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[54] **METHOD FOR TRANSFERRING A HORIZONTALLY ARRANGED ROCKET FROM A VESSEL TO A FLOATING STRUCTURE LOCATED AT SEA**

[75] Inventors: **Bjørn Kindem, Kråkerøy; Per Herbert Kristensen, Rykkin; Bjørn Reidar Lien, Oslo, all of Norway**

[73] Assignee: **Kvaerner Maritime AS, Lysaker, Norway**

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[58] Field of Search 89/1.801, 1.802, 89/1.804, 1.805, 1.809, 1.81, 1.815, 1.8; 43/6.5; 414/282, 283, 137.9, 22.54, 138.4, 292; 14/27

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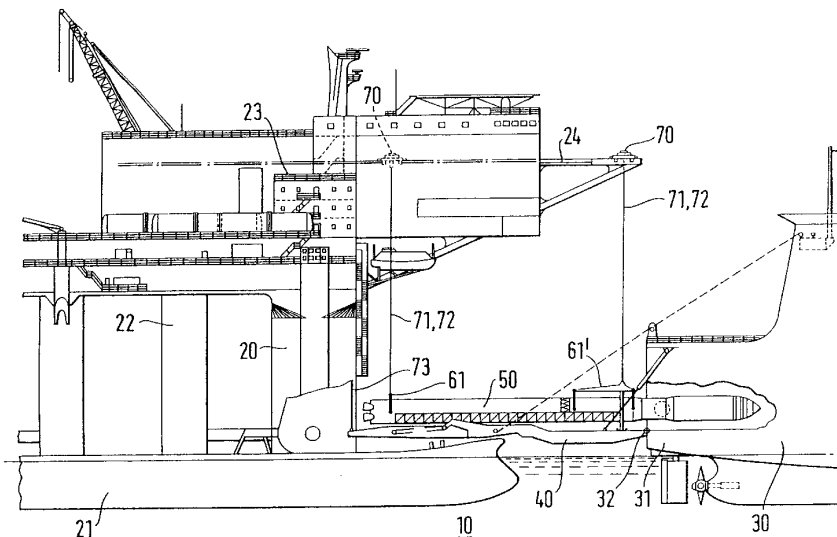
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Primary Examiner—Michael J. Carone
Assistant Examiner—Fredrick T. French, III
Attorney, Agent, or Firm—Birch, Stewart, Kolasch & Birch, LLP

[57] ABSTRACT

In a method for transferring a horizontally arranged rocket from a vessel to a floating structure, a ramp is provided in a position projecting out from the vessel, entirely or partially below a lifting device provided on a floating structure, and is connected to the floating structure. The rocket is moved completely or partially out on the ramp, and is lifted over to the floating structure by the floating structure's lifting device.

9 Claims, 3 Drawing Sheets



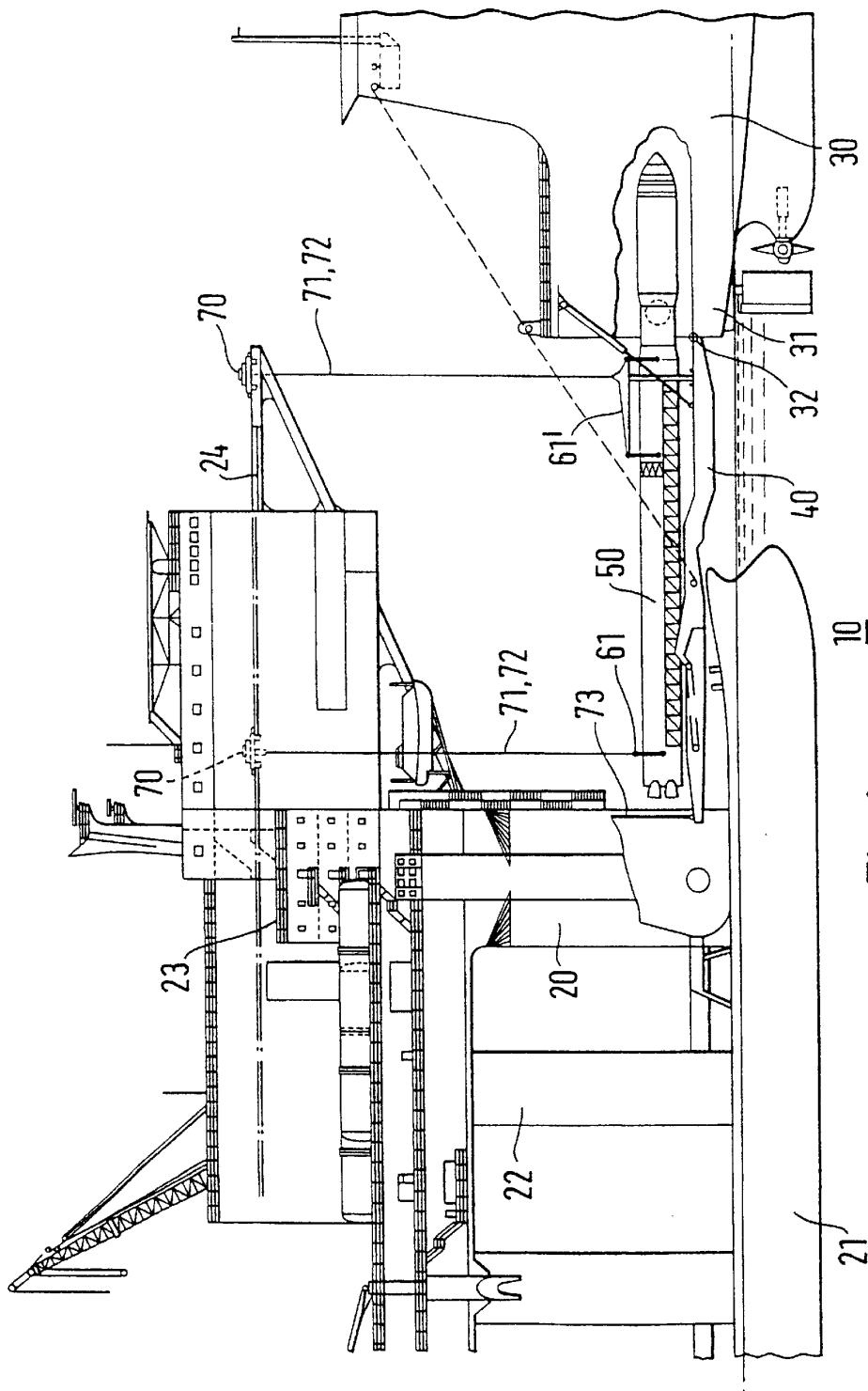


Fig. 1

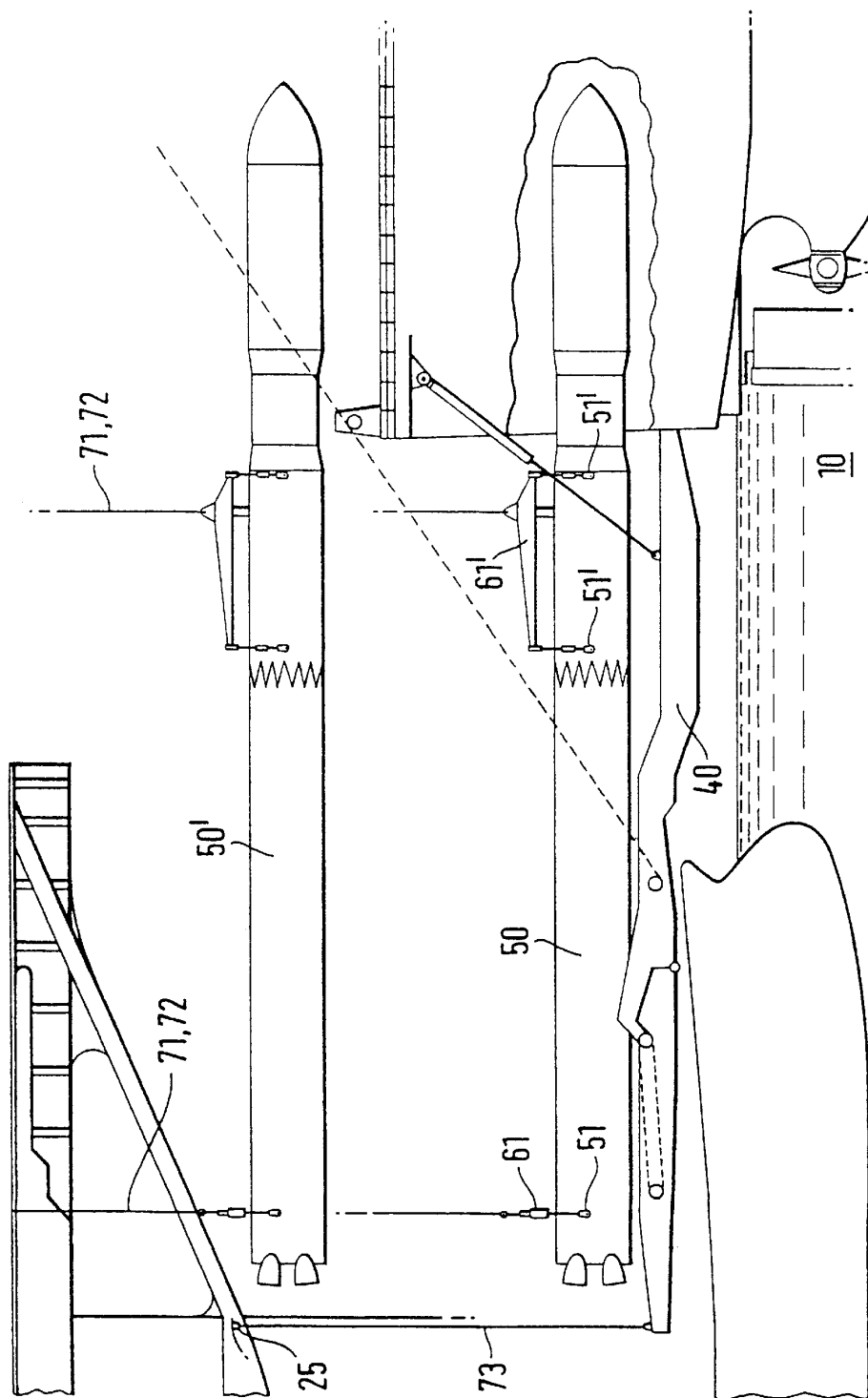


Fig. 2

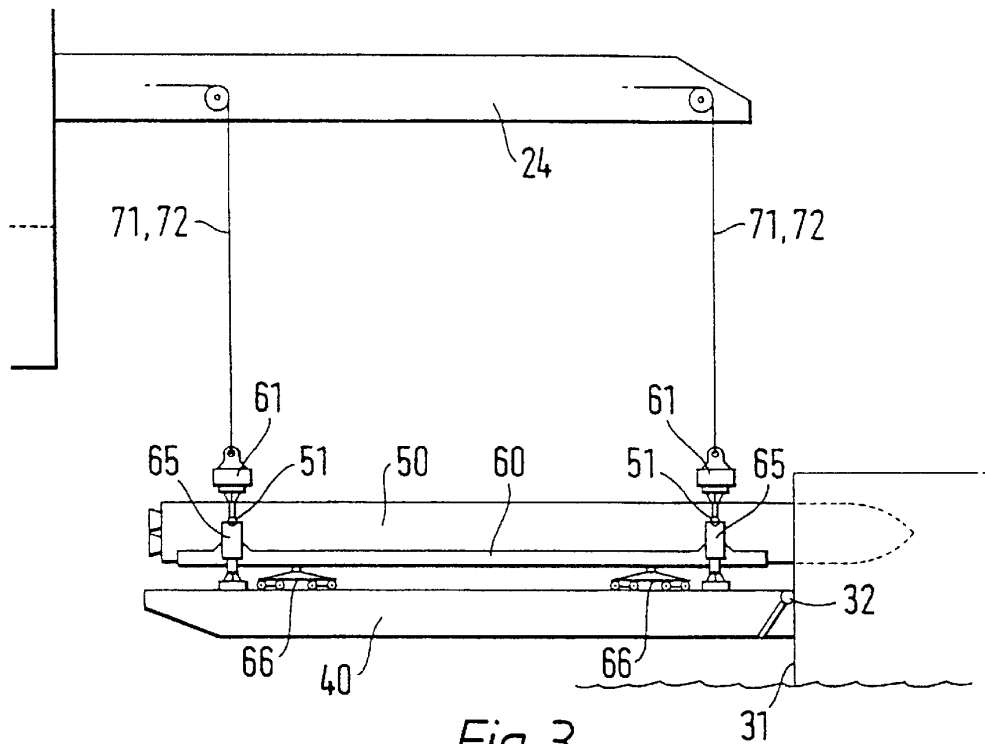


Fig. 3

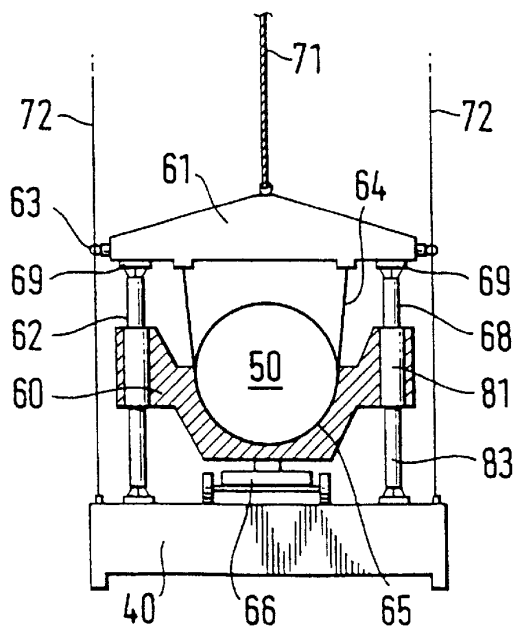


Fig. 4

**METHOD FOR TRANSFERRING A
HORIZONTALLY ARRANGED ROCKET
FROM A VESSEL TO A FLOATING
STRUCTURE LOCATED AT SEA**

This application is the national phase under 35 U.S.C. §371 of prior PCT International Application No. PCT/N097/00050 which has an International filing date of Feb. 18, 1997 which designated the United States of America, the entire contents of which are hereby incorporated by reference.

The invention concerns a method for transferring a horizontally arranged rocket from a vessel to a floating structure located at sea, wherein the rocket contains a payload which, e.g., has to be transported into space, and wherein the transfer is effected by bringing the rocket entirely or partially to a ramp, from which it is lifted in a horizontal position over to the floating structure.

Large rockets for transport of payloads into space may be 50 m or more in length. Such rockets contain a number of sophisticated technical systems, such as mechanical, electrical and optical systems, and both the rocket's technical systems and structural design are highly optimized with regard to weight. On account of this optimization the rockets are principally designed in order to withstand the loads to which they are exposed during launching, while they are only designed for small external stresses, such as stresses generated by wave movement and weather conditions.

The actual rocket consists of several stages and a payload, which, e.g., may be a satellite. The different stages and the payload are built separately and subsequently brought to an assembly location.

Due to the earth's rotation the equator is the most favourable place for launching rockets. However, the assembly and preparation of a large rocket requires substantial resources both in the form of expertise and material, and the availability of such resources is best in areas which are not situated at the equator.

Norwegian patent applications 951693, 951694 and 951695 describe the assembly and launch of rockets where the rocket is assembled in a horizontal position on board a vessel, and subsequently brought aboard a transportable floating platform for transport to a launch site and launching. The rocket can thereby be launched at the equator, while at the same time all the technical aids and technical expertise are easily available, since the aids and expertise can be present on board the vessel or platform. The above-mentioned patent applications do not, however, describe how the rocket is transferred from the vessel to the platform.

A vessel and a floating structure, such as a launch platform for a rocket, will normally have different movements in the water. The movements are mainly due to the influence of the waves, and the differences in movement are due to the fact that the vessel and the floating structure have different shapes and masses, and also that the influence of the waves on the vessel and the floating structure will be displaced in time in relation to each other. When objects are transferred between two vessels at sea where the objects are lifted by means of a lifting device on one vessel, this difference in movement is a recognized problem, since the objects can bump against the other vessel and be damaged.

The object of the invention is to provide a method for transferring a horizontally arranged rocket from a vessel to a floating structure, where the rocket is only exposed to small stresses due to the different movements of the vessel and the floating structure.

The object is achieved according to the invention with a method of the type mentioned in the introduction, characterized by the features which are indicated in the claims.

Thus, by means of the present invention the differences in movement between the vessel and the floating structure are reduced by setting up a ramp between the vessel and the floating structure. The ramp is connected to the vessel in such a manner that a rocket can be transferred from the vessel to the ramp in a practical fashion, e.g. on a carriage, while the ramp is simultaneously connected to the floating structure, thus holding the ramp completely or partially steady in relation thereto.

In a preferred embodiment the ramp is pivotally connected to the vessel, while a section of the ramp which is located furthest from the vessel is suspended in securing wires from the floating structure.

In this patent application the term "critical height" is understood to mean a minimum lifting height where there is no longer any risk of collision between the rocket and the base, especially a saddle.

The invention will now be explained in more detail in connection with a description of a specific embodiment and with reference to the drawing, in which

FIG. 1 is a side view of a rocket horizontally arranged on a ramp,

FIG. 2 shows the rocket in two different positions during a vertical lift,

FIG. 3 shows the rocket and the ramp in closer detail, and FIG. 4 shows a lifting yoke and a device for use in lifting.

The same reference numerals are used for corresponding parts in all the figures.

FIG. 1 illustrates a floating structure 20 with pontoons 21 and columns 22, floating at sea 10. On top of the columns 22 there is provided a deck structure 23 with a crane beam 24. Beside the floating structure there is located a vessel 30, of which only the stern 31 is shown. An elongated ramp 40 is placed in a position projecting out from the vessel 30, so that the ramp 40 is substantially located below the crane beam 24.

The end of the ramp which is located closest to the vessel is pivotally connected to the vessel about a horizontal axis 32, thus enabling the ramp to be rotated in relation to the vessel. The end of the ramp which is located furthest from the vessel 30 is connected to the floating structure 20 by being suspended in vertical securing wires 73 from an attachment point 25 on the floating structure. In this manner a ramp is obtained, one end of which is continuously connected to the vessel 30, and the other end of which has a constant vertical distance from the crane beam 24. The vessel's vertical movement will be transferred to the end of the ramp which is located closest to the vessel, while the floating structure's vertical movement will be transferred to the end of the ramp which is suspended in the wires 73. Thus the ramp forms a far better basis for a vertical lift of an object, in this case a rocket, than, e.g., the vessel's afterdeck.

When a rocket 50 is transferred from the vessel to the floating structure, the rocket is moved entirely or partially out on to the ramp 40 and lifted over to a floating structure by means of a lifting device 70, which in the illustrated embodiment is composed of lifting wires 71 from the crane beam 24.

FIG. 2 illustrates the lifting of the rocket, where the rocket is shown in two positions, a position on the ramp 40 before the lift, and a position 50' where the rocket has been lifted upwards in the direction of the crane beam 24. The rocket is lifted by means of two lifting yokes, a rear lifting yoke 61 in the form of a lifting beam, and a front lifting yoke 61' in the form of a frame. The rear lifting yoke 61 lifts the rocket

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