(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 105 115 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
21.12.2022 Bulletin 2022/51

(21) Application number: **21805338.7**

(22) Date of filing: **25.08.2021**

(51) International Patent Classification (IPC):
B63B 49/00 *(2006.01)* ***B63B 79/30*** *(2020.01)*
B63B 79/15 *(2020.01)* ***B63B 79/40*** *(2020.01)*

(86) International application number:
PCT/KR2021/011343

(87) International publication number:
WO 2022/234894 (10.11.2022 Gazette 2022/45)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **03.05.2021 KR 20210057230**

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(54) **SAFE RETURN TO HARBOR PROGRAM FOR HYBRID SHIP, AND CONTROL DEVICE HAVING PROGRAM INSTALLED THEREON**

(57) Provided is a safe return program and a control apparatus with the program installed. More particularly, provided is a safe return program for a hybrid boat and a control apparatus with the program installed, wherein the program computes in real time a distance to empty of a hybrid boat powered by a battery and a hydrogen fuel cell together and displays the distance to empty on an electronic map so that the navigator navigating the boat is able to return safely.

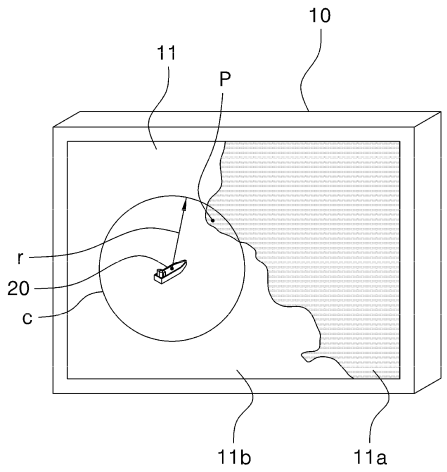

FIG. 1

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Description

Technical Field

[0001] The present disclosure relates to a safe return program and a control apparatus with the program installed. More particularly, the present disclosure relates to a safe return program for a hybrid boat and a control apparatus with the program installed, wherein the program computes in real time a distance to empty of a hybrid boat powered by a battery and a hydrogen fuel cell together and displays the distance to empty on an electronic map so that the navigator navigating the boat is able to return safely.

Background Art

[0002] Worldwide environmental regulations have been strengthened to reduce emission of greenhouse gases and air pollutants, and various measures have been enacted accordingly. In addition, there is a growing need for effective and reasonable energy-saving methods along with minimization of environmental pollution.

[0003] As the regulations on emission of greenhouse gases entered into force in the United Nations Framework Convention on Climate Change, the International Maritime Organization legislated regulations on factors in marine environment destruction caused by boats. Accordingly, the regulations will be strengthened aiming for a 30 % reduction of the greenhouse gas emission by 2025 compared to the current situation. In addition, in the International Convention for the Prevention of Pollution from Ships, Annex VI strengthens regulations on emission of nitrogen oxides and sulfur oxides, so the need for effective and reasonable energy-saving methods has gradually increased.

[0004] Boats have been developed focusing on a diesel electric propulsion system, but recently, there has been an effort to develop an eco-friendly hybrid boat using a battery or a hydrogen fuel cell as a power source.

[0005] In the meantime, a hybrid boat operates using a battery charged on the land and a hydrogen fuel cell together, but when the battery goes dead or the hydrogen runs out during the operation, the hybrid boat cannot return. Therefore, it is particularly important to check the remaining charge of the battery and the remaining hydrogen in real time.

[0006] Although the remaining charge of the battery and the remaining hydrogen are determined, it is difficult to accurately compute a distance to empty in real time.

Disclosure

Technical Problem

[0007] Accordingly, the present disclosure has been made keeping in mind the above problems occurring in the related art, and the present disclosure is directed to providing a safe return program that is capable of accurately computing a distance to empty of a hybrid boat in operation, wherein the hybrid boat uses a battery and a hydrogen fuel cell as a power source.

[0008] In addition, the present disclosure is directed to providing a safe return program that is capable of displaying a safe return distance so that the operator can intuitively recognize the safe return distance.

Technical Solution

[0009] In order to achieve the above-described objectives, the present disclosure provides a safe return program stored in a computer-readable recording medium and allowing a computer to function as the following means: an information input means configured to receive information on a remaining battery life from a battery of a boat, information on a remaining hydrogen from a hydrogen fuel cell of the boat, and information on a current speed from a speedometer of the boat; a distance-to-empty computation means configured to compute in real time a distance to empty that the boat is capable of returning in a current condition, from the information on the remaining battery life, the information on the remaining hydrogen, and the information on the current speed; and a distance-to-empty display means configured to display, on an electronic map output on a display of the boat, a current position of the boat and a circle of which a radius is the distance to empty, with the current position of the boat in a center of the circle.

[0010] In an exemplary embodiment, the safe return program may further allow the computer to function as the following means: a reference torque value storage means configured to store therein reference torque values according to a speed change of the boat; and a distance-to-empty correction means configured to receive the current speed and a current torque of the boat, and decrease the distance to empty when the current torque is higher than the reference torque value corresponding to the current speed or increase the distance to empty when the current torque is lower that the reference torque value corresponding to the current speed.

[0011] In an exemplary embodiment, the safe return program may further allow the computer to function as a weather information receiving means configured to receive weather information including a wave height, a wind direction, and a wind speed over a communication network, wherein the distance-to-empty correction means may be configured to decrease the distance to empty when the wave height received currently is higher than a reference wave height or increase the distance to empty when the wave height received currently is equal to or lower than the reference wave height; to increase the distance to empty when the wind direction received currently is toward a return position or decrease the distance to empty when the wind direction received currently is toward a direction opposite to the return position; and to adjust a degree of increase or decrease according to the

wind speed received currently when increasing or decreasing the distance to empty according to the wind direction received currently.

[0012] In addition, the present disclosure further provides a control apparatus having the safe return program installed thereon, wherein the control apparatus is installed in the boat and displays the distance to empty of the boat on the electronic map output on the display of the boat.

Advantageous Effects

[0013] The present disclosure has the following effects.

[0014] First, according to the safe return program of the present disclosure, a distance to empty of the boat is computed using the remaining battery life, the remaining hydrogen, and the current speed, and the distance to empty is displayed in a circle on the electronic map so that the operator can recognize the distance to empty intuitively and can return safely.

[0015] In addition, according to the safe return program of the present disclosure, the distance to empty is corrected according to the current torque value of the boat, so that the distance to empty is computed by accurately determining the speed as well as the actual power consumption.

[0016] In addition, according to the safe return program of the present disclosure, weather information, such as a wave height, a wind direction, and a wind speed, is used to correct the distance to empty more accurately.

Description of Drawings

[0017]

FIG. 1 is a diagram illustrating display of a distance to empty on a display by a safe return program according to an embodiment of the present disclosure.

FIG. 2 is a diagram illustrating a control apparatus on which a safe return program is installed, according to an embodiment of the present disclosure.

FIG. 3 is a diagram illustrating functions of a safe return program according to an embodiment of the present disclosure.

FIG. 4 is a diagram illustrating correction of a distance to empty depending on a current speed and a torque by a safe return program according to an embodiment of the present disclosure.

FIG. 5 is a diagram illustrating correction of a distance to empty depending on a wind direction by a safe return program according to an embodiment of the present disclosure.

Best Mode

[0018] As the terms used in the present disclosure, general terms that are widely used at present are selected, but terms that are arbitrarily selected by the applicant are used in particular cases. In this case, these terms should be interpreted as not the titles of the terms but the meaning described in the detailed description for implementing the disclosure or the meaning of the terms.

[0019] Hereinafter, a technical configuration of the present disclosure will be described in detail with reference to preferred embodiments illustrated in the accompanying drawings.

[0020] However, the present disclosure is not limited to the embodiment described herein and may be embodied in various forms. Throughout the whole specification, the same reference numerals designate the same elements.

[0021] FIG. 1 is a diagram illustrating display of a distance to empty on a display by a safe return program according to an embodiment of the present disclosure.

[0022] Referring to FIG. 1, the safe return program according to the embodiment of the present disclosure is a program for displaying a distance to empty on a display 10 provided in a boat so that the operator of the boat is able to recognize the distance to empty intuitively.

[0023] That is, the safe return program performs a function of assisting the boat in returning safely without drifting due to battery dead or running out of a hydrogen fuel during operation.

[0024] In addition, the distance to empty is displayed on an electronic map 11 output from the display 10, and is indicated by a circle c of which the radius denotes the distance to empty, with the current position of a boat 20 in the center of the circle.

[0025] That is, it is recognized at a glance whether the boat 20 navigating on the sea 11b is able of returning safely to a return position P on the land 11a.

[0026] In addition, the safe return program of the present disclosure is installed on the control apparatus, such as a computer, an embedded system, or a smart device, and performs the functions of the safe return program. The safe return program may be provided separately, or may be installed on the control apparatus and provided with the control apparatus.

[0027] In addition, when the safe return program is provided separately, the safe return program provided being stored in a recording medium. The recording medium may be specially designed and configured for the present disclosure, or may be known to those skilled in the field of computer software and usable by them.

[0028] For example, the recording medium may be a hardware device that is specially configured to store and perform program commands by a single one or a combination of the following: magnetic recording media, such as hard disks, floppy disks and magnetic tapes, optical recording media, such as CDs and DVDs, magneto-optical recording media for both magnetic and optical recording, ROM, RAM, flash memory, etc.

[0029] In addition, the safe return program may be a program composed of program commands, local data files, or local data structures, or a combination thereof.

Alternatively, the safe return program may be a program written in a mechanical language code formatted by a compiler as well as in a high level language code that may be implemented by a computer using an interpreter.

[0030] In addition, the safe return program may be stored in a server system capable of transmitting data over a communication network, and the control apparatus may access the server system and download and install the safe return program.

[0031] FIG. 2 is a diagram illustrating a control apparatus on which a safe return program is installed, according to an embodiment of the present disclosure.

[0032] Referring to FIG. 2, the safe return program 100 is installed on the control apparatus 200. The control apparatus 200 is connected to a battery 30, a hydrogen fuel cell 40, a speedometer 50, a motor 60, a weather center server 70, and a smart device 80 of a navigator. By receiving information from the battery 30, the hydrogen fuel cell 40, the speedometer 50, the motor 60, the weather center server 70, and the smart device 80, the control apparatus 200 computes a distance to empty and displays the distance to empty on the display 10 of the boat.

[0033] In addition, referring to FIG. 3, the safe return program 100 makes the control apparatus 200 function as an information input means 110, a distance-to-empty computation means 120, a distance-to-empty display means 130, a reference torque value storage means 140, a distance-to-empty correction means 150, and a weather information receiving means 160 to compute a distance to empty, and displays the distance to empty on the display 10.

[0034] The information input means 110 receives remaining battery life information from the battery 30, remaining hydrogen information from the hydrogen fuel cell 40, and current speed information from the speedometer 50.

[0035] From the remaining battery life information, the remaining hydrogen information, and the current speed information, the distance-to-empty computation means 120 computes in real time a distance to empty that the boat 20 is capable of returning in a current condition.

[0036] In addition, the distance to empty may be computed in various ways. A total power remaining now is computed using the remaining battery life information and the remaining hydrogen information, the time period for which the boat is operable is determined by computing the power consumed per hour at the current speed, and the speed multiplied by the time period is the distance to empty.

[0037] The distance-to-empty display means 130 displays the circle c of which the radius r is the distance to empty, with the position of the boat 20 in the center of the circle on the electronic map 11 output on the display 10, so that the operator of the boat recognizes the distance to empty at a glance.

[0038] That is, the operator recognizes that the boat is able to return safely when the return position P is inside the circle c. When the return position P is outside the circle c, the boat is unable to return safely, so the operator asks for help from outside or increases the distance to empty by reducing power consumption in order to return safely.

[0039] In the meantime, even when the boat is in operation at the same speed on the sea, torque values vary according to a change in an environment such as a wave height, a wind direction, or a wind speed. Therefore, the distance to empty needs to be corrected by applying the change in the torque value.

[0040] The reference torque value storage means 140 stores reference torque values therein that are average torque values according to a speed change as shown in FIG. 4.

[0041] The distance-to-empty correction means 150 receives a current speed and a current torque from the speedometer 60 and the motor 60, respectively. When the current torque t1 is higher than the reference torque value corresponding to the current speed s1, the distance-to-empty correction means 150 decreases the distance to empty. When the current torque t2 is lower than the reference torque value corresponding to the current speed s2, the distance-to-empty correction means 150 increases the distance to empty.

[0042] That is, when the wave is high or the wind blows in the direction opposite to the return position P and the torque value increases at the same speed, power consumption increases and thus the distance to empty is decreased. When the wave is low or the wind blows in the direction of the return position P and the torque value decreases at the same speed, the power consumption decreases and thus the distance to empty is increased.

[0043] In the meantime, the current torque value of the boat is affected by weather conditions as well as various states of the boat. Therefore, in the present disclosure, the distance to empty is corrected using weather information additionally to compute a distance to empty precisely.

[0044] The weather information receiving means 160 is connected to the weather center server 70 or the smart device 80 of the operator over the communication network. The weather information receiving means 160 receives weather information directly from the weather center server 70 or receives weather information indirectly through the smart device 80.

[0045] In addition, the weather information includes a wave height, a wind direction, and a wind speed.

[0046] In addition, the distance-to-empty correction means 150 decreases the distance to empty when the current wave height is higher than a reference wave height. The distance-to-empty correction means 150 increases the distance to empty when the current wave height is equal to or lower than the reference wave height.

[0047] In addition, referring to FIG. 5, when the current wind direction w1 is toward the return position P, the distance-to-empty correction means 150 increases the distance to empty to change the size from the previously displayed circle r to the diameter-increased circle r1.

When the current wind direction w2 is toward the direction opposite to the return position P, the distance-to-empty correction means 150 decreases the distance to empty to change the size from the previously displayed circle r to the diameter-decreased circle r2.

[0048] In addition, the distance-to-empty correction means 150 may adjust the degree to which the circle r increases or decreases, according to the current wind speed.

[0049] Accordingly, the operator is able to intuitively recognize the distance to empty varying according to weather conditions, and to return safely.

[0050] As described above, while the present disclosure has been illustrated and described in conjunction with the preferred embodiment, the present disclosure is not limited to the aforementioned embodiment. The embodiment can be changed and modified in various forms by those skilled in the art without departing from the spirit of the disclosure.

Claims

1. A safe return program stored in a computer-readable recording medium and allowing a computer to function as the following means:

   an information input means configured to receive information on a remaining battery life from a battery of a boat, information on a remaining hydrogen from a hydrogen fuel cell of the boat, and information on a current speed from a speedometer of the boat;
   a distance-to-empty computation means configured to compute in real time a distance to empty that the boat is capable of returning in a current condition, from the information on the remaining battery life, the information on the remaining hydrogen, and the information on the current speed; and
   a distance-to-empty display means configured to display, on an electronic map output on a display of the boat, a current position of the boat and a circle of which a radius is the distance to empty, with the current position of the boat in a center of the circle.

2. The safe return program of claim 1, wherein the safe return program further allows the computer to function as the following means:

   a reference torque value storage means configured to store therein reference torque values according to a speed change of the boat; and
   a distance-to-empty correction means configured to receive the current speed and a current torque of the boat, and decrease the distance to empty when the current torque is higher than the reference torque value corresponding to the current speed or increase the distance to empty when the current torque is lower that the reference torque value corresponding to the current speed.

3. The safe return program of claim 2, wherein the safe return program further allows the computer to function as a weather information receiving means configured to receive weather information including a wave height, a wind direction, and a wind speed over a communication network,
   wherein the distance-to-empty correction means is configured to decrease the distance to empty when the wave height received currently is higher than a reference wave height or increase the distance to empty when the wave height received currently is equal to or lower than the reference wave height; to increase the distance to empty when the wind direction received currently is toward a return position or decrease the distance to empty when the wind direction received currently is toward a direction opposite to the return position; and to adjust a degree of increase or decrease according to the wind speed received currently when increasing or decreasing the distance to empty according to the wind direction received currently.

4. A control apparatus having the safe return program of any one of claims 1 to 3 installed thereon, wherein the control apparatus is installed in the boat and displays the distance to empty of the boat on the electronic map output on the display of the boat.

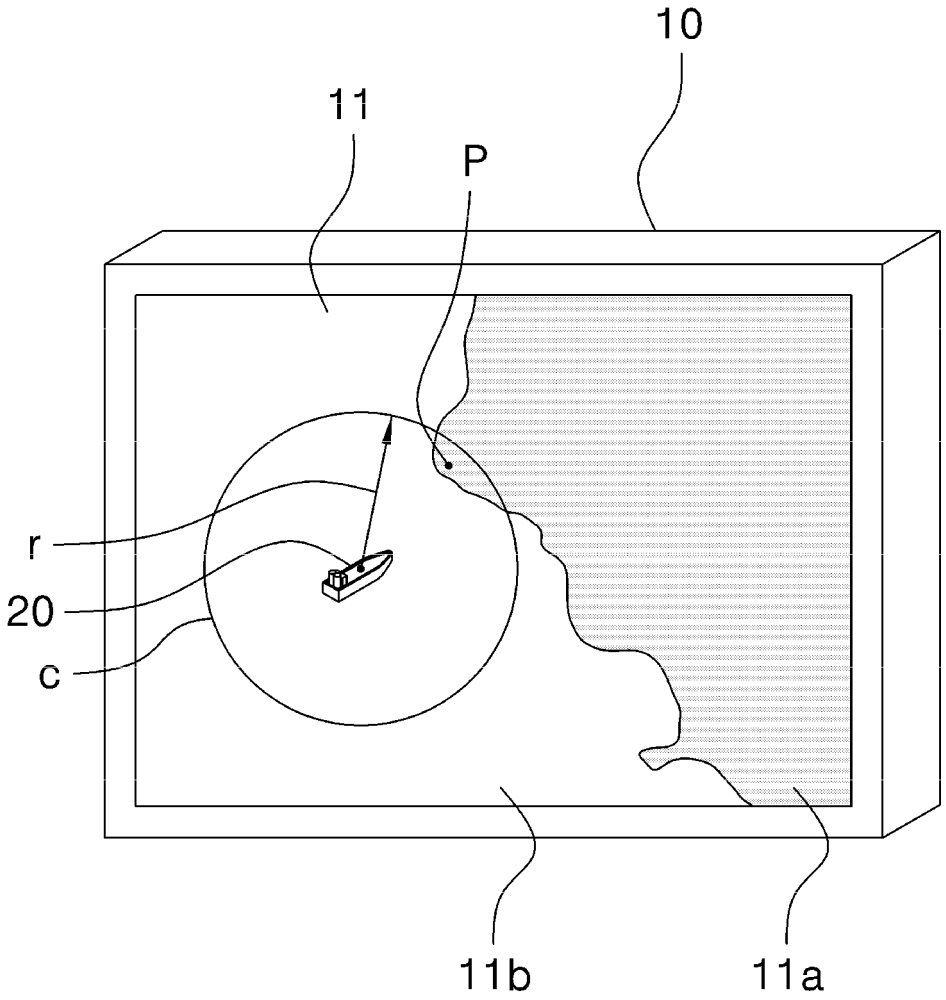

FIG. 1

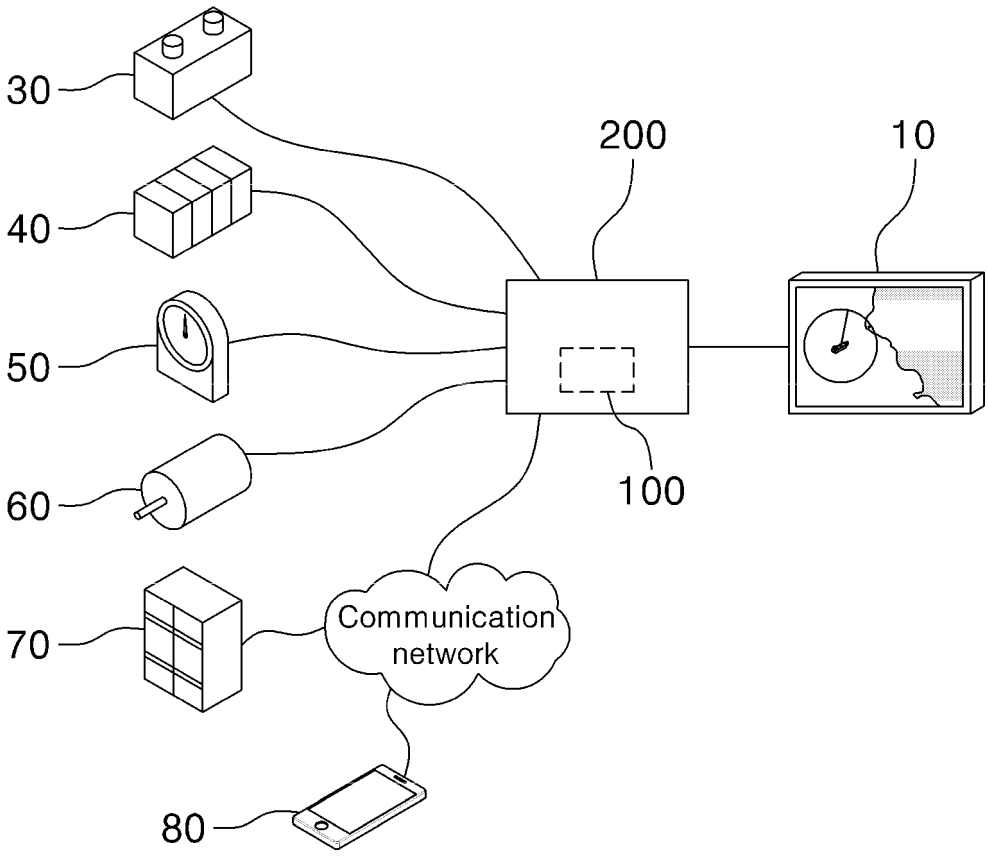

FIG. 2

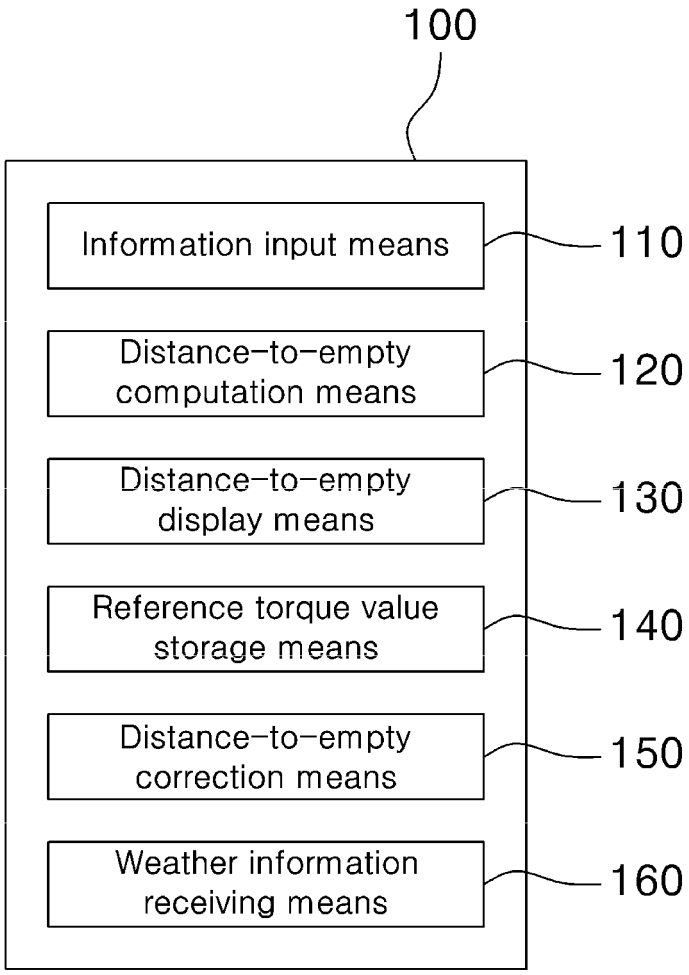
100
Information input means
110
Distance-to-empty computation means
120
Distance-to-empty display means
130
Reference torque value storage means
140
Distance-to-empty correction means
150
Weather information receiving means
160

FIG. 3

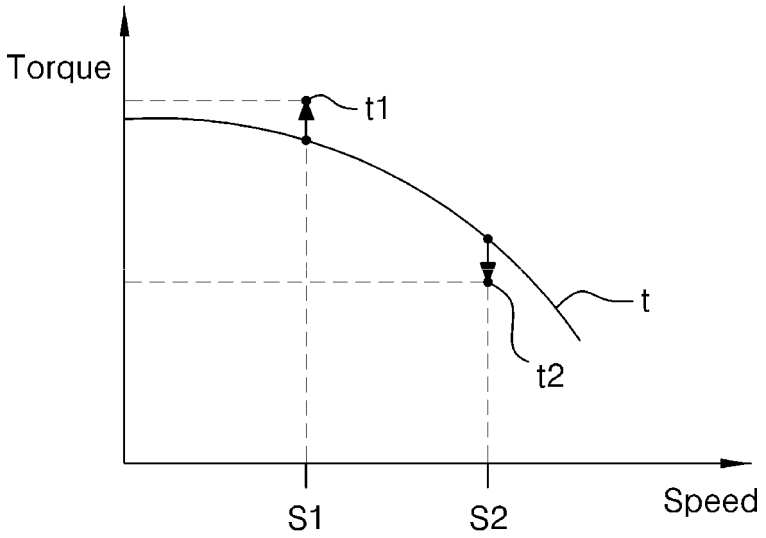

FIG. 4

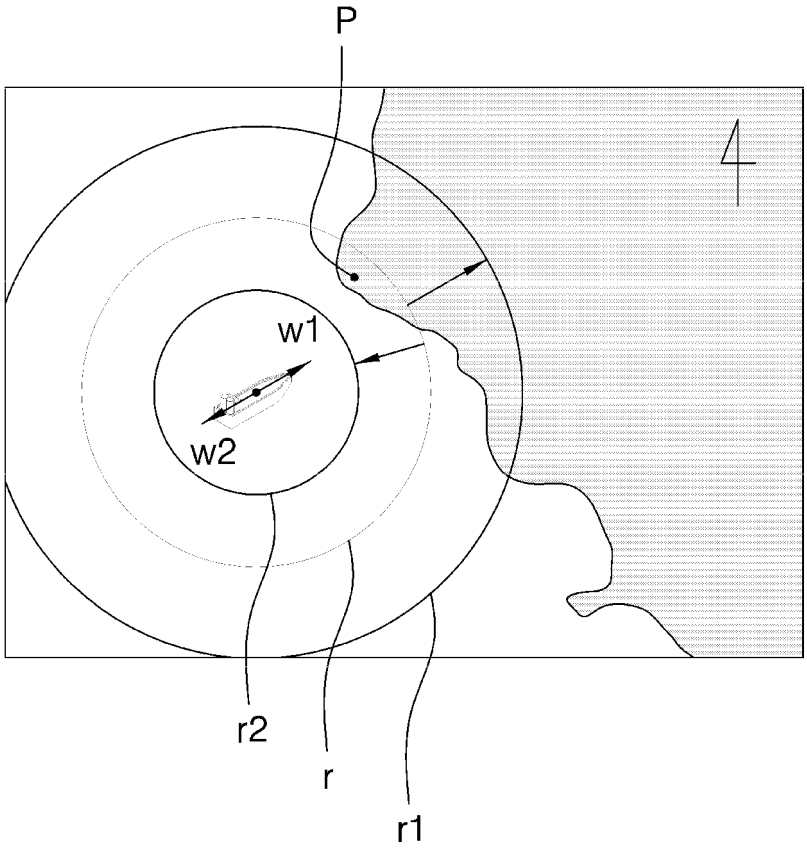

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2021/011343

A. CLASSIFICATION OF SUBJECT MATTER

B63B 49/00(2006.01)i; **B63B 79/30**(2020.01)i; **B63B 79/15**(2020.01)i; **B63B 79/40**(2020.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B63B 49/00(2006.01); B63H 20/00(2006.01); B63H 21/00(2006.01); B63H 21/17(2006.01); B63H 21/21(2006.01); G01C 21/20(2006.01); G06T 11/20(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: 하이브리드(hybrid), 선박(ship), 배터리(battery), 제어(control), 표시(display)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2020-0056089 A (SAMSUNG HEAVY IND. CO., LTD.) 22 May 2020 (2020-05-22) See paragraphs [0025], [0067]-[0069], [0074]-[0079], [0091] and [0093].	1-4
Y	KR 10-2016-0122547 A (GEMET CO., LTD.) 24 October 2016 (2016-10-24) See paragraphs [0037]-[0044].	1-4
A	JP 2015-085924 A (ONODERA TEKKOSHO KK) 07 May 2015 (2015-05-07) See paragraphs [0028]-[0034] and figures 1-8.	1-4
A	KR 10-1466320 B1 (GEMET CO., LTD.) 27 November 2014 (2014-11-27) See paragraphs [0054]-[0064].	1-4
A	US 2016-0229500 A1 (NIPPON YUSEN KABUSHIKI KAISHA) 11 August 2016 (2016-08-11) See claim 15 and figures 1-3.	1-4

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 January 2022	**20 January 2022**
Name and mailing address of the ISA/KR **Korean Intellectual Property Office** **Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208** Facsimile No. **+82-42-481-8578**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2021/011343

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		WO 2015-045117 A1	02 April 2015

Form PCT/ISA/210 (patent family annex) (July 2019)