US006024006A

United States Patent [19]

Kindem et al.

[11] **Patent Number: 6,024,006**

[45] **Date of Patent: Feb. 15, 2000**

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

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[21] Appl. No.: **09/125,396**

[22] PCT Filed: **Feb. 18, 1997**

[86] PCT No.: **PCT/NO97/00050**

§ 371 Date: **Aug. 18, 1998**

§ 102(e) Date: **Aug. 18, 1998**

[87] PCT Pub. No.: **WO97/29947**

PCT Pub. Date: **Aug. 21, 1997**

[30] **Foreign Application Priority Data**

Feb. 19, 1996 [NO] Norway 96 0658

[51] **Int. Cl.**[7] **F41A 9/00**

[52] **U.S. Cl.** **89/1.801**; 89/1.805; 89/1.809; 89/1.815; 414/137.9; 414/138.4; 114/292

[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

[56] **References Cited**

U.S. PATENT DOCUMENTS

H683	10/1989	Brubaker	89/1.802
175,019	3/1876	Borgfeldt	114/292
834,335	10/1906	Taylor	414/138.4
3,284,888	11/1966	McClain et al.	89/1.801
3,303,740	2/1967	Grayson et al.	89/1.815
3,831,311	8/1974	Cushing	43/6.5
4,444,087	4/1984	Hunter et al.	89/1.802
4,590,634	5/1986	Williams	14/27
4,747,334	5/1988	Kuriiwa	89/1.802
4,839,062	6/1989	Sanders	43/6.5
4,916,999	4/1990	Palmer et al.	89/1.815
4,998,369	3/1991	Lamon	43/6.5
5,032,040	7/1991	Ingle	14/27
5,042,358	8/1991	Kuriiwa	89/1.815
5,191,162	3/1993	Czimmek	89/1.802
5,379,863	1/1995	Sugawara et al.	414/282
5,649,333	7/1997	Chernjawski	14/27
5,845,875	12/1998	Deel	244/63
5,908,999	6/1999	Kristensen et al.	89/1.801
5,918,306	6/1999	Kristensen et al.	89/1.801
5,932,830	8/1999	Kristensen et al.	89/1.801

FOREIGN PATENT DOCUMENTS

57165	8/1982	European Pat. Off.	89/1.801
3315888A1	11/1984	Germany .	
951693	5/1995	Norway .	
951694	5/1995	Norway .	
951695	5/1995	Norway .	
2070554A	9/1981	United Kingdom .	
WO9634795	11/1996	WIPO .	

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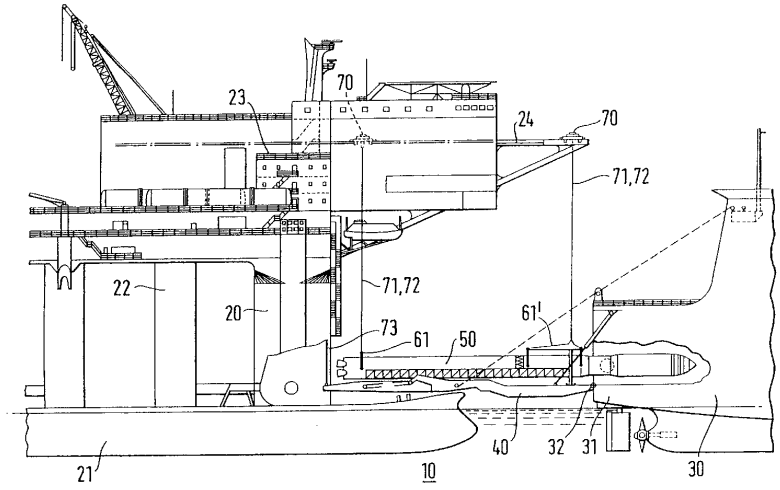
[57] **ABSTRACT**

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



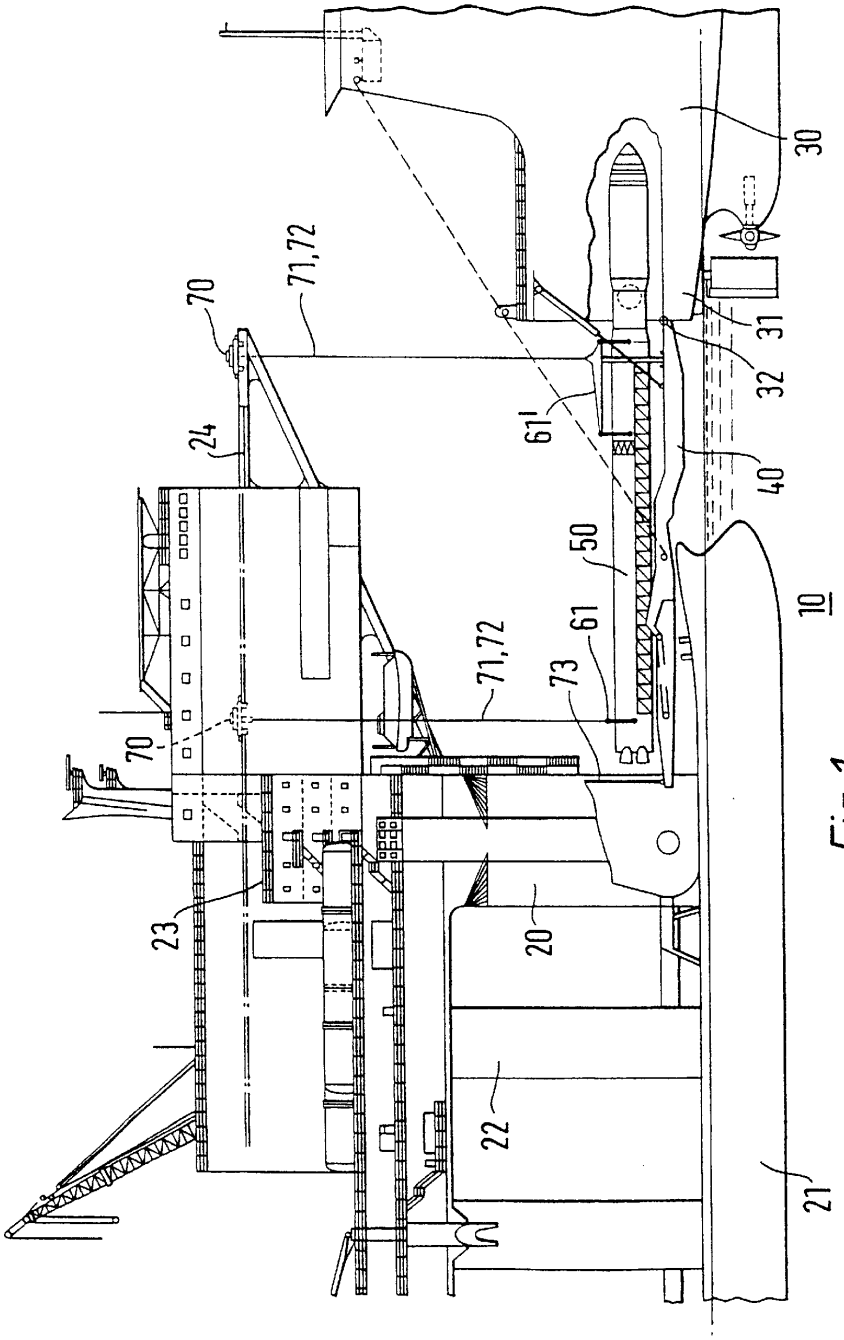


Fig. 1

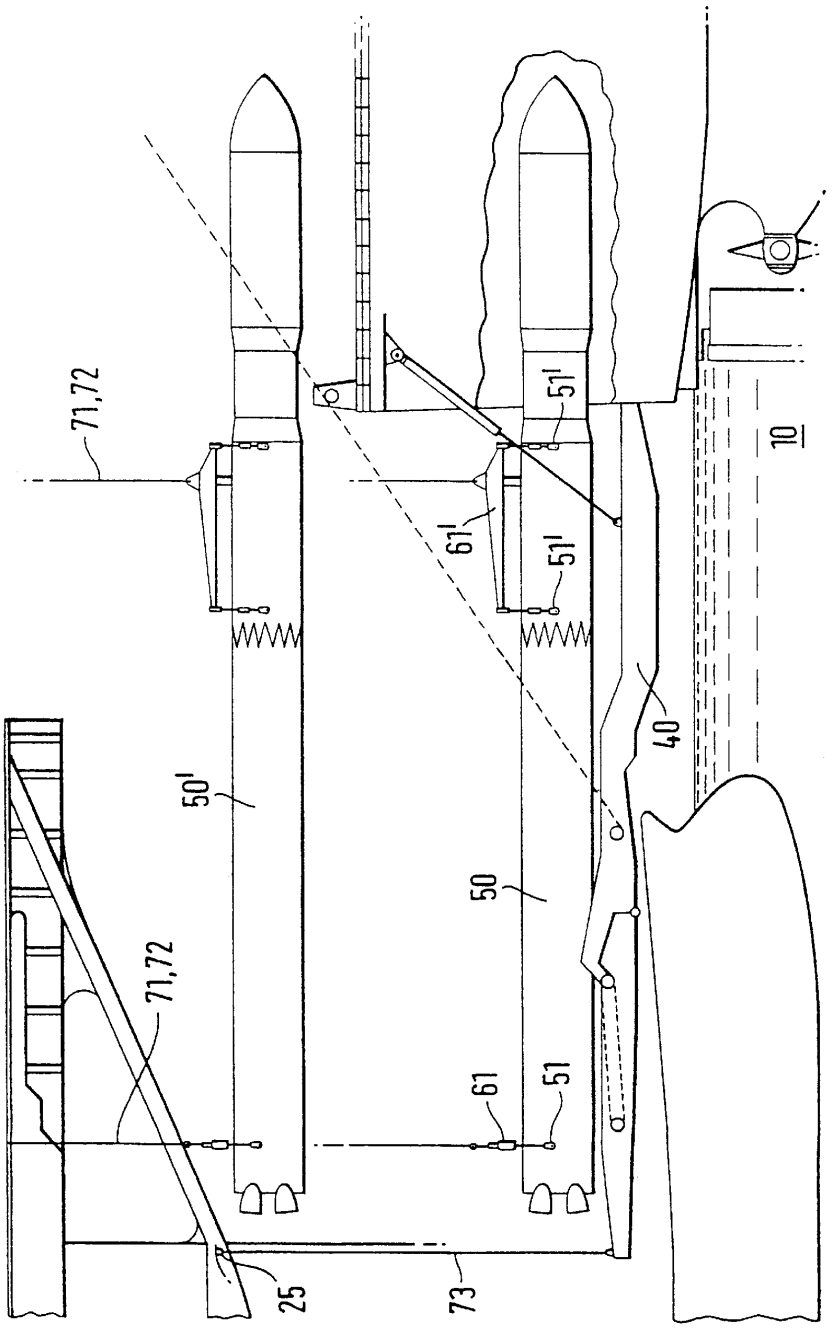


Fig. 2

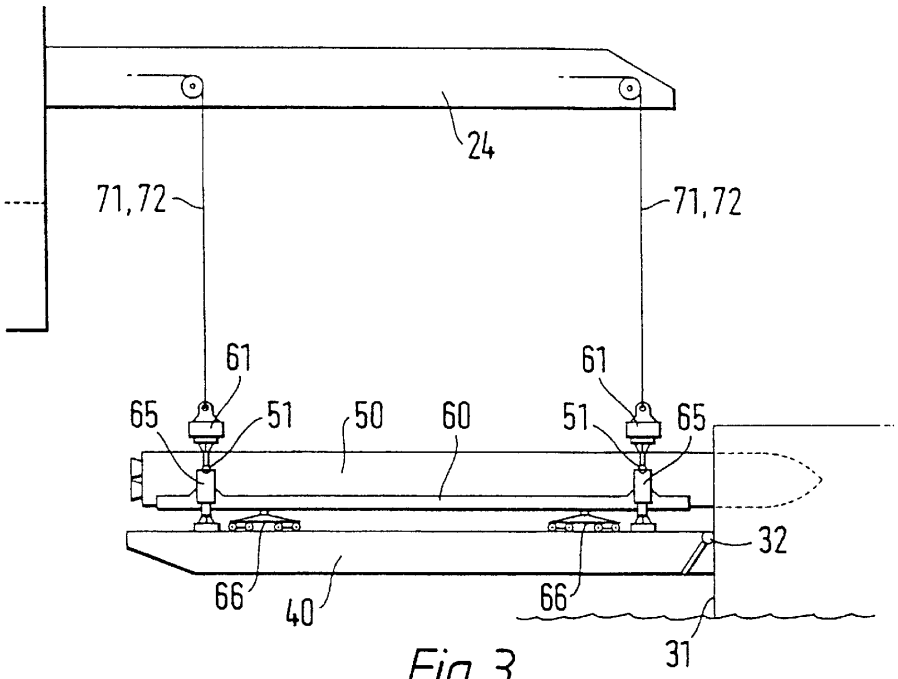


Fig. 3

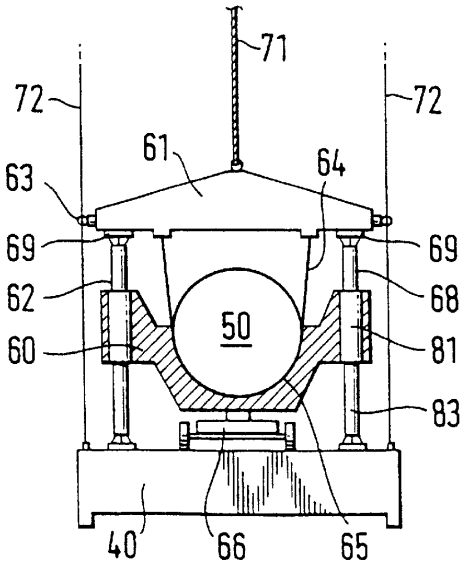


Fig. 4

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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