Aug. 5, 1969 C. D. PHILLIPS ET AL 3,459,102

MISSILE LOADING APPARATUS

Filed Nov. 13, 1967 3 Sheets-Sheet 1

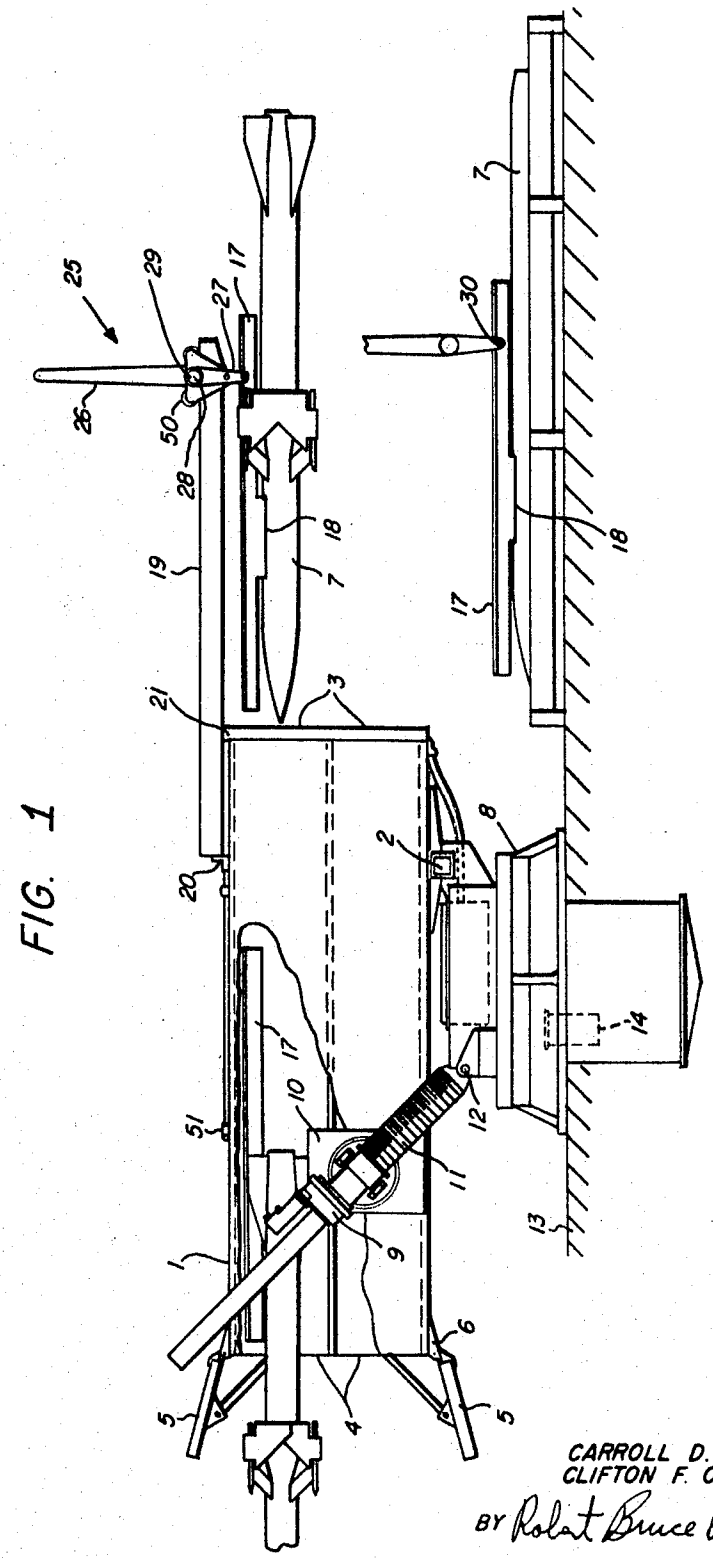


FIG. 1

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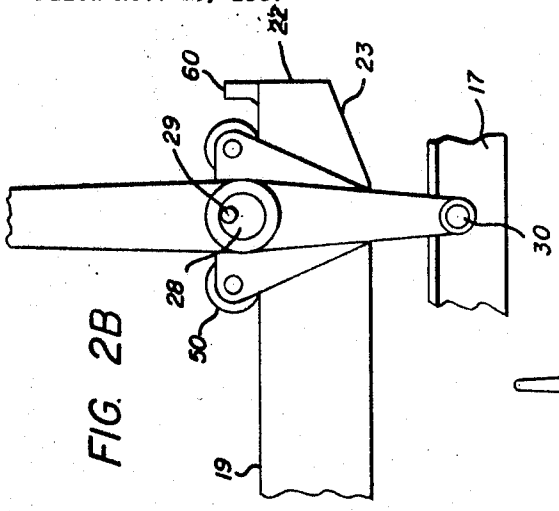


FIG. 2B

FIG. 2A

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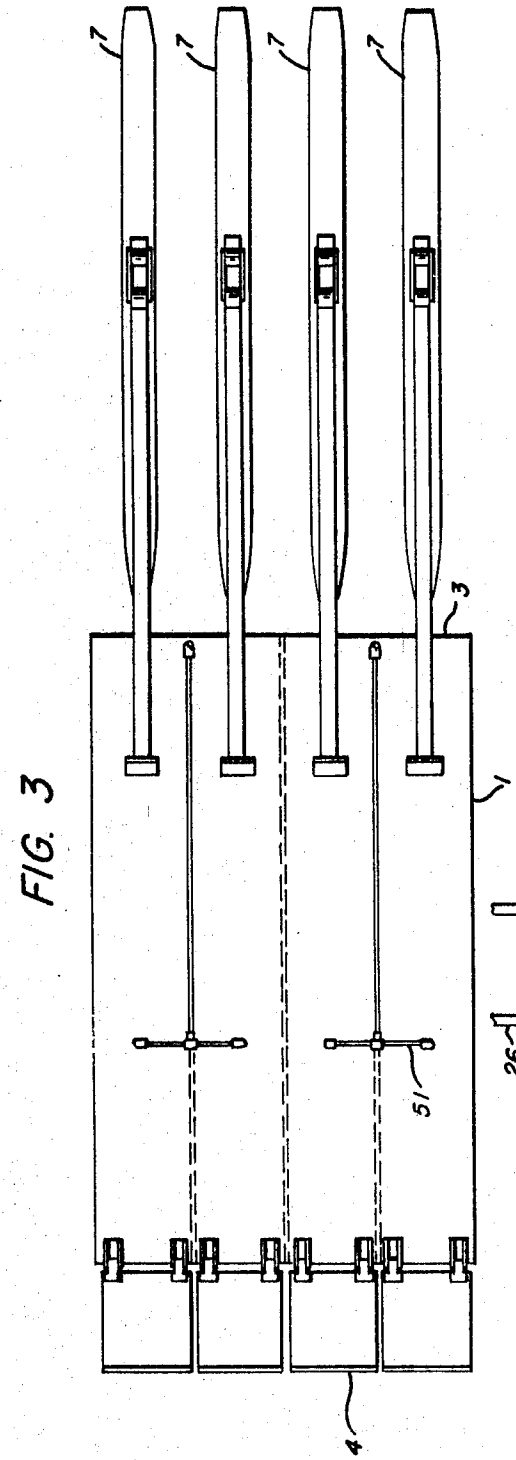


FIG. 3

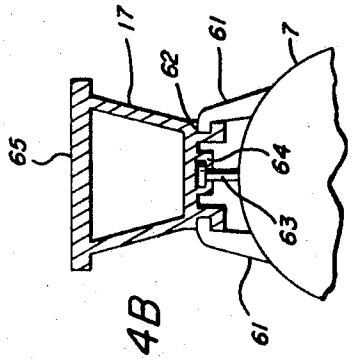


FIG. 4B

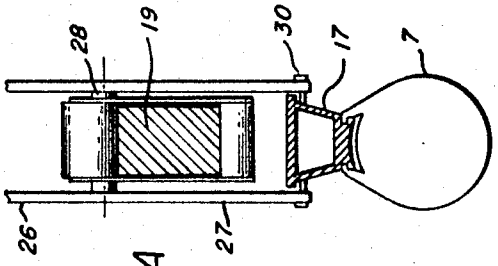


FIG. 4A

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MISSILE LOADING APPARATUS

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Int. Cl. F41f 3/04, 9/00

U.S. Cl. 89—1.805 7 Claims

ABSTRACT OF THE DISCLOSURE

A missile loading apparatus comprising a launch chamber rotatable through an elevation angle and having one end open to receive a missile therein. A guide rail is affixed to each missile prior to loading, the rail being insertable with the missile into the chamber. A lever secured to the open end of the chamber and projecting a distance therefrom has its projecting end formed in the shape of a parabolic taper to compensate for vertical deflections. Grasping means coupling the projected end of the lever engages the guide rail when the open end of the chamber is depressed, and translates the engaged guide rail opposite the chamber when the chamber is horizontal. The oppositely disposed missile is then inserted into the chamber.

BACKGROUND OF THE INVENTION

This invention relates to missile loading apparatus, and more particularly, to deck level missile loading apparatus for shipboard use and in similar platform environments.

In the prior art, the loading of missiles at deck level on shipboard required elaborate lifting devices. The lifting devices served as platforms for crews to stand on and for access to the various portions of the missile and launcher requiring manual or machine attention. Illustrative of the difficulties found in prior systems was the fact that numerous mechanical and electrical connections necessary between the missile and the launch control apparatus were made only when the missile was in place within the lanucher. Another disadvantage was that elaborate winching and extra power sources took substantial space in the constrained environment of a ship's deck.

It is accordingly an object of the invention to devise a missile loading apparatus which increases efficiency by using the power available to the launcher to perform the lifting function.

It is an object of the invention to secure a geometric arrangement of elements to minimize crowding on a ship's deck.

It is another object of the invention to reduce time for loading and launching.

It is a still further object to devise a structure using simplified deflection compensation devices.

SUMMARY OF THE INVENTION

The above and other objects of this invention are satisfied in an embodiment comprising a launch chamber rotatable through an elevation angle and having one end open to receive a missile. A separable guide rail is affixed to each missile and is capable of being inserted into the launch chamber. A lever is secured to the open end of the chamber and projects a distance therefrom. The lever has its projecting end parabolically tapered to compensate for vertical deflection. Grasping means coupling the projected end of the lever are used for engaging the guide rail when the open end of the chamber is depressed and for translating the engaged guide rail opposite the chamber when the chamber is horizontal. The oppositely disposed missile may then be inserted into the chamber.

This structure permits rear end loading and thereby avoids placing loading apparatus in front of the launching chamber. Furthermore, it takes advantage of the launch chamber elevation power drive for performing the lifting function. Also, the use of a guide rail separable from the launch chamber permits a number of preliminary mechanical connections to be made. This reduces and simplifies the time and numbers of connections necessary when the missile is engaged with the launcher.

A first launch chamber may be mounted atop a second chamber. In this situation, the grasping means are modified to include a dual length lifting link pivotably mounted at the end of the projecting lever. A first link length is equal to the vertical distance between the lever and the major axis of the top launch chamber. A second link length is equal to the vertical distance between the lever and the bottom chamber major axis. When the open end of the chambers are depressed, the link that corresponds to the desired chamber may be rotatably positioned. This facilitates attachment to the guide rail. This structural modification maintains the simplicity of the apparatus even though it is required to load missiles into multple chambers.

The grasping means may be further modified to include an eccentric crank device for manually correcting for vertical beam deflection when the guide rail is positioned opposite the corresponding chamber. This permits minor vertical adjustments to be performed prior to actual insertion.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows an elevation view of the invention with the launch chamber in the horizontal position.

FIG. 2A shows launcher in elevated position.

FIG. 2B shows link engagements on lever and guide rail.

FIG. 3 is a plan view of a portion of the invention in which the guide rail is shown partially inserted in the launch chamber.

FIG. 4A shows link and guide rail pin connection.

FIG. 4B shows a cross-sectional view of the guide rail and missile coupling.

In FIG. 1 a number of chambers may be mounted together, preferably one atop the other. However, in the description of the invention reference will most often be made to a single chamber.

Launch chamber **1** rests in pedestal **8**. The cradle is pivotably mounted in the elevation angle direction on pedestal **8** at pivot point **2**. Rotation about point **2** through an elevation angle θ is accomplished by a pair of elevation actuators **9** secured to launch chamber trunnion plate **10** and connected to opposite sides of the chamber. A ball screw **11** is connected at one end to trunnion plate **10** and at the other end is pivotably connected at point **12** to pedestal **8** to increase the elevation angle when rotated by a suitable motor in a first direction and to decrease the elevation angle when rotated in the opposite direction. The elevating mechanism itself is conventional and does not constitute part of this invention and, therefore, further detail is believed unnecessary.

One end **3** of the chamber **1** is open to receive a missile **7** therein. The other end **4** is covered by a cell door **5** pivoted thereto at point **6**. The door opens automatically when the missile is launched.

The pedestal **8** is shown mounted on deck **13**.

The launcher is adapted to support small-to-medium size missiles in a weight range between 500 to 3000 pounds for surface-to-air target intercept purposes. When a missile has been inserted in a chamber, mechanical connections must exist between the controls within the missile and the external launch controls. This type of missile is

guided out of the launcher by a guide rail. One guide rail **17** is shown by dotted lines within chamber **1**.

In this invention, however, guide rails **17** are separable from the chamber and may be affixed to each missile at a point **18** along the longitudinal extent of the missile. The guide rail contains a hold back latching mechanism capable of grasping hooks contained on the body of the missile. This facilitates the preliminary mechanical coupling connections to be made (not shown) before the missile is loaded into the launch chamber.

A lever **19** is secured at the open end **3** of the chamber by fasteners **20** and **21** and projects a substantial distance behind the open end of the chamber. The lever is contoured parabolically upwards to compensate for static deflection. A lift **25** has a first link length and a second link length **27** and is pivotably mounted at point **28** at the end **22** of the lever. The dual length lift link is primarily designed to permit the loading of two chambers. The loading of multiple chambers will be described subsequently. The loading of the top chamber using link length **27** is illustrated and described here.

An eccentric crank (not shown) has its pivot at pin **29** and provides a small vertical adjustment to compensate for beam deflections during linear engagement of the guide rail with the launch chamber. Lift link **27** engages the guide rail at point **29** and is secured by a pin therethrough.

Lever **19** may be manually installed and lifted into place. During installation, the launch chamber is elevated approximately 30° to facilitate the placement of the lever.

As shown in FIGS. 1, 2A, and 3 missile **7** is located at the rear end of the launch chamber **1**. It is in line with the particular chamber to be loaded. Guide rail **17** has been pre-installed on missile **7** with preliminary mechanical connections made. To connect the shorter lift link **27**, employed in the multi-tier arrangement when the upper tier is being loaded, the launch chamber is elevated with the electrical controls usually used to adjust the launcher in the proper elevation position for launch purposes. The connection is then made between the link and the guide rail by a suitable pin at point **30**.

In FIG. 2A, the rear end **3** is shown depressed at an angle of 30°. Lift link **26** is engaged to guide rail **17** at pivot **30**. The positioning of the launcher occurs entirely through the elevation actuators **9**.

To position the missile for insertion into the chamber, the chamber is depressed to 0° elevation. It may be also stated that the rear end becomes elevated by 30°. While the missile is being lifted, it is necessary to provide restraint in the lateral or roll directions. This restraint is provided by the lifting link.

Since the missile loading apparatus was envisioned primarily for shipboard installation, it is expected that motion in the roll direction would result principally from lateral acceleration about the ship's roll center with a site thrust vector of approximately 1.0*g* vertical missile weight.

After the launcher is fully horizontal, the missile is positioned at within a small tolerance of the proper elevation. This deviation is corrected by use of an eccentric pin **29** of lift link **25**. Vertical deflection of the lever **19** is compensated for by the provision of the parabolic upward contour of lever **19** with supplementary correction provided by crank **28**. Illustratively, if a parabola is in an upward direction with a maximum displacement of 0.23 inch this would be equivalent to the calculated deflection downward when the beam is subjected to the 1.06 vertical missile load.

Missile insertion may be accomplished either by manual or machine translation of the missile into the launch chamber. During the initial travel, the missile weight may be supported on rollers **50** as shown in FIGS. 1 and 2B to ease the insertion force. The lift link is pushed toward the chamber. As the missile enters, it is necessary to engage the guide rail. After suitable engagement, the link pin may be removed from the guide rail. The missile can now be fully inserted through the engagement of the chamber supporting the guide rail. A rail latch may be used to lock the rail and chamber together.

For the lifting and insertion of a missile into a lower tier chamber, the lift link **25** may be rotated about pivot **28** such that link **26** may be attached to the guide rail at point **30**.

FIG. 2B shows a portion of the link engaging the lever and the guide rail. Each link length **26** and **27** is bifurcated (see FIG. 4A) to facilitate translation of the non-engaged vertical link along the lever. A roller carriage **50** mounted on the top surface of the lever permits the translation of the entire link and attached guide rail and missile. When the open end **3** of the launch chamber is depressed, a stop **60** placed at the extreme end of the lever prevents the roller carriage from sliding off. Similarly, a latch mechanism may be incorporated to prevent back sliding of the roller carriage along the lever when installed aboard ship in heavy seas.

The configuration of the eccentric crank pivot pin **29** is such as to provide vertical correction when either link is engaged.

In FIG. 3 missile **7** with guide rail **17** affixed thereto is shown in the plan view. Upon the guide rail being fully inserted into launch chamber **1** the electrical connections to the external launch control mechanism and the missile may be accomplished by mechanically connecting conduit to the guide rail at point **51**.

FIG. 4A is a cross-sectional view of lift link **27** engaging guide rail **17** with a pin **30** inserted clear through the forks of the lift link **26** and the guide rail **17**.

The guide rail and missile coupling is shown in the cross-sectional view of FIG. 4B. The top **65** of guide rail **17** extends beyond the sides for lips which are inserted into corresponding fittings (not shown) in the launcher. A recessed lip **62** is adapted to be slidably inserted into protrusions **61** extending from the missile. A stop **63** also attached to the missile is positioned forward of the protrusions **61** along the missile length towards the nose end. This stop abuts within a correspondingly positioned holder **64** of the guide rail.

For affixing the guide rail to the missile the rail is slid on the front end of the missile opposite the protrusions and pushed back towards the tail end of the missile. The recess **62** must slidably engage protrusions **61** on either side until stop **64** is nestled within holder **64**.

In summary, a missile loading has been described in which a launch chamber rotatable in the elevation angle direction has an open end for missile insertion therein. A lever secured at the open end and projecting a distance therefrom has its projection end parabolically contoured to compensate for vertical deflection. A guide rail necessary for launching the missile is affixed to the missile prior to loading. A link lift coupled to the projected lever end engages the affixed guide rail when the open end of the launch chamber is depressed. The missile is translated opposite the corresponding chamber as the chamber becomes horizontal. The missile is then inserted into the chamber by horizontal translation until the guide rail is locked and secured.

We claim:

1. In a shipboard missile launcher of the type having a deck mount the combination comprising:

a missile launch cell having fore and aft open ends, the aft end being adapted to receive a missile therein;

means for rotatably mounting in elevation angle the launch cell to the deck mount;

a guide rail affixed to each missile along its longitudinal extent and insertable into the cell through the aft end;

a lever mounted on the cell and extending rearwardly so as to project over the aft end parallel to the lon-

gitudinal cell axis, the lever including a stop secured along its extent;

carriage means slidably mounted upon the lever and inhibited in a downward motion by the stop when the aft cell end is depressed;

a lift link pivotably affixed to the carriage means and extending below the lever;

means for engaging the guide rail and attached missile to the extended below portion of the lift link when the aft end of the cell becomes depressed and for translating the engaged guide rail and attached missile to a position opposite to the aft cell end and substantially parallel to the longitudinal cell axis when the cell becomes horizontally placed; and

means for manually translating and inserting the oppositely disposed engaged guide rail and attached missile into the aft end of the cell.

2. In a shipboard missile launcher according to claim **1**, wherein the carriage means comprise:

means for vertically adjusting the position of the engaged guide rail and attached missile with respect to the longitudinal axis of the cell to compensate for cantilever deflection of the lever.

3. In a shipboard missile launcher of the type having a deck mount the combination comprising:

a missile launch cell, having fore and aft open ends, the aft end being adapted to receive a missile therein;

means for rotatably mounting in elevation angle the launch cell to the deck mount;

a guide rail affixed to each missile along its longitudinal extent and insertable into the cell through the aft end;

a lever mounted on the cell and extending rearwardly so as to project over the aft end parallel to the longitudinal cell axis, the lever including a stop secured along its extent, the projecting portion of the lever having a parabolic contour to compensate for vertical deflection;

carraige means slidably mounted on the lever and inhibited in a downward motion by the stop when the aft cell end is depressed;

a lift link pivotably affixed to the carriage means and extending below the lever;

means for engaging the guide rail and attached missile to the extended below portion of the lift link when the aft end of the cell becomes depressed and for translating the engaged guide rail and attached missile to a position opposite the aft cell end and substantially parallel to the longitudinal cell axis when the cell becomes horizontally placed; and

means for manually translating and inserting the oppositely disposed engaged guide rail and attached missile into the aft end of the cell.

4. In a shipboard missile launcher of the type having a deck mount, the combination comprising:

a first and a second missile launch cell mounted one atop the other each having fore and aft open ends, each aft end being adapted to receive a missile therein;

means for rotatably mounting in elevation angle the first and second launch cells to the deck mount;

a guide rail affixed to each missile along its longitudinal extent and insertable into the cells through their aft ends;

a lever mounted on the top cell and extending rearwardly so as to project over the aft cell ends parallel to the longitudinal cell axes, the lever including a stop secured along its extent;

carriage means slidably mounted upon the lever and inhibited in a downward motion by the stop when the aft cell is depressed;

a dual length lift link pivotably affixed to the carriage means, the first link length being equal to the vertical distance between the lever and the top cell longitudinal axis, the second link length being equal to the vertical distance between the lever and the bottom cell longitudinal axis, the dual length link being selectively rotatable to match the link length to the cell into which it is desired to load a missile;

means for engaging the guide rail and attached missile to the preselected link length when the aft end of the cell becomes depressed and for translating the engaged guide rail and attached missile to a position opposite to the aft cell end and substantially parallel to the longitudinal cell axis when the cells become horizontally placed; and

means for manually translating and inserting the oppositely disposed engaged guide rail and attached missile into the aft end of the cell.

5. In a shipboard missile launcher according to claim **4**, wherein the carriage means include:

means for vertically adjusting the position of the engaged guide rail and attached missile with respect to the longitudinal axis of either cell to compensate for cantilever deflection.

6. In a shipboard missile launcher according to claim **4**, wherein the projecting portion of the lever has a parabolic upward contour to compensate for vertical cantilever deflections.

7. In a shipboard missile launcher of the type having a deck mount the combination comprising:

a missile launch cell having fore and aft open ends, the aft end being adapted to receive a missile therein;

means for rotatably mounting in elevation angle the launch cell to the deck mount;

a guide rail affixed to each missile along its longitudinal extent and insertable into the cell through the aft end;

a lever mounted on the cell and extending rearwardly so as to project over the aft end parallel to the londitudinal cell axis, the lever including a stop secured along its extent, the projecting portion of the lever having a parabolic taper to compensate for vertical cantilever deflections;

carriage means slidably mounted upon the lever and inhibited in a downward motion by the stop when the aft cell end is depressed;

a lift link pivotably affixed to the carriage means and extending below the lever;

means for engaging the guide rail and attached missile to the extended below portion of the lift link when the aft end of the cell becomes depressed and for translating the engaged guide rail and attached missile to a position opposite to the aft cell and substantially parallel to the longitudinal cell axis when the cell becomes horizontally placed, the carriage means include:

means for vertically adjusting the position of the engaged guide rail and attached missile with respect to the longitudinal axis of the cell to compensate for cantilever deflection; and

means for manually translating and inserting the oppositely disposed engaged guide rail and attached missile into the aft end of the cell.

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U.S. Cl. X.R.

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