



(11)

EP 3 088 291 A1

(12)

EUROPEAN PATENT APPLICATION

published in accordance with Art. 153(4) EPC

(43) Date of publication:

02.11.2016 Bulletin 2016/44

(51) Int Cl.:

B63B 11/04 (2006.01)

B65D 90/12 (2006.01)

F17C 13/08 (2006.01)

(21) Application number: **14873993.1**

(86) International application number:

PCT/JP2014/006347

(22) Date of filing: **19.12.2014**

(87) International publication number:

WO 2015/098069 (02.07.2015 Gazette 2015/26)

(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

(30) Priority: 27.12.2013 JP 2013270643

(71) Applicant: **Kawasaki Jukogyo Kabushiki Kaisha**
Kobe-shi, Hyogo 650-8670 (JP)

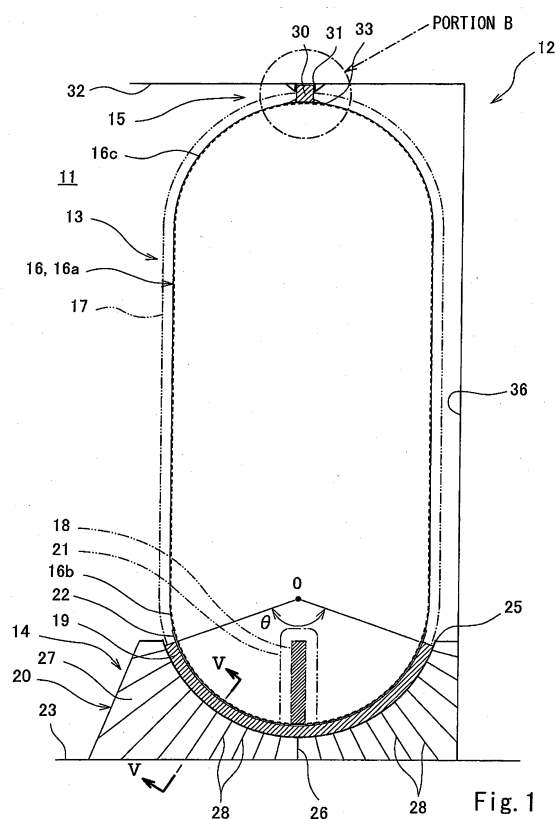
(72) Inventors:

- **KADA, Kazuo**
Kobe-shi
Hyogo 650-8670 (JP)
- **SHIMIZU, Yusuke**
Kobe-shi
Hyogo 650-8670 (JP)
- **HASEGAWA, Yuta**
Kobe-shi
Hyogo 650-8670 (JP)

(74) Representative: **Leinweber & Zimmermann**
Rosental 7, II. Aufgang
80331 München (DE)

(54) VERTICAL FUEL TANK AND SUPPORT STRUCTURE

(57) A fuel tank support structure is a support structure for installing a fuel tank in a vertically placed state in a hull, the fuel tank serving to store a fuel that is used by a ship to travel, the support structure including: the fuel tank that is placed vertically; a lower support structure that supports a lower tank portion of the fuel tank; and an upper support structure that supports an upper tank portion of the fuel tank. The lower support structure is configured to support a load that is exerted on the fuel tank vertically and loads that are exerted on the fuel tank in a ship width direction and a ship length direction when the hull swings, and the upper support structure is configured to support the loads that are exerted on the fuel tank in the ship width direction and the ship length direction when the hull swings.



Description

Technical Field

[0001] The present invention relates to a vertical type fuel tank and a support structure for installing the fuel tank in a vertically placed state in the hull of a ship, the fuel tank storing a fuel that is used by the ship to travel, the fuel tank being, for example, a cylindrical tank.

Background Art

[0002] Conventionally, for example, horizontal type cylindrical tanks to be loaded on a ship have been widely used, and their support structure and design technology have been established. Specifically, such a horizontal type cylindrical tank is securely and stably supported by a support structure that includes saddles that are provided at the front and rear of the tank.

[0003] Japanese Laid-Open Patent Application Publication No. 2003-240198 discloses one example of a support structure of such a horizontal type cylindrical tank.

Citation List

Patent Literature

[0004] PTL 1: Japanese Laid-Open Patent Application Publication No. 2003-240198

Summary of Invention

Technical Problem

[0005] However, the horizontal type cylindrical tank as described above requires an installation space that accommodates, at least, the length of the cylindrical tank. In order to effectively utilize the limited space of the hull, it is demanded to reduce the installation space of the horizontal type cylindrical tank.

[0006] Moreover, for example, assume a case where a fuel used by a ship to travel is stored in the above-described horizontal type cylindrical tank. In this case, in order to make the installation space for the installation of the fuel tank, for example, the space of a liquid cargo hold or a cargo hold for storing a liquid cargo or a cargo loaded in the hull is reduced. Therefore, there is a high demand for reducing the installation space for the installation of the fuel tank in the ship length direction.

[0007] Meanwhile, a space that is short in the ship length direction but deep in the vertical direction may be formed in the hull due to, for example, design reasons of the hull and the size and shape of the liquid cargo hold or the cargo hold for storing a liquid cargo or a cargo loaded in the hull. Such a space is required to be utilized effectively.

[0008] Examples of such a space include: a compartmented area between the engine room and the liquid cargo hold

or the cargo hold of the ship; and a compartmented area below living quarters of the ship.

[0009] The present invention has been made in order to solve the above-described problems. An object of the present invention is to provide a vertical type fuel tank and a support structure that make it possible to reduce a fuel tank installation space in the ship length direction and effectively utilize the limited space of the hull.

Solution to Problem

[0010] In order to solve the above-described problems, the inventors of the present invention focused their attention on a vertically placed fuel tank and its support structure so as to efficiently place the fuel tank in a compartment that is formed deep in the vertical direction and efficiently arrange the hull compartments without reducing the cargo hold area of the hull.

[0011] A vertical type fuel tank support structure according to the present invention is a fuel tank support structure for installing a fuel tank in a hull, the fuel tank extending vertically and serving to store a fuel that is used by a ship to travel, the vertical type fuel tank support structure including: the fuel tank that is placed vertically; a lower support structure that supports a lower tank portion of the fuel tank; and an upper support structure that supports an upper tank portion of the fuel tank. The lower support structure is configured to support a load that is exerted on the fuel tank vertically and loads that are exerted on the fuel tank in a ship width direction and a ship length direction when the hull swings. The upper support structure is configured to support the loads that are exerted on the fuel tank in the ship width direction and the ship length direction when the hull swings.

[0012] The fuel tank, which is included in the vertical type fuel tank support structure according to the present invention, is capable of storing, for example, a propulsion engine fuel used for the traveling of the ship in which the fuel tank is provided. The fuel tank includes a cylindrical body portion, and the upper tank portion and the lower tank portion of the fuel tank are each formed to have a hemispherical shape.

[0013] In the vertical type fuel tank support structure according to the present invention, the lower support structure supporting the lower tank portion is disposed along an outer surface of the lower tank portion, and the lower support structure includes: first and second retaining portions that cross each other at a lowermost part of the lower tank portion; and a support base that supports the lower tank portion via the first and second retaining portions. The first retaining portion extends from the lowermost part of the lower tank portion to both sides in the ship width direction, and the second retaining portion extends from the lowermost part of the lower tank portion to both sides in the ship length direction.

[0014] In the vertical type fuel tank support structure according to the present invention, the upper support structure supporting the upper tank portion includes: a

first member that is provided on the upper tank portion and that is in a shape of a rectangular parallelepiped; and a second member that sandwiches the first member. The first and second members are provided for the purpose of preventing swinging of the tank in front-rear and right-left directions.

[0015] The load that is vertically exerted on the vertically placed fuel tank and the loads that are exerted on the vertically placed fuel tank in the ship width direction and the ship length direction when the hull swings can be supported by the lower support structure and the upper support structure of the tank.

[0016] In the vertical type fuel tank support structure according to the present invention, in a case where a low-temperature liquefied gas (e.g., liquefied natural gas (LNG)) is stored in the tank, the first and second retaining portions of the lower support structure supporting the lower tank portion and the rectangular-parallelepiped-shaped first member provided on the upper tank portion may be each formed by a thermal insulating member.

[0017] Accordingly, external heat can be suppressed from entering the tank via the first and second retaining portions of the lower support structure supporting the lower tank portion or via the rectangular-parallelepiped-shaped member provided on the upper tank portion. This makes it possible to suppress the occurrence of boil-off from the low-temperature liquefied gas.

Advantageous Effects of Invention

[0018] According to the vertical type fuel tank and the support structure of the present invention, the fuel tank is supported in a vertically placed state. This makes it possible to reduce the installation space of the fuel tank in the ship length direction and effectively utilize the limited space of the hull.

Brief Description of Drawings

[0019]

Fig. 1 is a sectional side view of a vertical type fuel tank support structure according to the present invention.

Fig. 2 is a front sectional view of the support structure shown in Fig. 1.

Fig. 3 is a top plan view of a fuel tank shown in Fig. 1 (as seen from above).

Fig. 4 is a bottom view of the fuel tank shown in Fig. 1 (as seen from below).

Fig. 5 is a sectional view of a lower support structure shown in Fig. 1, the sectional view being taken along a line V-V of Fig. 1.

Fig. 6 is a sectional view of the lower support structure shown in Fig. 2, the sectional view being taken along a line VI-VI of Fig. 2.

Fig. 7 is a partially-enlarged front view of a portion B of an upper support structure shown in Fig. 1, and

is a partially-enlarged front view of a portion B' of the upper support structure shown in Fig. 2.

Description of Embodiments

[0020] A vertical type fuel tank support structure 11 shown in Fig. 1 is a support structure for installing a fuel tank 13 in a vertically placed state in a ship 12, the fuel tank 13 serving to store a fuel that is used by the ship 12 to travel. The vertical type fuel tank 13 serves to store, for example, a propulsion engine fuel used for the traveling of the ship 12, in which the fuel tank 13 is installed.

[0021] The vertical type fuel tank support structure 11 shown in Fig. 1 includes the fuel tank 13, a lower support structure 14, and an upper support structure 15. The lower support structure 14 is provided on a flat 23. The upper support structure 15 is provided on a deck 32. The reference sign 36 in Fig. 1 indicates a bulkhead.

[0022] The fuel tank 13 is vertically installed by means of the fuel tank support structure 11. The stored fuel is a liquefied gaseous fuel containing, for example, liquefied natural gas (LNG).

[0023] As shown in Fig. 1 to Fig. 4, the fuel tank 13 includes a metal tank body 16. The tank body 16 is formed to have a vertical cylindrical shape, and includes a cylindrical body portion 16a. A hemispherical lower tank portion 16b is provided under the body portion 16a, and a hemispherical upper tank portion 16c is provided over the body portion 16a.

[0024] The tank body 16, which has a vertical cylindrical shape, is coated by thermal insulators 17 as shown in Fig. 1. The thermal insulators 17, which are in a large number, have thermal insulation capacity, and are mounted to the tank body 16.

[0025] The lower support structure 14 shown in Fig. 1 serves to support the lower tank portion 16b of the fuel tank 13, and is capable of supporting a load that is exerted on the fuel tank 13 vertically and loads that are exerted on the fuel tank 13 in the ship width direction and the ship length direction when the hull swings.

[0026] As shown in Fig. 4, Fig. 5, and Fig. 6, the lower support structure 14 is disposed along the outer surface of the lower tank portion 16b, and includes: first and second retaining portions 18 and 19, which cross perpendicularly to each other at the lowermost part of the lower tank portion 16b; and a support base 20, which supports the lower tank portion 16b via the first and second retaining portions 18 and 19.

[0027] As shown in Fig. 2, the first retaining portion 18 is configured to extend from the lowermost part of the lower tank portion 16b to both sides in the ship width direction in an arc-like manner. As shown in Fig. 1, the second retaining portion 19 is configured to extend from the lowermost part of the lower tank portion 16b to both sides in the ship length direction in an arc-like manner. The central angle θ of each of the first and second retaining portions 18 and 19 formed in the arc-like manner

is, for example, 140° to 150°. It should be noted that the point O shown in Fig. 1 is the central point.

[0028] These first and second retaining portions 18 and 19 are highly rigid and have thermal insulation capacity. For example, the first and second retaining portions 18 and 19 are made of laminated phenolic resin. As shown in Fig. 4, the first and second retaining portions 18 and 19 are mounted to the outer surface of the lower tank portion 16b via first and second reinforcing plates 21 and 22 (wear plates). The first and second reinforcing plates 21 and 22 are fixed to the lower tank portion 16b.

[0029] It should be noted that the reference sign 29B in Fig. 5 indicates a second upper fixing portion. The second upper fixing portion 29B fixes the second retaining portion 19 on the second reinforcing plate 22. Similarly, the reference sign 29A in Fig. 6 indicates a first upper fixing portion. The first upper fixing portion 29A fixes the first retaining portion 18 on the first reinforcing plate 21.

[0030] As shown in Fig. 5 and Fig. 6, the support base 20 serves to support the lower tank portion 16b via the first and second retaining portions 18 and 19, and is fixedly installed on the flat 23 of the hull. The support base 20 includes two first and second upper plates 24 and 25, each of which is formed in an arc-like manner, such that the first and second upper plates 24 and 25 are in contact with the lower surfaces of the first and second retaining portions 18 and 19, respectively. These two first and second upper plates 24 and 25 are supported by first and second support plates 26 and 27, respectively. Each of the first and second support plates 26 and 27 is provided with a plurality of fall-preventing plates 28 for supporting each of the first and second support plates 26 and 27 so that the first and second support plates 26 and 27 will not fall. These first and second support plates 26 and 27 and the fall-preventing plates 28 are fixedly provided on the flat 23.

[0031] The upper support structure 15 shown in Fig. 7 includes: a first member 30, which is provided on the uppermost part of the upper tank portion 16c and which is in the shape of a rectangular parallelepiped; and a second member 31, which is provided on (the hull-side portion of) the deck 32 of the hull and which sandwiches the first member 30 in a surrounding manner.

[0032] It should be noted that the reference sign 34 in Fig. 7 indicates a third lower fixing portion. The third lower fixing portion 34 fixes the first member 30 on a third reinforcing plate 33 by sandwiching the first member 30 in a surrounding manner.

[0033] These first and second members 30 and 31 are highly rigid, and one of, or each of, the first and second members 30 and 31 has thermal insulation capacity. The first and second members 30 and 31 are made of, for example, laminated phenolic resin. As shown in Fig. 6, the first member 30 is mounted to the outer surface of the upper tank portion 16c via the third reinforcing plate 33 (wear plate).

[0034] The fuel tank 13 supported by the vertical type fuel tank support structure 11 shown in Fig. 1 is, for ex-

ample, disposed in a vertically placed state in a compartmented area between an engine room and a liquid cargo hold or a cargo hold of the ship, or disposed in a vertically placed state in a compartmented area below living quarters of the ship.

Industrial Applicability

[0035] As described above, the vertical type fuel tank support structure and the vertical type fuel tank according to the present invention have an excellent advantage of making it possible to reduce the installation space of the fuel tank and effectively utilize the limited space of the hull. Thus, the present invention is suitably applicable to vertical type fuel tanks and support structures thereof.

Reference Signs List

[0036]

11	vertical type fuel tank support structure
12	ship
13	fuel tank
14	lower support structure
15	upper support structure
16	tank body
16a	body portion
16b	lower tank portion
16c	upper tank portion
17	thermal insulator
18	first retaining portion
19	second retaining portion
20	support base
21	first reinforcing plate
22	second reinforcing plate
23	flat
24	first upper plate
25	second upper plate
26	first support plate
27	second support plate
28	fall-preventing plate
29	second upper fixing portion
30	first member
31	second member
32	deck
33	third reinforcing plate
34	third lower fixing portion
36	bulkhead

Claims

1. A vertical type fuel tank support structure for installing a fuel tank in a hull, the fuel tank extending vertically and serving to store a fuel that is used by a ship to travel, the vertical type fuel tank support structure comprising:

the fuel tank that is placed vertically;
 a lower support structure that supports a lower
 tank portion of the fuel tank; and
 an upper support structure that supports an up-
 per tank portion of the fuel tank,

5

wherein

the lower support structure is configured to support
 a load that is exerted on the fuel tank vertically and
 loads that are exerted on the fuel tank in a ship width
 direction and a ship length direction when the hull
 swings, and

10

the upper support structure is configured to support
 the loads that are exerted on the fuel tank in the ship
 width direction and the ship length direction when
 the hull swings.

15

2. The vertical type fuel tank support structure accord-
 ing to claim 1, wherein

the fuel tank includes a cylindrical body portion,
 the lower tank portion is formed to have a hemispher-
 ical shape,

20

the lower support structure is disposed along an out-
 er surface of the lower tank portion,

the lower support structure includes:

25

first and second retaining portions that cross
 each other at a lowermost part of the lower tank
 portion; and

a support base that supports the lower tank por-
 tion via the first and second retaining portions,

30

the first retaining portion extends from the lowermost
 part of the lower tank portion to both sides in the ship
 width direction, and

35

the second retaining portion extends from the low-
 ermost part of the lower tank portion to both sides in
 the ship length direction.

3. The vertical type fuel tank support structure accord-
 ing to claim 2, wherein
 each of the first and second retaining portions is
 formed by a thermal insulating member.

40

4. The vertical type fuel tank support structure accord-
 ing to any one of claims 1 to 3, wherein

45

the fuel tank includes a cylindrical body portion,
 the upper tank portion is formed to have a hemispher-
 ical shape, and

the upper support structure includes:

50

a first member that is provided on the upper tank
 portion and that is in a shape of a rectangular
 parallelepiped; and

a second member that is provided at the hull
 side and that sandwiches the first member in a
 surrounding manner.

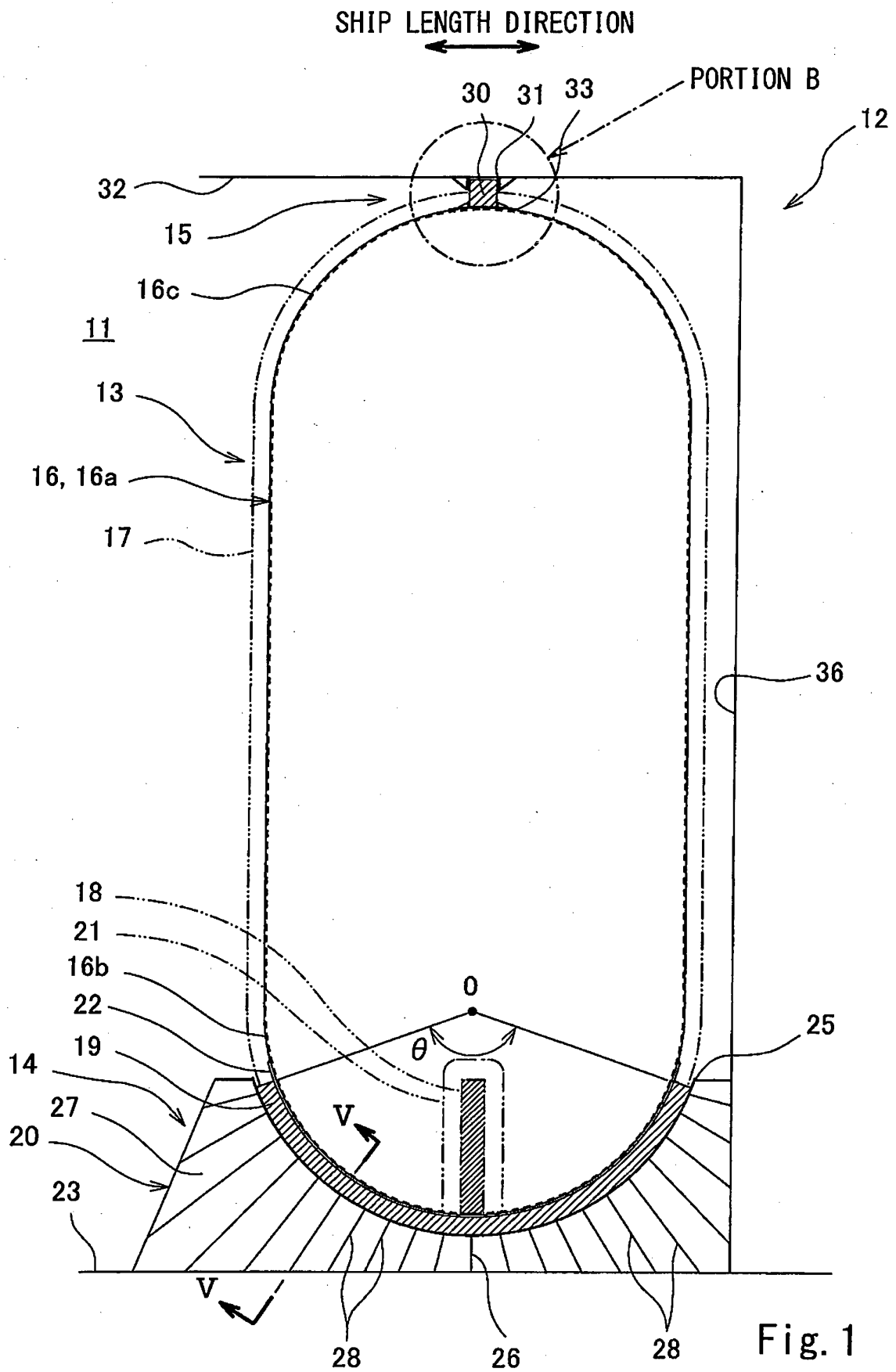
55

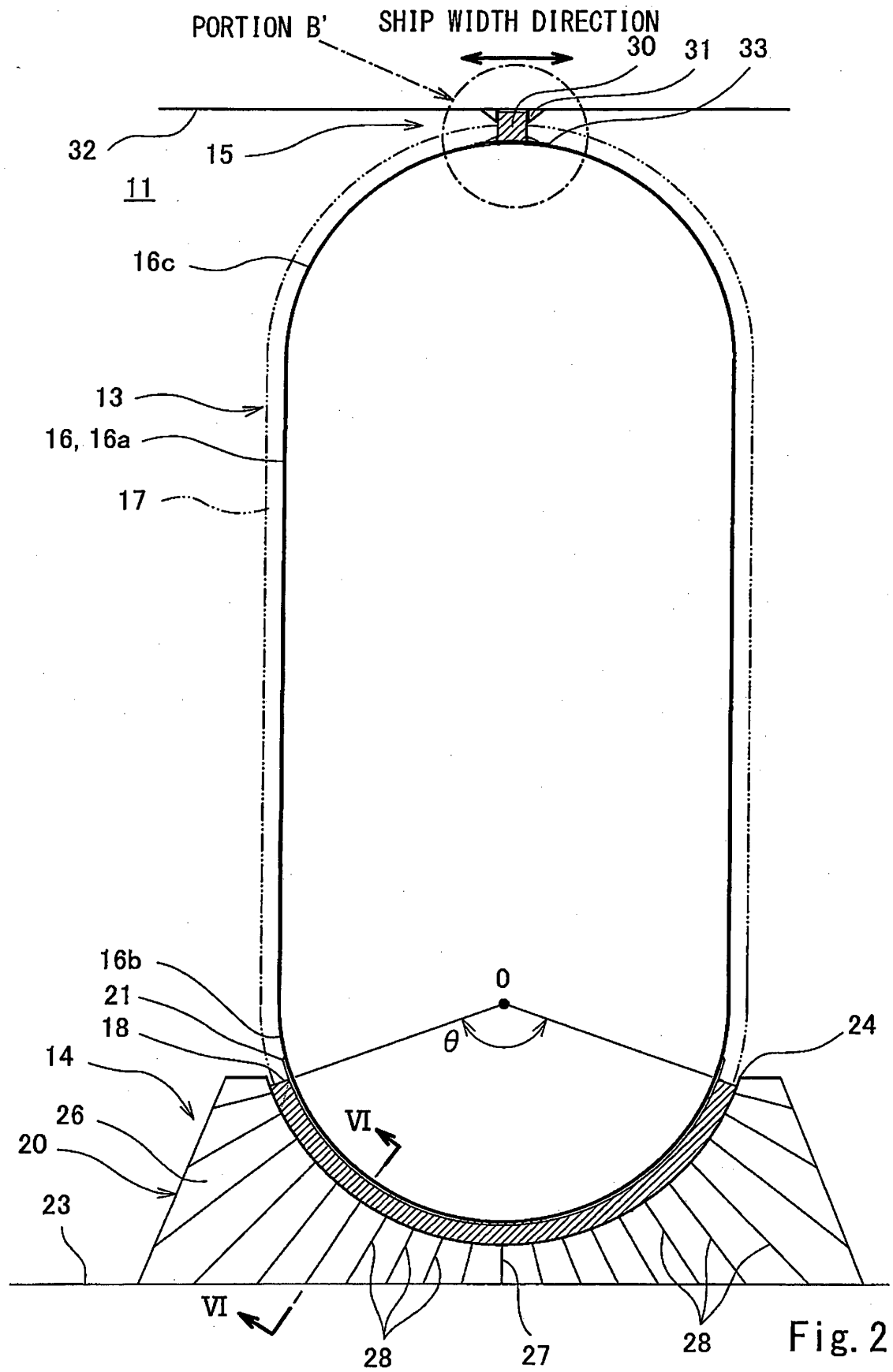
5. The vertical type fuel tank support structure accord-
 ing to claim 4, wherein
 one of, or each of, the first and second members is
 formed by a thermal insulating member.

6. The vertical type fuel tank support structure accord-
 ing to any one of claims 1 to 5, wherein
 the vertically placed fuel tank is disposed in a com-
 parted area between an engine room and a liquid
 cargo hold or a cargo hold of the ship, or disposed
 in a compartmented area below a living quarter of the ship.

7. The vertical type fuel tank support structure accord-
 ing to any one of claims 1 to 6, wherein
 the fuel tank has a vertical cylindrical shape, and
 stores liquefied natural gas.

8. A vertical type fuel tank applied to the vertical type
 fuel tank support structure according to any one of
 claims 1 to 7.





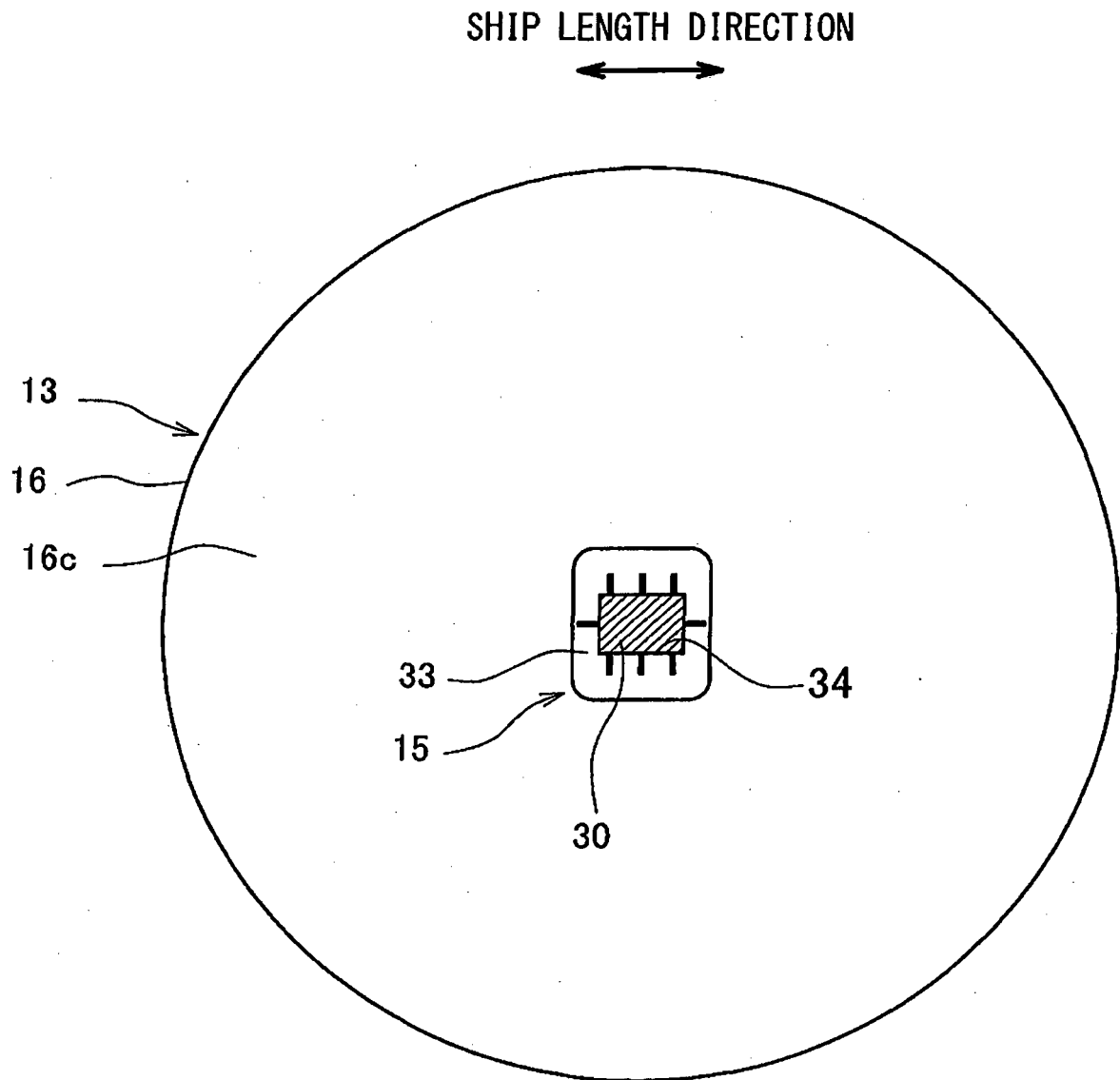


Fig. 3

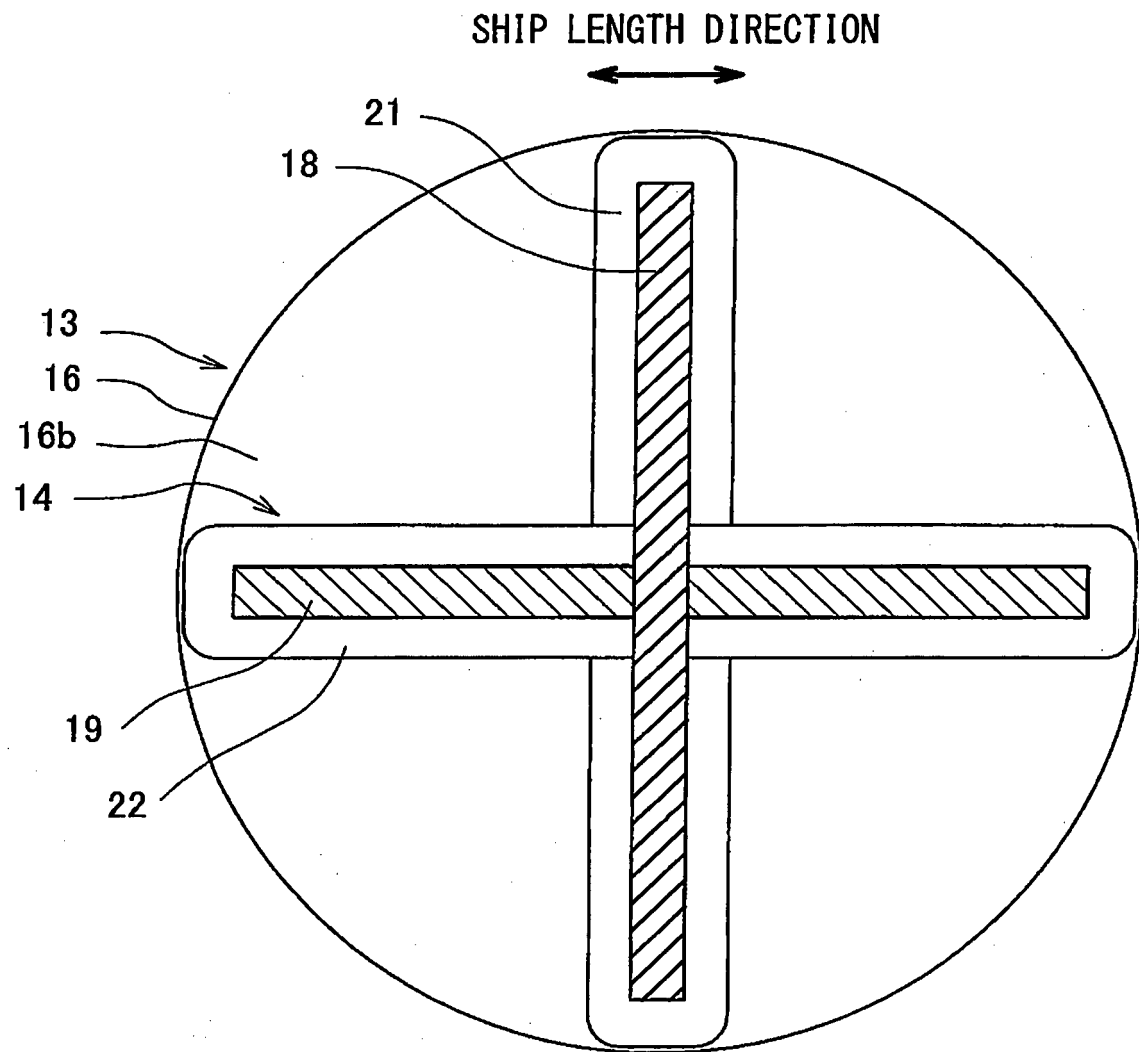


Fig. 4

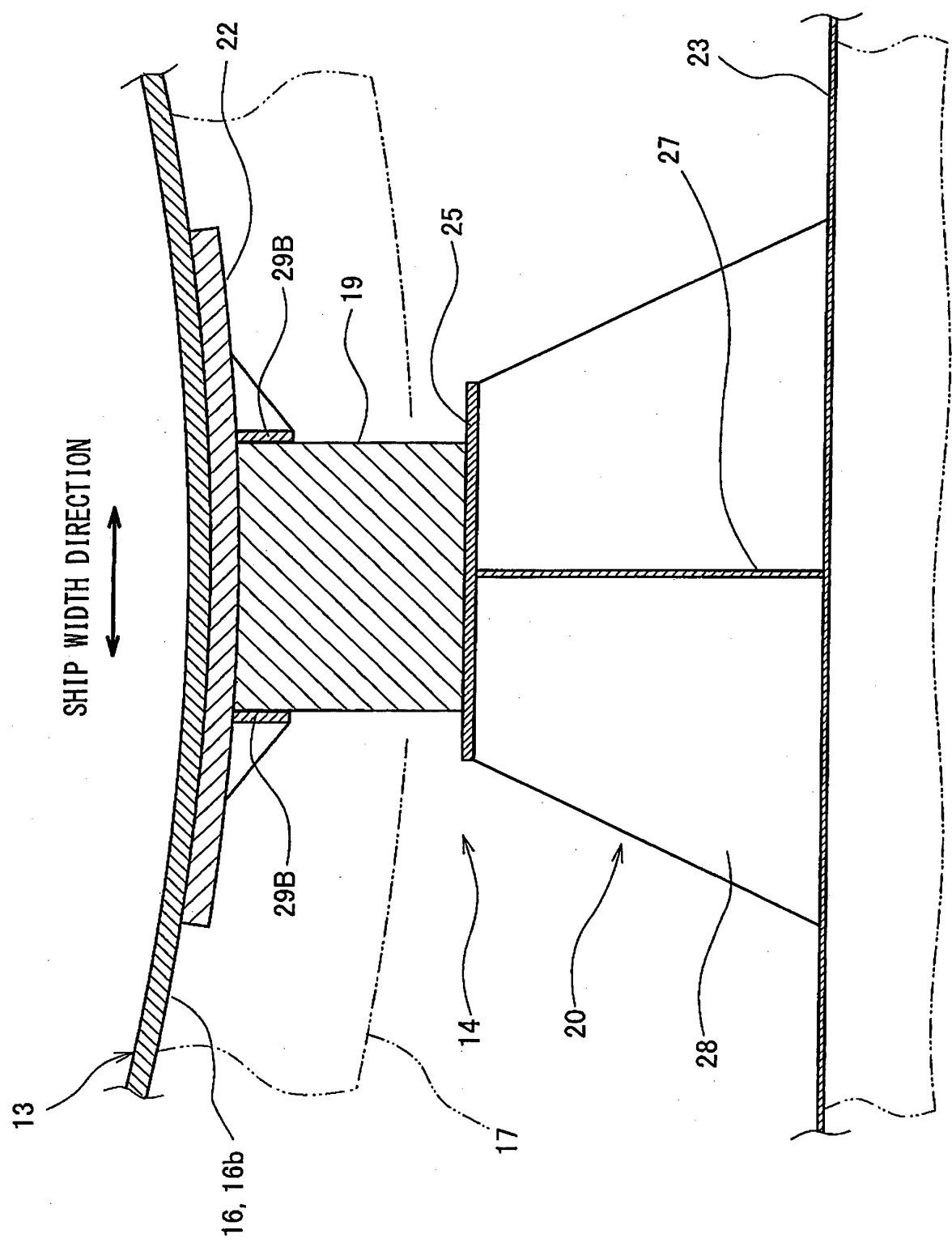
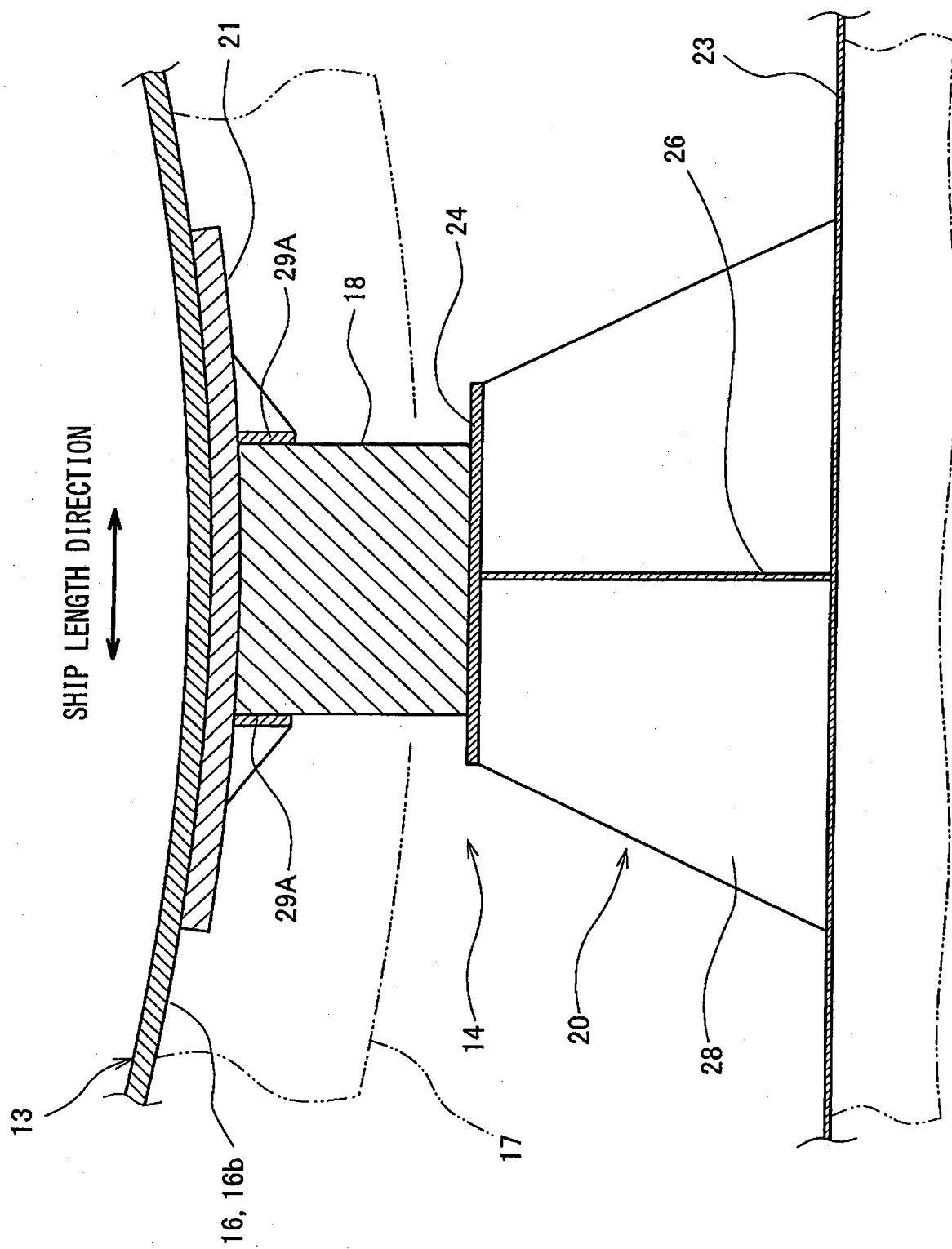


Fig. 5



Fi. 6

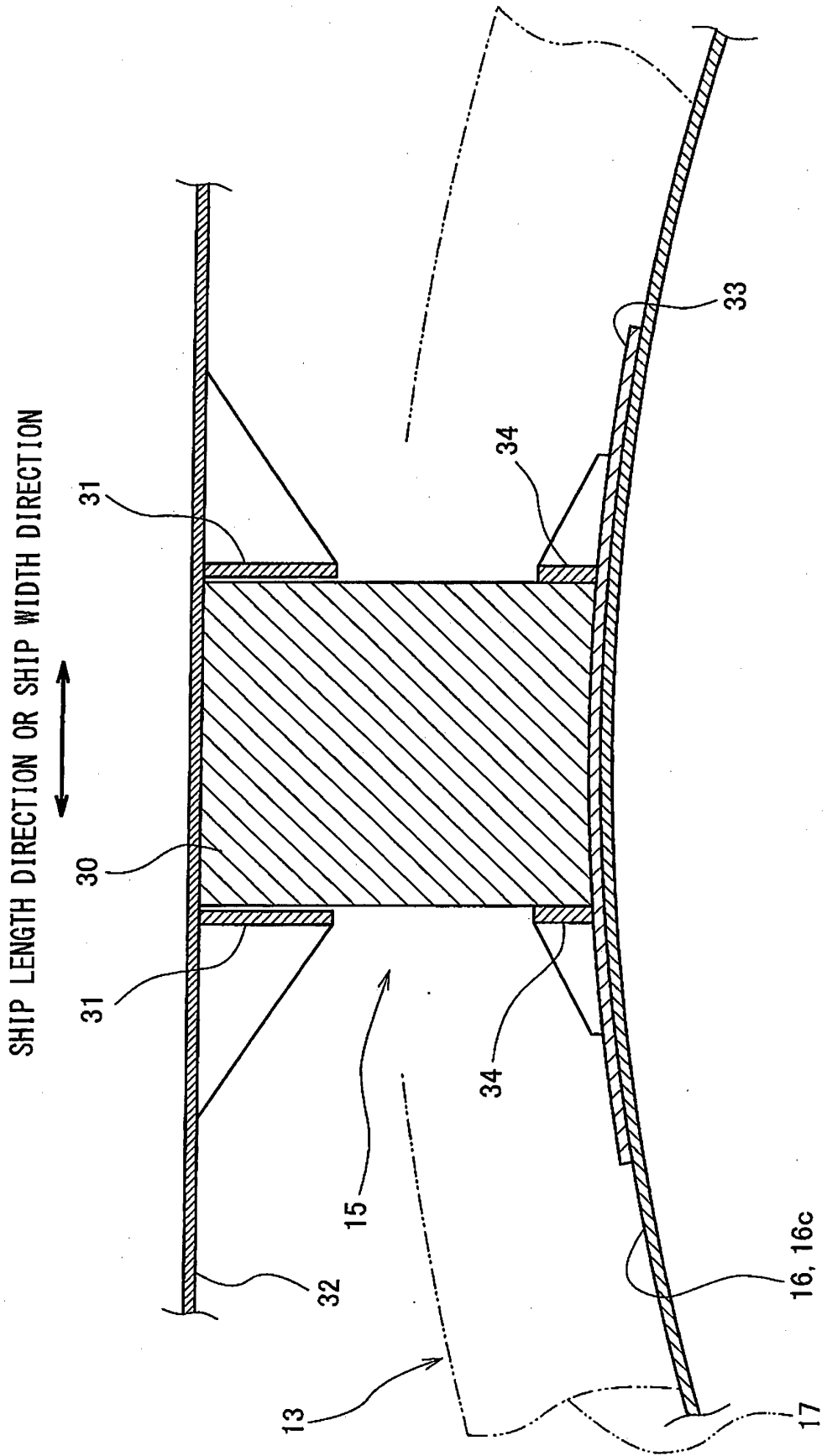


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/006347

A. CLASSIFICATION OF SUBJECT MATTER

B63B11/04(2006.01)i, B65D90/12(2006.01)i, F17C13/08(2006.01)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)

B63B11/04, B65D90/12, F17C13/08

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015

Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3270700 A (VEHOC CORP.), 06 September 1966 (06.09.1966), 2nd to 4th columns; fig. 1 to 6 & GB 1093012 A & DE 1556981 A1 & FR 1440345 A & CH 436008 A & NL 6508944 A & NO 119776 B & AT 272126 B	1-8
Y	JP 2006-168711 A (Snecma, Alstom Power Conversion), 29 June 2006 (29.06.2006), paragraphs [0038] to [0087]; fig. 1 to 4 & US 2006/0225448 A1 & EP 1650125 A1 & FR 2877078 A1 & CN 1766403 A	1-8

☒ 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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"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
04 February 2015 (04.02.15)Date of mailing of the international search report
17 February 2015 (17.02.15)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/006347

C (Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2002-274597 A (Hitachi Zosen Corp.), 25 September 2002 (25.09.2002), paragraphs [0001], [0007] to [0027]; fig. 1 to 4 (Family: none)	2-3
A	JP 2013-505173 A (Daewoo Shipbuilding & Marine Engineering Co., Ltd.), 14 February 2013 (14.02.2013), paragraphs [0200] to [0208]; fig. 40 to 42 & US 2013/0192510 A1 & EP 2441661 A1 & WO 2012/053705 A1 & KR 10-1130658 B1 & AU 2011236086 A1 & SG 184484 A1 & CN 103153775 A	1-8
A	JP 53-36019 A (Teikoku Sanso Kabushiki Kaisha), 04 April 1978 (04.04.1978), page 2; fig. 1 to 3 (Family: none)	1, 3
A	US 3312076 A (James S. CLARKE; Arthur J. PALMER), 04 April 1967 (04.04.1967), 2nd to 3rd columns; fig. 1 to 4 & GB 1130244 A & DE 1551577 A1 & FR 1508582 A & NL 6700724 A & NO 123370 B & SE 364229 B & ES 335749 A1	1, 4
A	DE 102012104634 A1 (MT AEROSPACE AG), 05 December 2013 (05.12.2013), paragraphs [0040] to [0070]; fig. 1 to 3 (Family: none)	4

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2003240198 A [0003] [0004]