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

(11) EP 2 551 184 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.01.2013 Bulletin 2013/05

(51) Int Cl.:
B63B 21/50 *(2006.01)*

(21) Application number: **12178016.7**

(22) Date of filing: **26.07.2012**

(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: **29.07.2011 US 201113194065**

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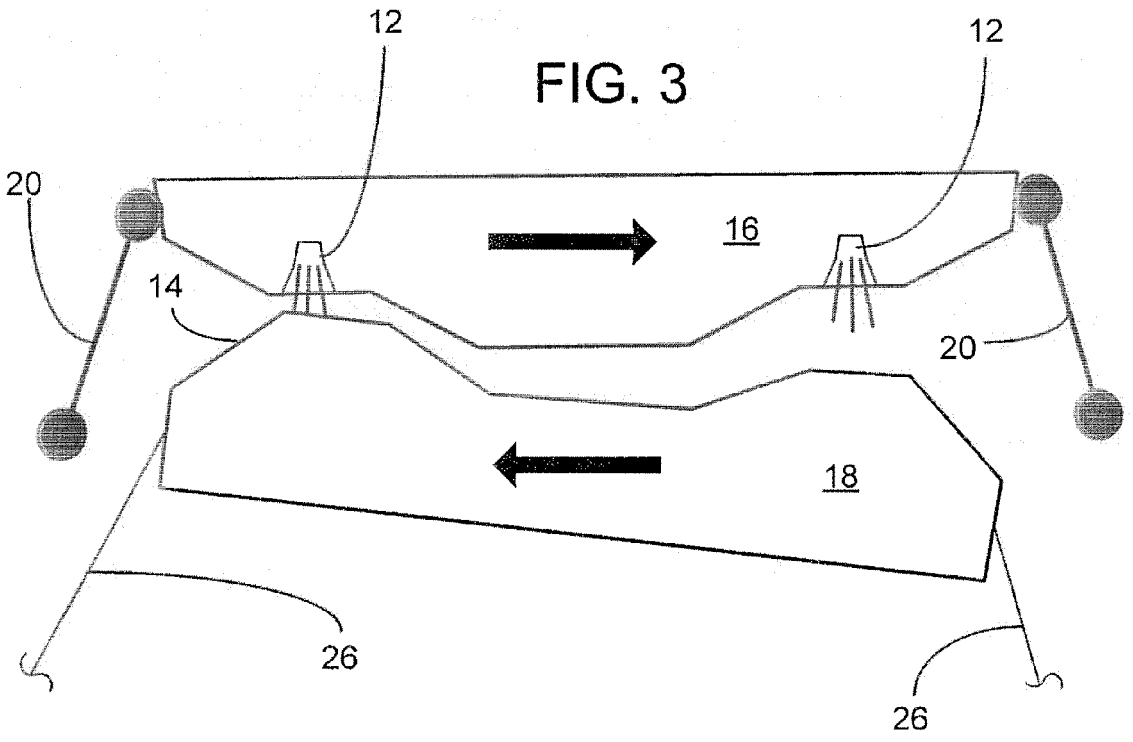
(54) Mooring disconnect arrangement

(57) A mooring disconnect arrangement (10) for a floating offshore structure (16) and a mooring buoy (18). At least one high pressure water jet (12) is positioned to direct water between the floating offshore structure and the mooring buoy. The floating offshore structure and mooring buoy are also provided with specially shaped complementary surfaces (22, 24) to assist in disconnection and separation. One or more mechanical restraining devices (20) may be used to retain the floating offshore structure and mooring buoy connected together during normal drilling or production operations.

FIG. 3



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Description

Field and Background

[0001] The invention is generally related to the disconnection of moored floating offshore structures from mooring buoys while under environmental loads.

[0002] In the offshore industry of drilling for and producing oil and natural gas, bottom founded and floating moored structures are used. There are times when floating structures that are moored in place must be released from their moorings and moved due to high environmental forces such as sea ice or storms such as hurricanes.

[0003] When it becomes necessary to disconnect a floating structure due to the eminent danger of high environmental forces it is preferable that the mooring arrangements remain intact for reattachment at a later time.

[0004] Current existing and proposed arrangements for disconnecting a floating structure from their mooring arrangements are based on two basic approaches.

[0005] One approach is to disconnect each mooring line individually. This can result in the individual lines becoming entangled. The mooring arrangement must then be recovered and reinstalled line-by-line. The risks associated with this approach are 1) recoil of the mooring lines when released under tension striking and causing damage to the floating structure and 2) being very time consuming to recover each line and reconnect individually. This approach is especially not practical in ice covered waters.

[0006] A second approach is the use of a buoy that supports a mooring spread and keeps all lines attached to the disconnected buoy for subsequent reconnection as a group. This approach is typically based on a conical shaped buoy arrangement that drops away from the floating structure and facilitates all of the mooring lines remaining connected to the disconnected buoy. This keeps the lines together in a group, as compared to individual line disconnect, but the height of the buoy being released is constrained by the beam dimension of the floating vessel being released. This can result in a longer time duration for the buoy to clear the disconnected floating structure.

[0007] The objectives of mooring systems that may be disconnected for this purpose are a quick release and quickly increasing the distance between the mooring and the floating offshore structure.

[0008] In general, the risks or problems that occur with these disconnectable arrangements are 1) binding between the disconnectable mooring buoy and floating structure when the mechanism is expected to release and 2) contact interaction between the disconnectable mooring buoy and floating structure that results in damage to one or both structures after the mooring system is released.

[0009] Binding may occur because the surfaces that are supposed to separate have been in contact for a number of years prior to the first disconnect attempt. The two bodies can be forced apart by mechanical devices, but these devices must be released as soon as separation occurs to prevent damage to the releasing device. Another major risk is that, due to the two bodies moving independently after release, but still in the same proximity, they can collide causing damage to one or both structures.

[0010] When the release mechanism is based on a conical buoy supporting the moorings, lower profiles of the buoy facilitate a quicker release and clearance growth. The load from the floating structure is transferred to the mooring arrangement through the contact area between the floating structure and the buoy. For a given design load, this area will be the same for any buoy shape. This area can be developed by making the disconnectable buoy high with a relatively small diameter (Fig. 1A) or by making the height low with a larger diameter (Fig. 1 B). Assuming the same rate of vertical separation, the buoy with the lower profile will separate more quickly than the higher buoy, thus reducing the risk of interaction after separation.

Summary

[0011] Aspects of the present invention have been developed at least in part in consideration of the drawbacks of know approaches.

[0012] Particular and preferred aspects and embodiments are set forth in the appended claims.

[0013] Viewed from one aspect, there is provided an improved means of releasing a floating offshore structure from its mooring while under environmental loads.

[0014] Viewed from another aspect, there can be provided a mooring disconnect arrangement for a floating offshore structure and a disconnectable mooring buoy. At least one high pressure water jet is positioned to direct water between the floating offshore structure and the mooring buoy. The floating offshore structure and mooring buoy are also provided with specially shaped complementary surfaces to assist in disconnection and separation. One or more mechanical restraining devices may be used to retain the floating offshore structure and mooring buoy connected together during normal drilling or production operations.

[0015] Various features and combinations therefor provided by the present teachings are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the teachings, their operating advantages and specific objects attained by their uses, reference is made to the accompanying drawings and descriptive matter in which examples are illustrated.

Brief Description of the Drawings

[0016] In the accompanying drawings, forming a part of this specification, and in which reference numerals shown in the drawings designate like or corresponding

parts throughout the same:

[0017] FIG. 1A illustrates a prior art high profile release buoy.

[0018] FIG. 1B illustrates a prior art low profile release buoy.

[0019] FIG. 2 - 5 schematically illustrate the separation of a floating structure from a mooring.

[0020] While the present teachings are susceptible to various modifications and alternative forms, specific embodiments are shown by way of example in the drawings and are herein described in detail. It should be understood, however, that drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the invention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the present invention as defined by the appended claims.

Detailed Description

[0021] As seen in Fig. 2, the mooring disconnect arrangement 10 comprises the use of high pressure water jets 12 in conjunction with specially shaped interface surfaces 14 on the floating offshore structure 16 and the mooring buoy 18.

[0022] It should be understood that only the lower portion of the floating offshore structure 16 is shown which is normally well below the surface of the water. Thus, the water surface is not shown in relation to the described arrangements and it is to be understood that the connection and disconnection sequences happen below the water surface.

[0023] The water jets 12 are preferably provided on the hull of the floating offshore structure 16. The water capacity and pressure, number of water jets 12, and spacing between the water jets 12 is determined by the size of the floating offshore structure 16 and mooring buoy 18.

[0024] During normal offshore operations of drilling for or producing oil and natural gas, mechanical connection or restraining devices 20 are used to restrain the floating offshore structure 16 and mooring buoy 18 locked together. Any suitable connection devices such as hydraulic rams or rack and pinion jacking arrangements may be used as the mechanical connection devices 20.

[0025] Ballasting force may also be used to force the floating offshore structure and mooring buoy together.

[0026] A downward facing cone shape 22 on the floating offshore structure 16 is preferably used in conjunction with a complementary shape 24 on the mooring buoy 18 for receiving the cone shape 22. As seen in the drawings, the cone shape 22 and its complementary shaped receiver 24 are preferably designed to have a low profile height that is less than currently existing designs.

[0027] In operation, the floating offshore structure 16 and mooring buoy 18 are held together during drilling or production operations by mechanical restraining devices 20. When environmental forces cause the need to disconnect, the mechanical restraining devices 20 are released and high pressure water jets 12 are activated to help initiate separation of the floating offshore structure 16 from the mooring buoy 18.

[0028] As seen in Fig. 3, the mooring lines 26 aid in retaining a force for causing the mooring buoy 18 to return to its normal equilibrium position.

[0029] Fig. 4 illustrates a scenario where the force of ice may cause the offshore floating structure 16 to rotate prior to full disconnection and separation from the mooring buoy 18. However, it can be seen that the specially shaped, low profile surfaces aid in separation.

[0030] As illustrated in Fig. 5, ballasting forces may also be used to aid in separation of the floating offshore structure 16 from the mooring buoy 18 by removing ballast from the floating offshore structure 16 (causing it to float upward) and adding ballast to the mooring buoy 18 (causing it to move downward). The illustrated change in normal trim angle of the mooring buoy 18 is caused by the ballasting forces and pressure from the water jets 12.

[0031] The presently teachings provide several advantages over the previously used means of disconnecting the mooring system.

[0032] It allows a floating structure to be disconnected from the mooring while under environmental loads, such as sea ice, and the upper section of the floating structure to be removed from the continued threat while keeping the mooring arrangement intact for reattachment to the floating structure.

[0033] The present approach can solve the problem of binding and maintains a safe distance between the floating structure and the buoy supporting the mooring arrangement.

[0034] The present approach can facilitate a quicker release than the prior art and thus reduces the risk of damage to the offshore structure and mooring due to contact during the release.

[0035] The method of release of the present approach helps to prevent binding between the buoy carrying the mooring lines and the floating structure.

[0036] Therefore, viewed from on perspective, there has been described a mooring disconnect arrangement for a floating offshore structure and a mooring buoy. At least one high pressure water jet is positioned to direct water between the floating offshore structure and the mooring buoy. The floating offshore structure and mooring buoy are also provided with specially shaped complementary surfaces to assist in disconnection and separation. One or more mechanical restraining devices may be used to retain the floating offshore structure and mooring buoy connected together during normal drilling or production operations.

[0037] The present disclosure includes combinations of features as set out in the following numbered clauses:

Clause 1 A mooring disconnect arrangement for a floating offshore structure and a mooring buoy, com-

prising: at least one high pressure water jet for directing water between the floating offshore structure and mooring buoy during the disconnection operation; and complementary low profile interface surfaces on the floating offshore structure and mooring buoy that aid in separation.

Clause 2 The mooring disconnect arrangement of clause 1, wherein the interface surface on the floating offshore structure is a cone shape.

Clause 3 The mooring disconnect arrangement of clause 2, wherein the interface surface on the floating offshore structure is an inverted cone shape.

Clause 4 A mooring disconnect arrangement for a floating offshore structure and a mooring buoy, comprising: at least one high pressure water jet for directing water between the floating offshore structure and mooring buoy during the disconnection operation;

complementary low profile interface surfaces on the floating offshore structure and mooring buoy that aid in separation; and releasable mechanical restraining means that lock the floating offshore structure and mooring buoy together during normal drilling and production operations.

Clause 5 The mooring disconnect arrangement of clause 4, wherein the interface surface on the floating offshore structure is a cone shape.

Clause 6 The mooring disconnect arrangement of clause 5, wherein the interface surface on the floating surface is an inverted cone shape.

Clause 7 A mooring disconnect arrangement for a floating offshore structure and a mooring buoy, comprising: at least one high pressure water jet for directing water between the floating offshore structure and mooring buoy during the disconnection operation; complementary low profile interface surfaces on the floating offshore structure and mooring buoy that aid in separation, with the interface surface on the floating offshore structure being an inverted cone shape; and releasable mechanical restraining means that lock the floating offshore structure and mooring buoy together during normal drilling and production operations.

[0038] While specific embodiments and/or details of the invention have been shown and described above to illustrate the application of the principles of the invention, it is understood that this invention may be embodied as more fully described in the claims, or as otherwise known by those skilled in the art (including any and all equivalents), without departing from such principles.

Claims

1. A mooring disconnect arrangement for a floating offshore structure and a mooring buoy, comprising:

   at least one high pressure water jet for directing water between the floating offshore structure and mooring buoy during the disconnection operation; and

   complementary low profile interface surfaces on the floating offshore structure and mooring buoy that aid in separation.

2. The mooring disconnect arrangement of claim 1, wherein the interface surface on the floating offshore structure is a cone shape or frustocone shape.

3. The mooring disconnect arrangement of claim 2, wherein the interface surface on the floating offshore structure is an inverted cone shape or inverted frustocone shape.

4. The mooring disconnect arrangement of claim 1, 2 or 3, further comprising:

   releasable mechanical restraining means that lock the floating offshore structure and mooring buoy together during normal drilling and production operations.

5. A method of disconnecting a floating offshore structure from a mooring buoy, the method comprising:

   directing water from a high pressure water jet between complementary low profile interface surfaces on the floating offshore structure and the mooring buoy.

6. The method of claim 5, wherein the interface surface on the floating offshore structure is a cone shape or frustocone shape.

7. The method of claim 6, wherein the interface surface on the floating offshore structure is an inverted cone shape or inverted frustocone shape.

8. The method of claim 5, 6 or 7, further comprising:

   releasing a mechanical restraining means that lock the floating offshore structure and mooring buoy together during normal drilling and production operations.

FIG. 1A
PRIOR ART

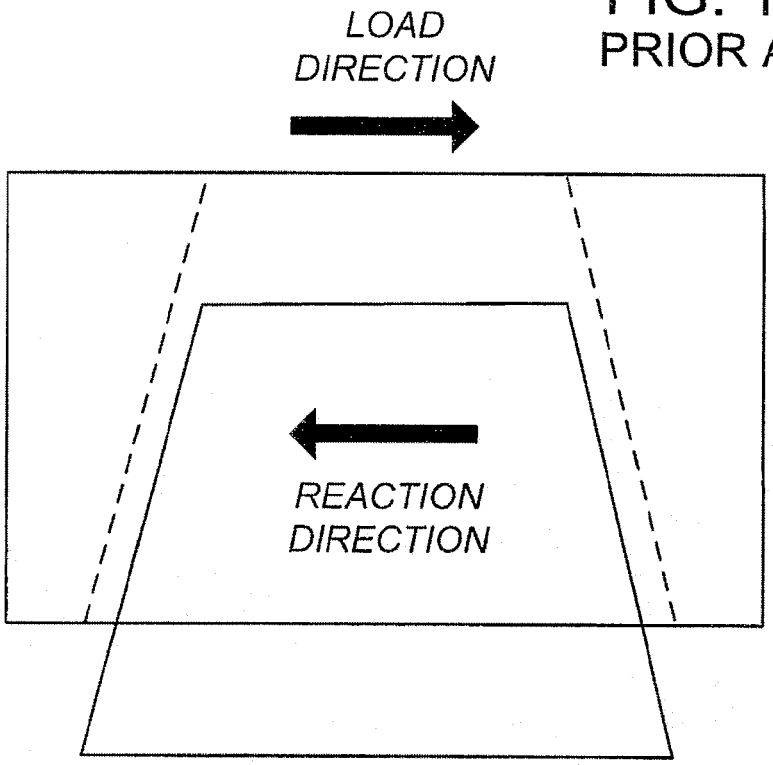


FIG. 1B
PRIOR ART

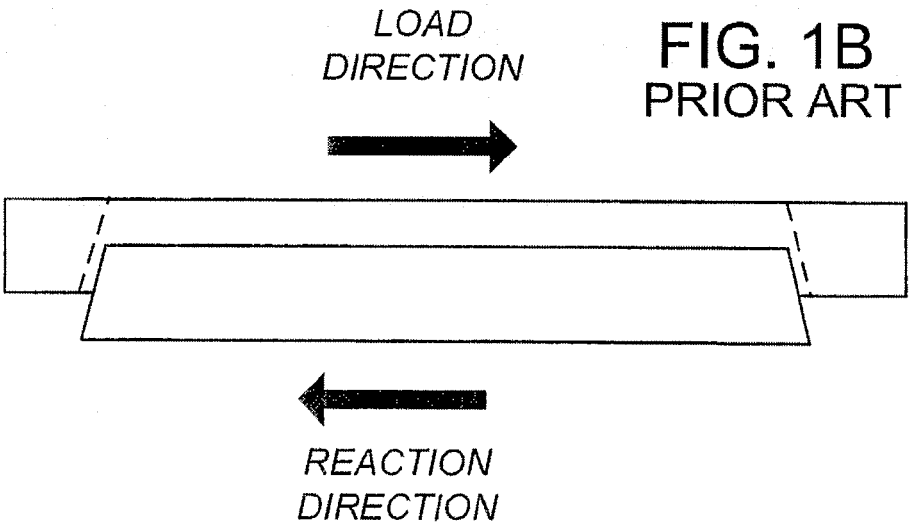


FIG. 2

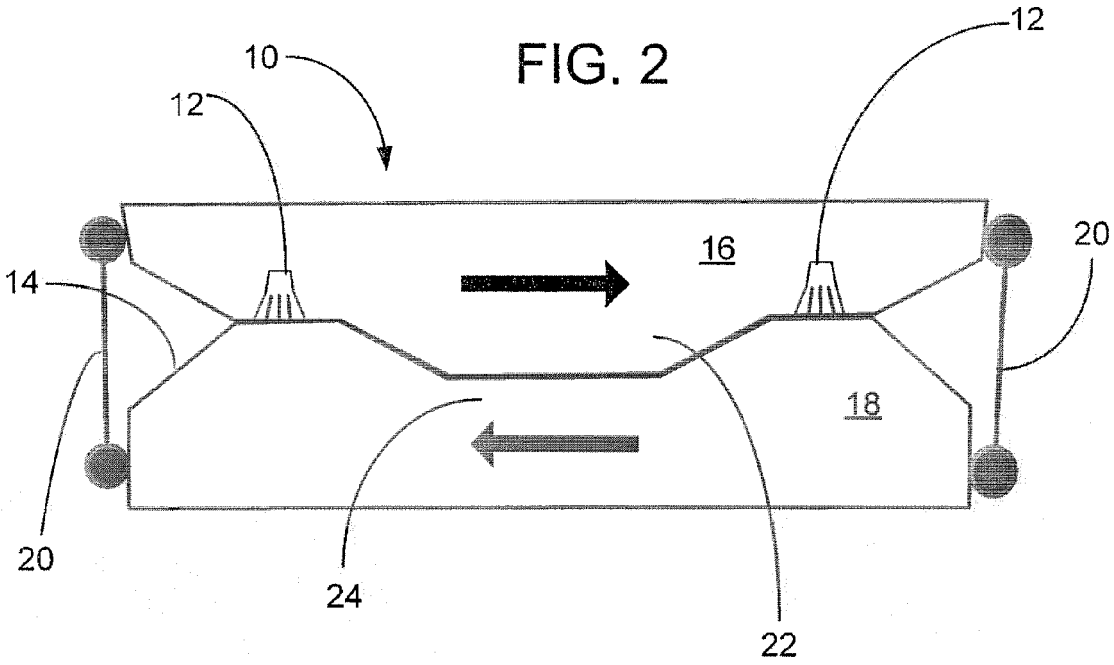


FIG. 3

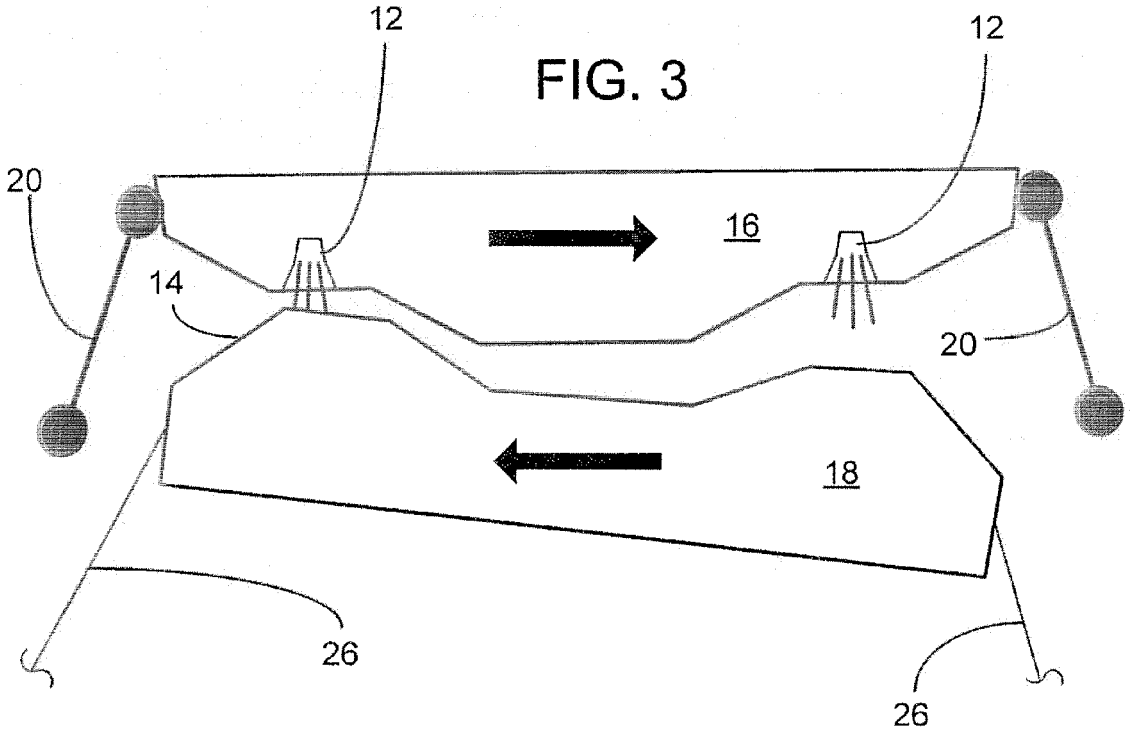


FIG. 4

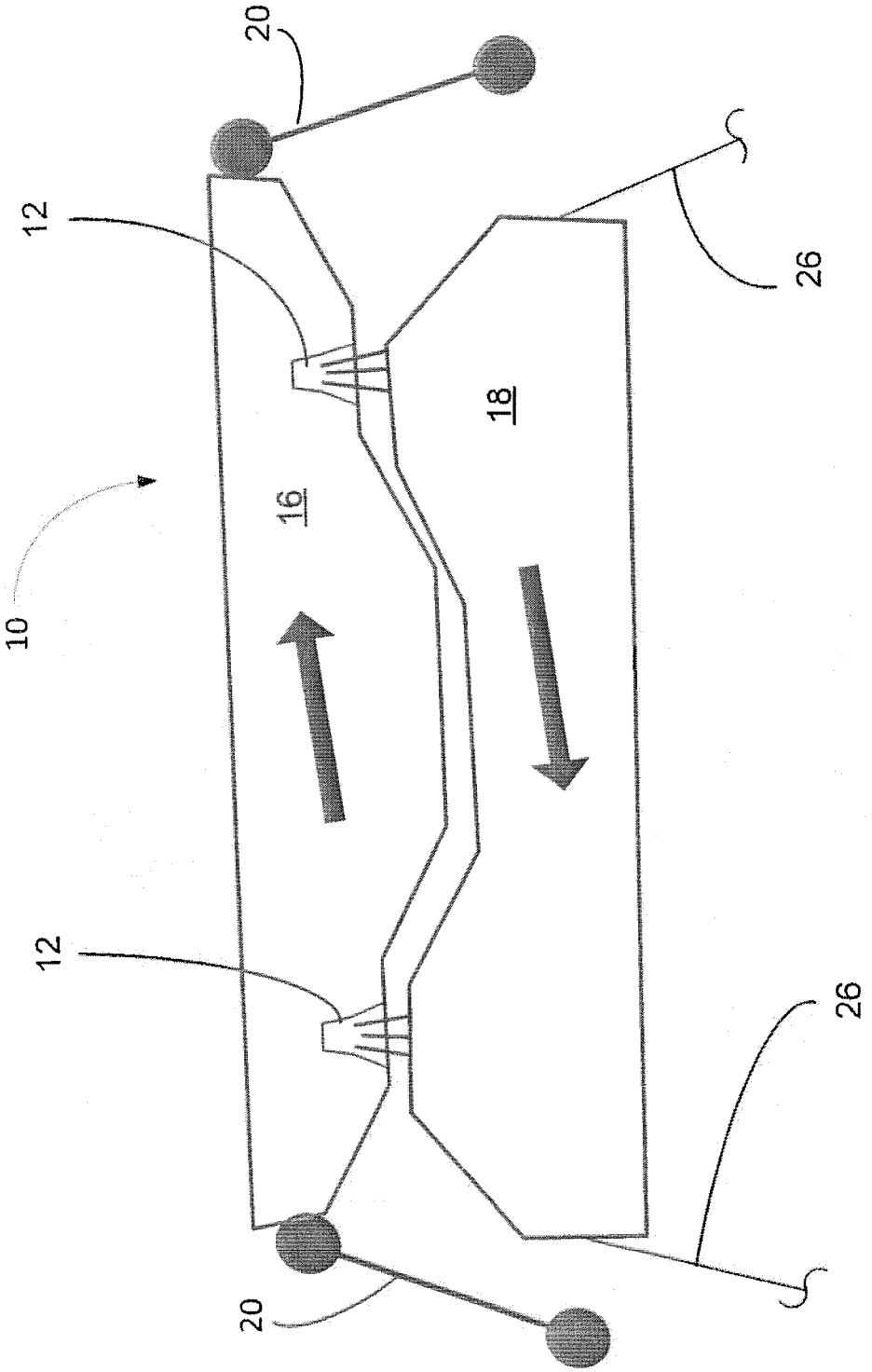
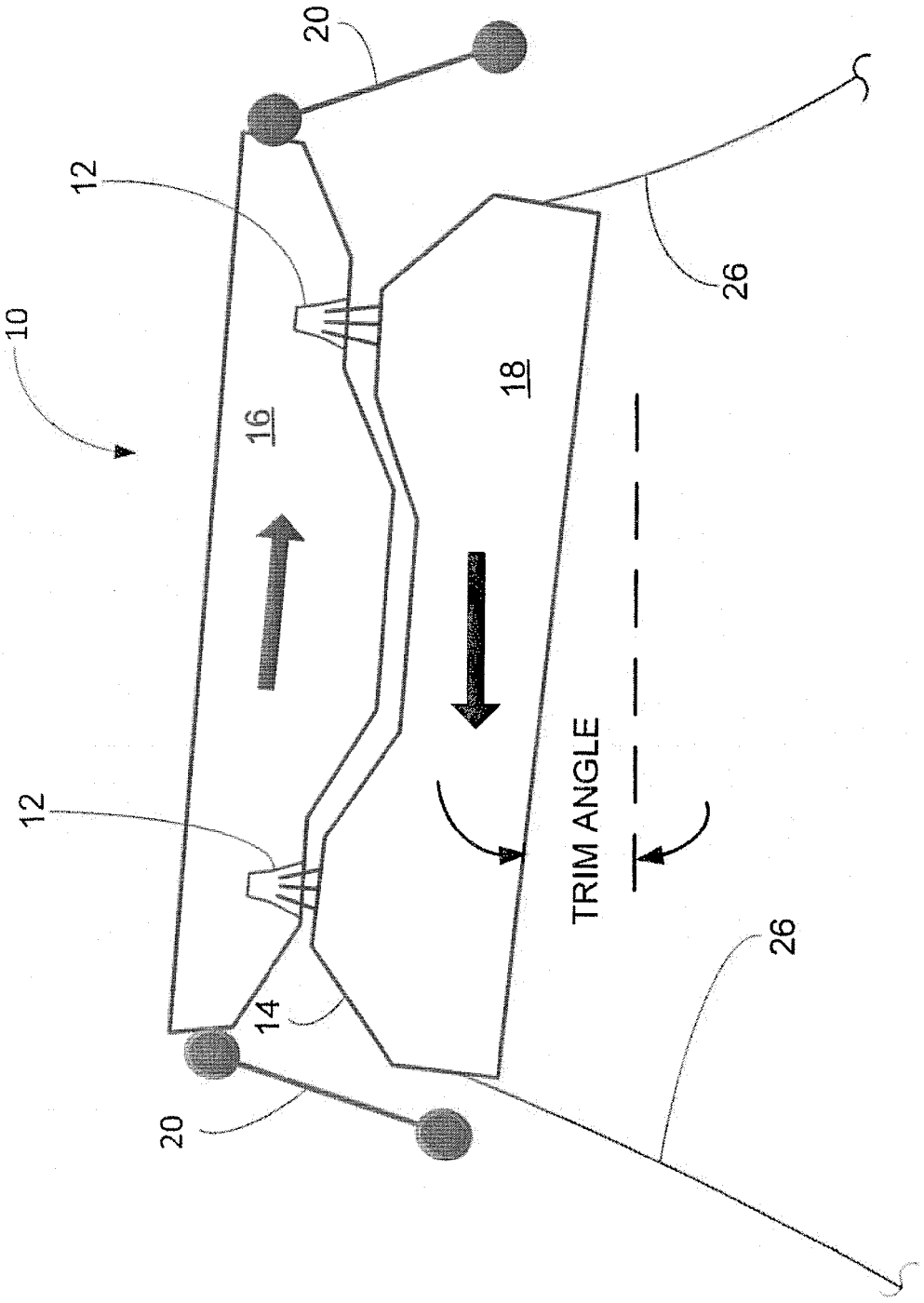


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 12 17 8016

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Place of search	Date of completion of the search	Examiner
Munich	12 November 2012	Vermeulen, Tom

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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