature changes to be expected during operation of the antenna module are also taken into account when presetting the pressure threshold. For example, the temperature of the antenna module once it has been retracted into the shaft may be higher than the water temperature under the marine vessel hull. When the antenna module is extended from the shaft and is operated, it is then cooled down to the water temperature. If the pressure in the antenna module is set at the higher temperature in the shaft, then it falls once the antenna module has been extended. The pressure threshold must not be undershot during this process since, otherwise, a false alarm would be triggered. When defining the pressure threshold, it is therefore necessary to ensure an appropriate safety margin with respect to the water pressure at the operating depth, with this being taken into account. If the operating depth is about 4 m below the water surface, the predetermined pressure threshold should be above about 1.0 to 1.5 bar gauge, or 2.0 to 2.5 bar absolute pressure. If this pressure is exceeded in the interior of the antenna module, the compressed-air reservoir 22 is disconnected from the antenna mount 11 by switching the metering valve 25, and, once the compressed-air reservoir 22 has been replenished, the shut-off valve 21 is closed, so that the air pressure in the compressed-air reservoir 22 is maintained once the compressed-air pump 23 has been switched off.

During use of the antenna module, the air pressure in the interior of the antenna module is sensed continuously by means of the pressure sensor 24. As long as the antenna module remains sealed, the pressure

- 7 -

in the interior of the antenna module remains approximately constant. If minor leaks occur, then compressed air flows out via the leaks into the water, thus preventing water from entering at the leakage points. At the same time, the pressure in the module interior falls. If the pressure falls below a preset value, which is set in the control electronics 26 and is equal to or slightly less than the abovementioned pressure threshold, then the control electronics 26 switch on the warning indication 27, indicating the pressure drop in the antenna module. The crew can then remove the antenna module from the water and can rectify the leakage points. If the underwater module is removed immediately after the warning indication 27 is illuminated, then no water can enter the antenna module in the meantime, since, as before, the pressure in the internal area is greater than the water pressure.

However, if the pressure in the antenna module falls very much more quickly as a result of a major leak and, for example, falls below a lower, second pressure threshold as well, then the control electronics 26 generate a switching signal for the metering valve 25. The switching of the metering valve 25 results in air flowing out of the compressed-air reservoir 22 into the interior of the antenna mount 11, thus preventing the pressure in the antenna module from falling further, with the risk of water ingress associated with this. When the metering valve 25 is switched, the control electronics 26 switch on the signaling unit 28, which emits a visual and/or audible warning signal. This signals to the crew that it is very urgently necessary to remove the antenna module from the water in order to prevent water ingress.

35

A different gas may, of course, also be used instead of air.

PATENT CLAIMS

1. An antenna module for a sonar device which is installed on board a marine vessel, has a hollow antenna mount (11) designed for arrangement on the marine vessel hull and has at least one underwater antenna (12, 13) which has a housing (14, 15), held on the antenna mount (11), and a transducer arrangement (16, 17), which is accommodated in the housing (14, 15) and has a multiplicity of electroacoustic transducers, characterized in that the antenna mount (11) and the housing (14, 15) are designed to be pressure-tight with their internal areas being connected, in that the internal areas are subject to a gas pressure, preferably air pressure, which is greater than the hydrostatic pressure at the operating depth of the antenna module, and in that a pressure sensor (24) is provided and monitors the gas pressure.
2. The antenna module as claimed in claim 1, characterized in that a warning indication (27) is provided and can be activated if the pressure falls below a preset value.
3. The antenna module as claimed in claim 1 or 2, characterized in that the antenna mount (11) is connected via a metering valve (25) to a compressed-gas reservoir (22), and in that the metering valve (25) can be controlled as a function of the pressure sensed by the pressure sensor (24).
4. The antenna module as claimed in claim 3, characterized in that the metering valve (25) is controlled such that it opens if the pressure drop detected by the pressure sensor (24) is below a preset value.

- 9 -

5. The antenna module as claimed in claim 4, characterized in that a signaling unit (28) is provided and identifies the opening of the metering valve (25).

5 6. The antenna module as claimed in one of claims 3 to 5, characterized in that the control input of the metering valve (25), the warning indication (27) and the signaling unit (28) are connected to an electronic control apparatus (26), to which the electrical output
10 signal from the pressure sensor (24) is supplied.

7. The antenna module as claimed in one of claims 3 to 6, characterized in that the connection of the compressed-gas reservoir (22), which passes via the
15 metering valve (25), and the pneumatic connection of the pressure sensor (24) are provided at that end of the antenna mount (11) which is remote from the underwater antenna (12, 13) and is sealed to be pressure-tight.

20

8. The antenna module as claimed in one of claims 1 to 7, characterized in that the compressed gas is formed by compressed air.