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Portable Overwater-underwater Dual-purpose Search-and-rescue Position Indicating Beacon and Position Indicating Method

Technical Field

[0001] The present invention belongs to the technical field of lifesaving indicating devices, in particular to a portable search-and-rescue position indicating beacon, and more particularly to a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon and a position indicating method.

Background Art

[0002] In recent years, with the rapid growth of the global economy, the status of the maritime transportation is becoming more and more significant, especially the rapid development of the ship science and technology and the raise of marine economy, the world shipping market has achieved an unprecedented expansion and development. The rapid development of the world shipping industry has brought great economic benefits, but also made the maritime traffic become more and more complicated. Although now, most of the ships are equipped with advanced navigation apparatuses, but the maritime traffic accidents causing significant casualties like collision, grounding, stranding, sinking still occur frequently, the life is priceless, so the maritime search-and-rescue work has a very important role.

[0003] At present, the maritime position indication commonly uses the AIS portable emergency search-and-rescue position indicating beacon (AIS-MOB), which is a portable emergency position-indicating alarm apparatus that uses ship positioning technology AIS and can be installed on a life jacket or carry-on . The apparatus can be started manually or automatically started when falling into the water to send personal position and alarm information on an AIS channels or an assigned dedicated channels, and the information can be received and displayed by all AIS terminal apparatuses and base station apparatuses within a certain distance. Through installing AIS portable emergency search-and-rescue position indicating beacon on staffs worked in the cabin or visitors, once the ship in distress or man overboard, the rescue personnel can search and rescue the drowning personnel according to the emergency search-and-rescue position indicating beacon or the reported location when the ship is in distress, and the searching and rescuing efficiency can be improved.

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[0004] The AIS-MOB in the existing technology has a defect in use, i.e., it can only send a distress signal when the carrier is on the water surface or the land, and once diving, the AIS signal cannot be propagated in water, and thus, underwater position instruction cannot be achieved. Due to the maritime condition is relatively worse when ship is in distress, personnel cannot remain in the original position after falling into the water. As time passed by, under the function of both the wind and the oceanic flow, the falling personnel will flow away from the position recorded in previous distress, and therefore, according to the position information sent in distress, rescuers cannot be guided correctly to search for the personnel trapped under water and the victims, which hinders timely rescue.

[0005] In addition, the traditional AIS-MOB generally comprises components such as a battery, a start switch, a GPS positioner, a microcontroller, an AIS controller and modulator, a power amplifier, and an AIS transmitting antenna. The operating principles thereof are as follows: after the switch is started manually or automatically with water, the microcontroller receives position information sent by the GPS positioner, and the information is modulated and encoded by the AIS controller and the modulator, is amplified by the power amplifier, and then is sent out through the AIS transmitting antenna. In this process, the power amplifier is one of the main components consuming battery power. If after the AIS-MOB is fallen into the water and there is no receiving apparatus that can receive the AIS signal in a certain distance, the transmission of the AIS-MOB belongs to an invalid transmission, and the power of the AIS-MOB battery is wasted, which directly leads to a shorten time for rescuing drowning personnel in distress, and affects the rescue effect.

Summary of the Invention

[0006] The purpose of the present invention is to provide a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon and a position indicating method, for solving the problem that the existing search-and-rescue position indicating beacon cannot be indicate positions both overwater and underwater.

[0007] In order to achieve the abovementioned invention purpose, the search-and-rescue position indicating beacon provided by the present invention is achieved by adopting the following technical solution:

[0008] A portable overwater-underwater dual-purpose search-and-rescue position indicating beacon, comprising a positioning device, a microcontroller, an AIS transmitting device and an

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underwater acoustic transduction device, wherein:

[0009] the positioning device is connected with the microcontroller for acquiring current position information and sending the same to the microcontroller;

[0010] the microcontroller receives the position information sent by the positioning device and sends the position information to the AIS transmitting device;

[0011] the AIS transmitting device is connected with the microcontroller for receiving the position information sent by the microcontroller, and transmitting the position information to the outside in a set time interval; and

[0012] the underwater acoustic transduction device is used for sending an underwater-sound signal.

[0013] The search-and-rescue position indicating beacon, as described above, further comprises an overwater-underwater detection switch unit; the overwater-underwater detection switch unit has a first switch position for disabling the underwater acoustic transduction device during power-on operation of the positioning device, the microcontroller and the AIS transmitting device, and a second switch position for powering-off and shutting down the positioning device, the microcontroller and the AIS transmitting device during power-on operation of the underwater acoustic transduction device.

[0014] The search-and-rescue position indicating beacon, as described above, further comprises an AIS receiving device connected with the microcontroller for receiving an AIS signal sent by the peripheral AIS apparatus, processing the received AIS signal, and sending the processed data to the microcontroller; the microcontroller receives the data sent by the AIS receiving device, and judges whether the data are valid; if the data are valid, the AIS transmitting device transmits the position information to the outside at a first time interval; and if the data are invalid, the AIS transmitting device transmits the position information to the outside at a second time interval, which is greater than the first time interval, or if the data are invalid, the AIS transmitting device does not transmit the position information to the outside.

[0015] According to the search-and-rescue position indicating beacon as described above, the AIS receiving device comprises:

[0016] an AIS receiving antenna for receiving the AIS signal sent by a peripheral AIS apparatus; and

[0017] an AIS signal frequency detection circuit for amplifying and detecting whether the AIS

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signal contains a carrier frequency point to which the AIS signal belongs and sending detection result data to the microcontroller;

[0018] the microcontroller judges the detection result data sent by the AIS signal frequency detection circuit, and if yes, determines that the detection result data are valid; and if not, determines that the detection result data are invalid.

[0019] According to the search-and-rescue position indicating beacon as described above, the AIS receiving device comprises:

[0020] an AIS receiving antenna for receiving the AIS signal sent by a peripheral AIS apparatus; and

[0021] an AIS demodulation circuit for amplifying and demodulating the AIS signal and sending demodulated AIS signal data to the microcontroller;

[0022] the microcontroller judges whether the demodulated AIS signal data contains 9-bit standard MMSI number, and if so, determines that the AIS signal data are valid; and

[0023] if not, further judges whether the demodulated AIS signal data contains a standard IMO number, and if so, determines that the AIS signal data are valid; and if not, determines that the AIS signal data are invalid.

[0024] According to the search-and-rescue position indicating beacon as described above, the AIS transmitting device comprises:

[0025] an AIS modulation and amplification circuit, an input end of which is connected with the microcontroller for encoding, converting, modulating and amplifying the position information in sequence to convert a digital signal into a radio frequency signal; and

[0026] an AIS transmitting antenna, an input end of which is connected with an output end of the AIS modulation and amplification circuit for transmitting the radio frequency signal.

[0027] Preferably, the AIS transmitting antenna and the AIS receiving antenna are the same AIS antenna, which is switched by a multi-way switch to achieve different functions.

[0028] To achieve the foregoing invention purpose, the position indicating method provided by the present invention is achieved by adopting the following technical solution:

[0029] a position indicating method of a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon, comprising an overwater position indicating process

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and an underwater position indicating process, wherein the overwater position indicating process comprises:

[0030] a positioning device acquires current position information and sends the same to a microcontroller;

[0031] the microcontroller receives the position information sent by the positioning device and sends the position information to an AIS transmitting device; and

[0032] the AIS transmitting device receives the position information sent by the microcontroller and transmits the position information to the outside at a set time interval; and

[0033] the underwater position indicating process comprises:

[0034] an underwater acoustic transduction device sends an acoustic signal.

[0035] According to the position indicating method as described above, the method further comprises: a process of detecting and judging whether the search-and-rescue position indicating beacon is located over or under water with an overwater-underwater detection switch unit, when it is determined that the search-and-rescue position indicating beacon is located over water, powering on the positioning device, the microcontroller and the AIS transmitting device to start working and performing the overwater position indicating process, and powering off the underwater acoustic transduction device to stop working and closing the underwater position indicating process; when it is determined that the search-and-rescue position indicating beacon is located under water, powering off the positioning device, the microcontroller and the AIS transmitting device to stop working and closing the overwater position indicating process, and powering on the underwater acoustic transduction device to start working and performing the underwater position indicating process.

[0036] According to the position indicating method as described above, the overwater position indicating process further comprises:

using an AIS receiving device to receive an AIS signal sent by a peripheral AIS apparatus, process the received AIS signal and transmit the processed data to the microcontroller; and

[0038] receiving, by the microcontroller, the data transmitted by the AIS receiving device and judging whether the data are valid; if the data are valid, the AIS transmitting device transmits the position information to the outside at a first time interval; and if the data are invalid, the AIS transmitting device transmits the position information to the outside at a second time interval, which is greater than the first time interval, or if the data are invalid, the AIS transmitting device

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does not transmit the position information to the outside.

[0039] The position indicating method as described above, the using an AIS receiving device to receive an AIS signal transmitted by a peripheral AIS apparatus, process the received AIS signal, and transmit the processed data to a microcontroller specifically comprises:

[0040] receiving an AIS signal transmitted by the peripheral AIS apparatus through an AIS receiving antenna; and

[0041] amplifying and detecting whether the AIS signal contains a carrier frequency point to which the AIS signal belongs by an AIS signal frequency detection circuit, and sending the detection results to the microcontroller; and

[0042] the receiving, by the microcontroller, the data transmitted by the AIS receiving device and judging whether the data are valid specifically comprises:

[0043] judging, by the microcontroller, whether the detection result data transmitted by the AIS signal frequency detection circuit is valid, and if yes, determines that the detection result data are valid; if not, determines that the detection result data are invalid.

[0044] The position indicating method as described above, the using an AIS receiving device to receive an AIS signal transmitted by a peripheral AIS apparatus, process the received AIS signal, and transmit the processed data to a microcontroller specifically comprises:

[0045] receiving an AIS signal transmitted by the peripheral AIS apparatus through an AIS receiving antenna; and

[0046] amplifying and demodulating the AIS signal and sending the demodulated AIS signal data to the microcontroller by an AIS demodulation circuit; and

[0047] the receiving, by the microcontroller, the data transmitted by the AIS receiving device and judging whether the data are valid specifically comprises:

[0048] judging, by the microcontroller, whether the demodulated AIS signal data contains a 9-bit standard MMSI number, and if so, determining that the AIS signal data are valid; and

[0049] if not, further judging whether the demodulated AIS signal data contains a standard IMO number, and if so, determining that the AIS signal data are valid; and if not, determining that the AIS signal data are invalid.

[0050] Compared with the prior art, the present invention has the following the advantages and

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positive effects.

[0051] 1. In the present invention, a positioning device, a microcontroller, an AIS transmitting device and an underwater acoustic transduction device are provided in the search-and-rescue position indicating beacon; over the water, under control of the microcontroller, by using the AIS transmitting device to transmit position information acquired by the positioning device to achieve the transmission of the AIS distress signal, an accurate position can be timely provided for rescue personnel; while under the water, the underwater acoustic transduction device can be used to transmit an acoustic signal for accurately positioning the target position to provide an accurate position to the rescue personnel, so that the rescue personnel can conduct rapid rescue.

[0052] 2. In the present invention, an AIS receiving device is provided in a search-and-rescue position indicating beacon, when position indication is performed over water, whether an AIS signal is transmitted or is transmitted at high frequency is decided by judging whether a peripheral AIS signal is received, since the power consumption of the AIS receiving device is far lower than that of the AIS transmitting device, the power consumption of the search-and-rescue position indicating beacon caused by the fact that no AIS receiving device exists in the peripheral while the AIS signal is transmitted or is transmitted at the high frequency is avoided, the effective working time of the search-and-rescue position indicating beacon is prolonged, namely, the time for sending a distress signal to the outside is prolonged, thus the search-and-rescue time needed by rescue personnel is shortened, and the search-and-rescue effect is improved.

[0053] After the detailed description of the preferred embodiments of the present invention is read in conjunction with the drawings, other features and advantages of the present invention will become more apparent.

Brief Description of the Drawings

[0054] Fig. 1 is a functional block diagram of example 1 of the portable overwater-underwater dual-purpose search-and-rescue position indicating beacon of the present invention;

[0055] Fig. 2 is a functional block diagram of example 2 of the portable overwater-underwater dual-purpose search-and-rescue position indicating beacon of the present invention;

[0056] Fig. 3 is a functional block diagram of the first embodiment of example 2 of Fig. 2;

[0057] Fig. 4 is a functional block diagram of the second embodiment of example 2 of Fig. 2;

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[0057] Fig. 5 is a functional block diagram of the third embodiment of example 2 of Fig. 2;

[0059] Fig. 6 is a flow diagram of example 1 of the position indicating method of a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon of the present invention; and

[0059] Fig. 7 is a flow diagram of example 2 of the position indicating method of a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon of the present invention.

Detailed Description of the Invention

[0061] In order to enable the purpose, the technical scheme and the advantages of the present invention to be clearer, the present invention will be further described as follows with combination of the accompanying drawings and examples.

[0062] Fig.1 shows a functional block diagram of example 1 of the portable overwater-underwater dual-purpose search-and-rescue position indicating beacon of the present invention. As shown in Fig.1, the search-and-rescue position indicating beacon of example 1 comprises a positioning device 11, a microcontroller 12, an AIS transmitting device 13 and an underwater acoustic transduction device 14, wherein:

[0063] The positioning device 11 is connected with the microcontroller 12 for acquiring current position information and sending the same to the microcontroller 12. The positioning device 11 may be used with one or combination of a GPS positioning module, a GNSS (Global Navigation Satellite System) positioning module, a Beidou positioning module, as long as the functions of positioning and acquiring position information are achieved. The position information may comprise the information about the current latitude and longitude where the position indicating beacon is located and the current time.

[0064] The microcontroller 12 receives the position information sent by the positioning device 11 and sends the same to the AIS transmitting device 13.

[0065] The AIS transmitting device 13 is connected with the microcontroller 12 for receiving the position information sent by the microcontroller 12 and transmitting the same at a preset time interval. The AIS transmitting device 13 may be implemented by the existing techniques, and has a basic function of performing digital signal-to-radio frequency signal conversion on the position information according to the AIS standard requirements, and packaging the position information

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which is converted into radio frequency signals as standard AIS signals and then transmitting the same. Specifically, the structure may comprise: an AIS modulation and amplification circuit, an input end of which is connected with the microcontroller 12 for coding, converting, modulating, and amplifying the position information in sequence to convert a digital signal into a radio frequency signal conversion; and an AIS transmitting antenna, an input end of which is connected with the output end of the AIS modulation and amplification circuit for transmitting the radio frequency signals. In addition, the AIS transmitting device 13 may also transmit by means of software radio.

[0066] The underwater acoustic transduction device is used for sending acoustic signals. Acoustic wave is the only known fluctuation spreading for a long distance in water, is far better than electromagnetic waves (i.e. radio waves and optical waves) in this respect, and can accurately position a target within a radius range of 1,000 m and in the depth of 60 m under water. In particular, the underwater acoustic transduction device works based on the piezoelectric effect of crystals (quartz or potassium sodium tartrate) piezoelectric ceramics (such as barium titanate and lead zirconate titanate) or the magnetostrictive effect of iron-nickel alloys. The so-called piezoelectric effect refers to cutting a crystal into slices in a certain direction and applying a pressure to a crystal slice to generate positive charges and negative charges on two end surfaces thereof. On the contrary, when a tensile force is applied to the crystal slice, charges opposite to pressure application are generated on two end surfaces thereof. The electrostrictive effect opposite to the piezoelectric effect refers to applying an alternating voltage to two end surfaces of the crystal, so that the crystal produces a mechanical deformation correspondingly. The ultrasonic wave can be generated and received by means of the electrostrictive effect and piezoelectric effect.

[0067] A positioning device, a microcontroller, an AIS transmitting device, and an underwater acoustic transduction device are provided in a search-and-rescue position indicating beacon; over the water, under control of the microcontroller, the AIS transmitting device transmits position information acquired by the positioning device, to transmit the AIS distress signal which can provide a timely and accurate position for rescue personnel; while under the water, the underwater acoustic transduction device can transmit an acoustic signal for accurately positioning the target position to provide an accurate position to the rescue personnel, so that the rescue personnel can conduct rapid rescue.

[0068] The positioning device 11, the microcontroller 12, and the AIS transmitting device 13 for overwater position indication, and the underwater acoustic transduction device 14 for underwater position indication can be powered on and operate all the time after the search-and-rescue position indicating beacon is started. In order to reduce the power consumption, preferably, an

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overwater-underwater detection switch unit 15 is provided in the search-and-rescue position indicating beacon. The overwater-underwater detection switch unit 15 has a first switch position for disabling the underwater acoustic transduction device 14 during power-on operation of the positioning device 11, the microcontroller 12 and the AIS transmitting device 13, and a second switch position for powering-off and shutting down the positioning device 11, the microcontroller 12 and the AIS transmitting device 13 during power-on operation of the underwater acoustic transduction device 14. That is, when the overwater-underwater detection switch unit 15 is at the first switch position, it represents that the search-and-rescue position indicating beacon is over the water (comprising the water surface), and the positioning device 11, microcontroller 12 and AIS transmitting device 13 are powered on and operate, thus realizing overwater position indication; while the underwater acoustic transduction device 14 is powered off and stops operating to avoid power consumption. when the overwater-underwater detection switch unit 15 is at the second switch position, it represents that the search-and-rescue position indicating beacon is under water at the moment, and the underwater acoustic transduction device 14 is powered on and operates, thus realizing underwater position indication; while the positioning device 11, the microcontroller 12 and the AIS transmitting device 13 are powered off and stop operating to avoid power consumption.

[0069] Fig. 2 is a functional block diagram of example 2 of the portable overwater-underwater dual-purpose search-and-rescue position indicating beacon of the present invention. As shown in Fig. 2, the search-and-rescue position indicating beacon of the present example comprises an AIS receiving device 26 besides a positioning device 21, a microcontroller 22, an AIS transmitting device 23, an underwater acoustic transduction device 24 and an overwater-underwater detection switch unit 25.

[0070] The AIS receiving device 26 is connected with the microcontroller 22 for receiving an AIS signal sent by a peripheral AIS apparatus, processing the received AIS signal, and sending the processed data to the microcontroller. Moreover, the microcontroller 22 receives the data sent by the AIS receiving device 26 and judges whether the data are valid, in addition to receiving the position information sent by the positioning device 21 and sending the position information to the AIS transmitting device 23. When the data are valid, the AIS transmitting device 23 transmits the position information to the outside at a first time interval; and when the data are invalid, the AIS transmitting device 23 transmits the position information to the outside at a second time interval, which is greater than the first time interval; or when data are invalid, the AIS transmitting device 23 does not transmit the position information to the outside.

[0071] As an implementation, the first time interval can send 8 frames of AIS signal comprising

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position information every minute, and the second time interval can send one frame of AIS signal comprising position information every minute or send 8 frames of AIS signal comprising position information every ten minutes.

[0072] As another implementation, the first time interval can send 8 frames of AIS signal comprising position information every minute, and the second time interval can send the AIS signal comprising position information every thirty minutes at one time, the duration of sending is one minute, and 8 frames of AIS signal are included.

[0073] In a word, the first time interval refers to the interval time for normally sending an AIS signal to the outside, and the second time interval can refer to the longer interval time for sending an AIS signal to the outside so as to reduce power consumption. It should be appreciated by those skilled in the art that the time intervals in other setting modes are also within the scope of protection of the present invention patent, and the specific spaced time can be set according to specific needs. When data are invalid, position information may not be transmitted to the outside, and is transmitted to the outside at a first time interval until the data are valid.

[0074] In the example, an AIS receiving device is provided in a search-and-rescue position indicating beacon, when position indication is performed over the water, whether an AIS signal is transmitted or is transmitted at high frequency is decided by judging whether a peripheral AIS signal is received, since the power consumption of the AIS receiving device is far lower than that of the AIS transmitting device, the power consumption of the search-and-rescue position indicating beacon caused by the fact that no AIS receiving device exists in the peripheral while the AIS signal is transmitted or is transmitted at the high frequency is avoided, the effective working time of the search-and-rescue position indicating beacon is prolonged, namely the time for outwards sending a distress signal is prolonged, thus the search-and-rescue time needed by rescue personnel is shortened, and the search-and-rescue effect is improved.

[0075] The AIS receiving device, can be achieved by multiple modes, with reference to Fig. 3, Fig. 4 and Fig. 5 and descriptions of the figures below.

[0076] According to the functional block diagram of the first embodiment of example 2 of Fig. 2 shown in Fig. 3, the AIS receiving device 26 comprises:

[0077] an AIS receiving antenna 261 for receiving AIS signals sent by a peripheral AIS apparatus; and

[0078] an AIS signal frequency detection circuit 262 for amplifying and detecting whether the AIS signal includes a carrier frequency point to which the AIS signal belongs and sending detection

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result data to the microcontroller 22. The carrier frequency points can be frequency points of 161.975 MHz and 162.025 MHz or other reserved frequency points.

[0079] Specifically, the AIS signal frequency detection circuit 262 can be achieved by adopting a filtering circuit to filter the frequency bands to which the AIS signals belong (generally, the frequency bands to which the AIS signals belong are 156.025 MHz to 162.025 MHz) and then observing a spectrum through Fourier transformation, as long as detection whether the carrier frequency points to which the AIS signals belong exist or not can be achieved. On this basis, the microcontroller 22 judges the detection result data sent by the AIS signal frequency detection circuit 262, if Yes, it is determined that the detection result data are valid; if No, it is determined that the detection result data are invalid.

[0080] Whether the AIS apparatus exists around is judged by detecting the carrier frequency points to which the AIS signals belong, and whether ships or search-and-rescue powers carrying the AIS apparatuses appear or not is judged during application in a marine rescue occasion. Due to the fact that judgment is made only by detecting the carrier frequency points, it needs not to analyze and judge the received AIS signals, the operating work time of the microcontroller 22 can be effectively shortened, thus the energy consumption can be further reduced, and the effective working time of the search-and-rescue position indicating beacon can be prolonged.

[0081] According to the functional block diagram of the second embodiment of example 2 of Fig. 2 shown in Fig. 4, the AIS receiving device 26 comprises:

[0082] an AIS receiving antenna 263 for receiving the AIS signals sent by a peripheral AIS apparatus, and

[0083] an AIS demodulation circuit 264 for amplifying and demodulating the AIS signals and sending demodulated AIS signal data to the microcontroller 22.

[0084] On this basis, the microcontroller 22 judges whether the demodulated AIS signal data contains 9-bit standard MMSI number, if so, determines that the AIS signal data are valid; if not, further judges whether the demodulated AIS signal data includes standard IMO number, if yes, determines that the AIS signal data are valid; if not, determines that the AIS signal data are invalid, wherein the MMSI refers to Maritime Mobile Service Identity and is a list of 9-bit digital codes sent by a ship radio communication system through a radio channel thereof; the IMO refers to an identification code of International Maritime Organization, is a code of each ship name and is a unique code including 7-bit pure digits.

[0085] As other implementations, the AIS receiving device 26 further can receive the AIS signals

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sent by the peripheral AIS apparatus by means of software radio, and process the received AIS signals through software radio, and send the processed data to the microcontroller 22. On this basis, the microcontroller 22 also may judge whether the data are valid by using software.

[0086] It should be appreciated by those skilled in the art that the AIS signals sent by the peripheral AIS apparatus can be received in a plurality of ways and also can be processed in a plurality of ways, and whether the AIS signals are valid may be judged in a plurality of ways, as long as the functions can be realized. In a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon, one of the implementations may be selected, or a plurality of implementations may be integrated for users to choose one for use or to use simultaneously.

[0087] Fig. 5 shows a functional block diagram of the third embodiment of example 2 of Fig. 2. As shown in Fig. 5, the AIS transmitting antenna of the AIS transmitting device 23 and the AIS receiving antenna of the AIS receiving device 26 are the same AIS antenna 28, and are switched through a multi-way switch 27 to realize different functions. The specific working process is as follows: the microcontroller 22 may control the multi-way switch 27 to switch the AIS antenna 28 to a transmitting channel or a receiving channel. When the search-and-rescue position indicating beacon operates in a status of receiving the AIS signals, the multi-way switch 27 switches the AIS antenna 28 to the receiving channel (switching off the transmitting channel at the same time); and when the search-and-rescue position indicating beacon operates in a status of sending own position information thereof, the multi-way switch 27 switches the AIS antenna 28 to the transmitting channel (switching off the receiving channel at the same time). By means of such a setting method, the volume of the search-and-rescue position indicating beacon can be reduced, such that the portability of the search-and-rescue position indicating beacon can be better.

[0088] In the examples as shown in Fig. 2 and Fig. 5, specific functions of components shown in the figures but not mentioned in the foregoing descriptions may refer to the descriptions of the example shown in Fig. 1.

[0089] Fig. 6 shows a flow diagram of example 1 of the position indicating method of a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon of the present invention. The flow of this example is completed on the basis of the search-and-rescue position indicating beacon of the example shown in Fig. 1.

[0090] As shown in Fig. 6, the position indicating method of a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon of this example comprises the following steps:

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[0091] step 60: starting the search-and-rescue position indicating beacon to operate; judging whether it is overwater position indication; if so, executing an overwater position indicating process of step 61, or otherwise, indicating executing underwater position indication and executing an underwater position indicating process of step 65;

[0092] step 61: executing the overwater position indicating process;

[0093] step 62: acquiring, by a positioning device, current position information and sending the same to a microcontroller;

[0094] step 63: receiving, by the microcontroller, the position information sent by the positioning device and sending the same to an AIS transmitting device;

[0095] step 64: receiving, by the AIS transmitting device, the position information sent by the microcontroller and transmitting the same to the outside at a set time interval;

[0096] step 65: executing the underwater position indicating process; and

[0097] step 66: sending an acoustic signal by an underwater acoustic transduction device.

[0098] The judging in step 60 may be implemented in a plurality of ways. One way of implementation is as follows: detecting and judging whether the search-and-rescue position indicating beacon is located over or under water with an overwater-underwater detection switch unit, if it is determined that the search-and-rescue position indicating beacon is located over water, powering on the positioning device, the microcontroller and the AIS transmitting device to start working and performing the overwater position indicating process, and powering off the underwater acoustic transduction device to stop working and closing the underwater position indicating process; if it is determined that the search-and-rescue position indicating beacon is located under water, powering off the positioning device, the microcontroller and the AIS transmitting device to stop working and closing the overwater position indicating process, and powering on the underwater acoustic transduction device to start working and performing the underwater position indicating process.

[0099] Moreover, the overwater position indicating process and the underwater position indicating process may be performed alternately. For example, overwater position indication is executed before the overwater search-and-rescue position indicating beacon falls into water; underwater position indication is executed after the search-and-rescue position indicating beacon falls into water; the search-and-rescue position indicating beacon falling into water floats on the water again over time, and overwater position indication is executed again.

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[0100] Please refer to the description of the example of Fig. 1 for the more specific implementation process and the produced positive effect of the example.

[0101] Fig. 7 shows a flow diagram of example 2 of the position indicating method of a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon of the present invention. The flow of this example is completed on the basis of the search-and-rescue position indicating beacon structure of the example of Fig. 2.

[0102] As shown in Fig. 7, the position indicating method of a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon of this example comprises the following steps:

[0103] step 70: starting the search-and-rescue position indicating beacon to operate; judging whether it is overwater position indication; if so, executing an overwater position indicating process of step 71, or otherwise, indicating executing underwater position indication and executing an underwater position indicating process of step 76;

[0104] step 71: executing the overwater position indicating process;

[0105] step 72: acquiring, by a positioning device, current position information and sending the same to a microcontroller;

[0106] step 73: receiving, by the AIS receiving device, the AIS signals sent by the peripheral AIS apparatus, processing the received AIS signals, and sending the processed data the microcontroller;

[0107] step 74: receiving, by the microcontroller, the position information sent by the positioning device and data sent by the AIS receiving device, judging whether the data are valid, and meanwhile sending the position information to the AIS transmitting device;

[0108] step 75: receiving, by the AIS transmitting device, the position information sent by the microcontroller and transmitting position information according to a data judgment result of the microcontroller. Specifically, when the data are valid, the AIS transmitting device transmits the position information to the outside at a first time interval; and when the data are invalid, the AIS transmitting device transmits the position information to the outside at a second time interval, which is greater than the first time interval, or when the data are invalid, the AIS transmitting device does not transmit the position information to the outside;

[0109] step 76: executing the underwater position indicating process; and

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[0110] step 77: sending, by the underwater acoustic transduction device, an acoustic signal.

[0111] Please refer to the description of example of Fig. 2 for the more specific implementation process and the produced positive effect of this example.

[0112] The above examples are only used for describing the technical solution of the present invention, but do not limit the present invention. Although the present invention has been described in detail with reference to the above-mentioned examples, modifications on the technical solutions recited by the above-mentioned example can be still employed, or equivalent substitutions of the partial technical features thereof can be adopted for those skilled in the art; the modifications or substitutions enable the essence of the corresponding technical solutions not to depart from the spirit and scope of the technical solution set forth in the present invention.

CLAIMS

1. A portable overwater-underwater dual-purpose search-and-rescue position indicating beacon, comprising a positioning device, a microcontroller, an AIS transmitting device and an underwater acoustic transduction device, wherein:

the positioning device is connected with the microcontroller for acquiring current position information and sending the same to the microcontroller;

the microcontroller receives the position information sent by the positioning device and sends the position information to the AIS transmitting device;

the AIS transmitting device is connected with the microcontroller, receives the position information sent by the microcontroller and transmits the position information to the outside at a preset time interval;

and

the underwater acoustic transduction device is used for sending an acoustic signal.

2. The search-and-rescue position indicating beacon according to claim 1, wherein the search-and-rescue position indicating beacon further comprises an overwater-underwater detection switch unit, which has a first switch position for disabling the underwater acoustic transduction device during power-on operation of the positioning device, the microcontroller and the AIS transmitting device, and a second switch position for powering-off and shutting down the positioning device, the microcontroller and the AIS transmitting device during power-on operation of the underwater acoustic transduction device.

3. The search-and-rescue position indicating beacon according to claim 1, wherein the search-and-rescue position indicating beacon further comprises an AIS receiving device connected with the microcontroller for receiving an AIS signal sent by a peripheral AIS apparatus, processing the received AIS signal and then sending the processed data to the microcontroller; the microcontroller receives the data sent by the AIS receiving device and determines whether the data are valid; when the data are valid, the AIS transmitting device transmits the position information to the outside at a first time interval; when the data are invalid, the AIS transmitting device transmits the position information to the outside at a second time interval, which is greater than the first time interval, or when the data are invalid, the AIS transmitting device does not transmit the position information to the outside.

4. The search-and-rescue position indicating beacon according to claim 3, wherein the AIS receiving device comprises:

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an AIS receiving antenna for receiving the AIS signal sent by the peripheral AIS apparatus;

and

an AIS signal frequency detection circuit for amplifying and detecting whether the AIS signal contains a carrier frequency point to which the AIS signal belongs and sending the detection result data to the microcontroller;

the microcontroller judges the detection result data sent by the AIS signal frequency detection circuit, if yes, determining that the detection result data are valid; and if not, determining that the detection result data are invalid.

5. The search-and-rescue position indicating beacon according to claim 3, wherein the AIS receiving device comprises:

an AIS receiving antenna for receiving the AIS signal sent by the peripheral AIS apparatus;

and

an AIS demodulation circuit for amplifying and demodulating the AIS signal and sending the demodulated AIS signal data to the microcontroller;

the microcontroller judges whether the demodulated AIS signal data contains a 9-bit standard MMSI number, and if so, determines that the AIS signal data are valid; and if not, further judges whether the demodulated AIS signal data contains a standard IMO number, and if so, determines that the AIS signal data are valid; and if not, determines that the AIS signal data are invalid.

6. The search-and-rescue position indicating beacon according to claim 4 or 5, wherein the AIS transmitting device comprises:

an AIS modulation and amplification circuit, an input end of which is connected with the microcontroller for encoding, converting, modulating and amplifying the position information in sequence to convert a digital signal into a radio frequency signal;

and

an AIS transmitting antenna, an input end of which is connected with an output end of the AIS modulation and amplification circuit for transmitting the radio frequency signal.

7. The search-and-rescue position indicating beacon according to claim 6, wherein the AIS transmitting antenna and the AIS receiving antenna are the same AIS antenna which is switched

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by a multi-way switch to achieve different functions.

8. A position indicating method of a portable overwater-underwater dual-purpose search-and-rescue position indicating beacon, wherein the method comprises an overwater position indicating process and an underwater position indicating process; the overwater position indicating process comprises:

a positioning device obtains current position information and sends the same to a microcontroller;

the microcontroller receives the position information sent by the positioning device and sends the position information to an AIS transmitting device;

and

the AIS transmitting device receives the position information sent by the microcontroller and transmits the position information to the outside at a set time interval; and

the underwater position indicating process comprises:

an underwater acoustic transduction device transmits an acoustic signal.

9. The position indicating method according to claim 8, wherein the method further comprises a process of detecting and judging whether the search-and-rescue position indicating beacon is located over or under water with an overwater-underwater detection switch unit, if it is determined that the search-and-rescue position indicating beacon is located over water, powering on the positioning device, the microcontroller and the AIS transmitting device to start working and performing the overwater position indicating process, and powering off the underwater acoustic transduction device to stop working and closing the underwater position indicating process; if it is determined that the search-and-rescue position indicating beacon is located under water, powering off the positioning device, the microcontroller and the AIS transmitting device to stop working and closing the overwater position indicating process, and powering on the underwater acoustic transduction device to start working and performing the underwater position indicating process.

10. The position indicating method according to claim 8, wherein the overwater position indicating process further comprises:

using an AIS receiving device to receive an AIS signal sent by a peripheral AIS apparatus, process the received AIS signal, and transmit the processed data to the microcontroller;

and

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receiving, by the microcontroller, the data sent by the AIS receiving device and judging whether the data are valid; if the data are valid, the AIS transmitting device transmits the position information to the outside at a first time interval; if the data are invalid, the AIS transmitting device transmits the position information to the outside at a second time interval, which is greater than the first time interval; or if the data are invalid, the AIS transmitting device does not transmit the position information to the outside.

11. The position indicating method according to claim 10, wherein the using an AIS receiving device to receive an AIS signal sent by a peripheral AIS apparatus, process the received AIS signal, and transmit the processed data to the microcontroller specifically comprises:

receiving the AIS signal transmitted by the peripheral AIS apparatus through an AIS receiving antenna;

and

amplifying and detecting whether the AIS signal contains a carrier frequency point to which the AIS signal belongs by AIS signal frequency detection circuit, and sending the detection results to the microcontroller;

the receiving, by the microcontroller, the data transmitted by the AIS receiving device and judging whether the data are valid specifically comprises:

judging, by the microcontroller, the detection result data transmitted by the AIS signal frequency detection circuit, if yes, determining that the detection result data are valid; and if not, determining that the detection result data are invalid.

12. The position indicating method according to claim 10, wherein the using an AIS receiving device to receive an AIS signal sent by a peripheral AIS apparatus, process the received AIS signal, and transmit the processed data to the microcontroller specifically comprises:

receiving, through an AIS receiving antenna, the AIS signal transmitted by the peripheral AIS apparatus;

and

amplifying and demodulating the AIS signal by an AIS demodulation circuit, and transmitting the demodulated AIS signal data to the microcontroller;

the receiving, by the microcontroller, the data transmitted by the AIS receiving device and judging whether the data are valid specifically comprises:

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judging , by the microcontroller, whether the demodulated AIS signal data contains 9-bit standard MMSI number, if so, determining that the AIS signal data are valid;

and

if not, further judging whether the demodulated AIS signal data contains standard IMO number, if so, determining that the AIS signal data are valid; and if not, determining that the AIS signal data are invalid.