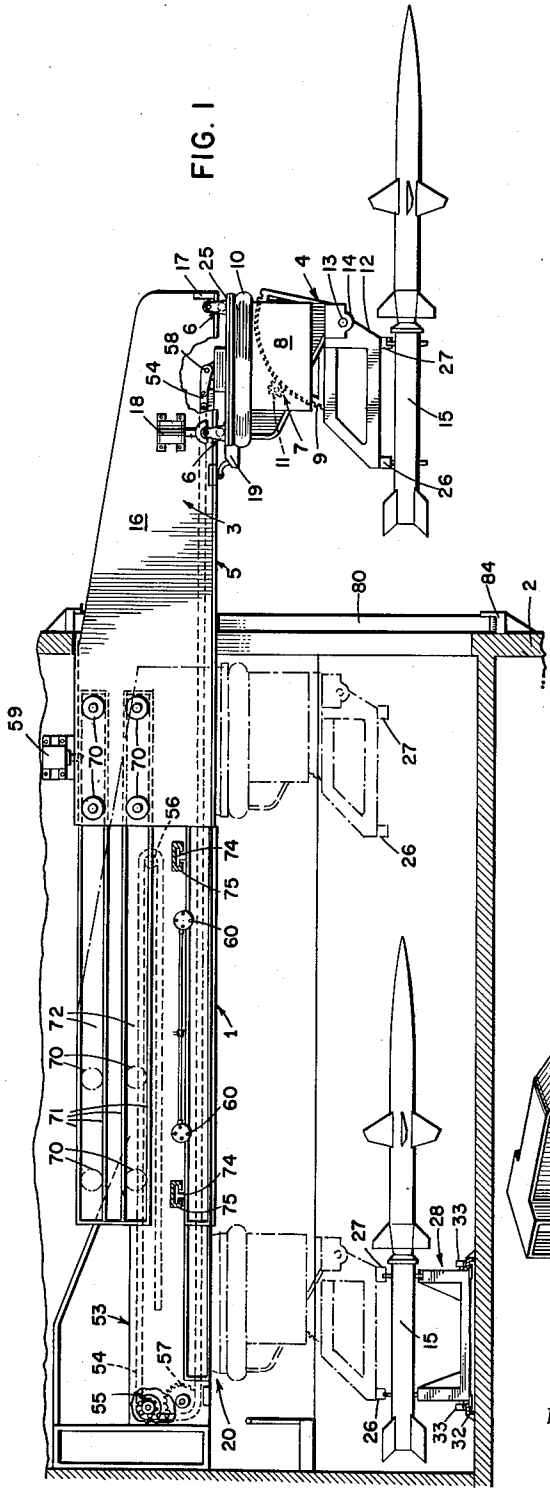
July 17, 1962 R. E. CARLBERG 3,044,362

BELOW DECK SHIPBOARD MISSILE LAUNCHING SYSTEM

Filed Dec. 29, 1958 4 Sheets-Sheet 1

FIG. 1



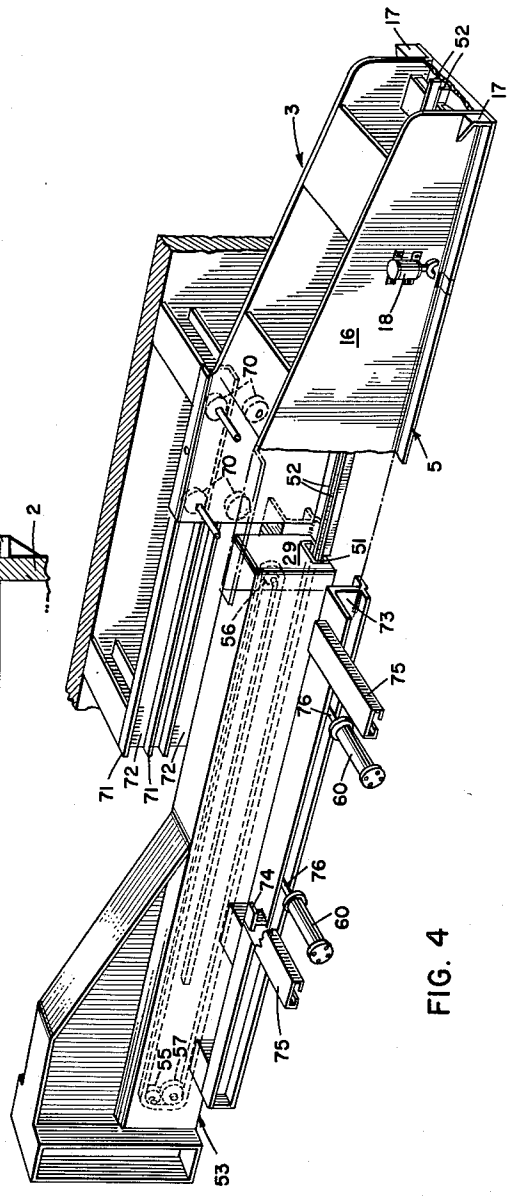


FIG. 4

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BELOW DECK SHIPBOARD MISSILE LAUNCHING SYSTEM

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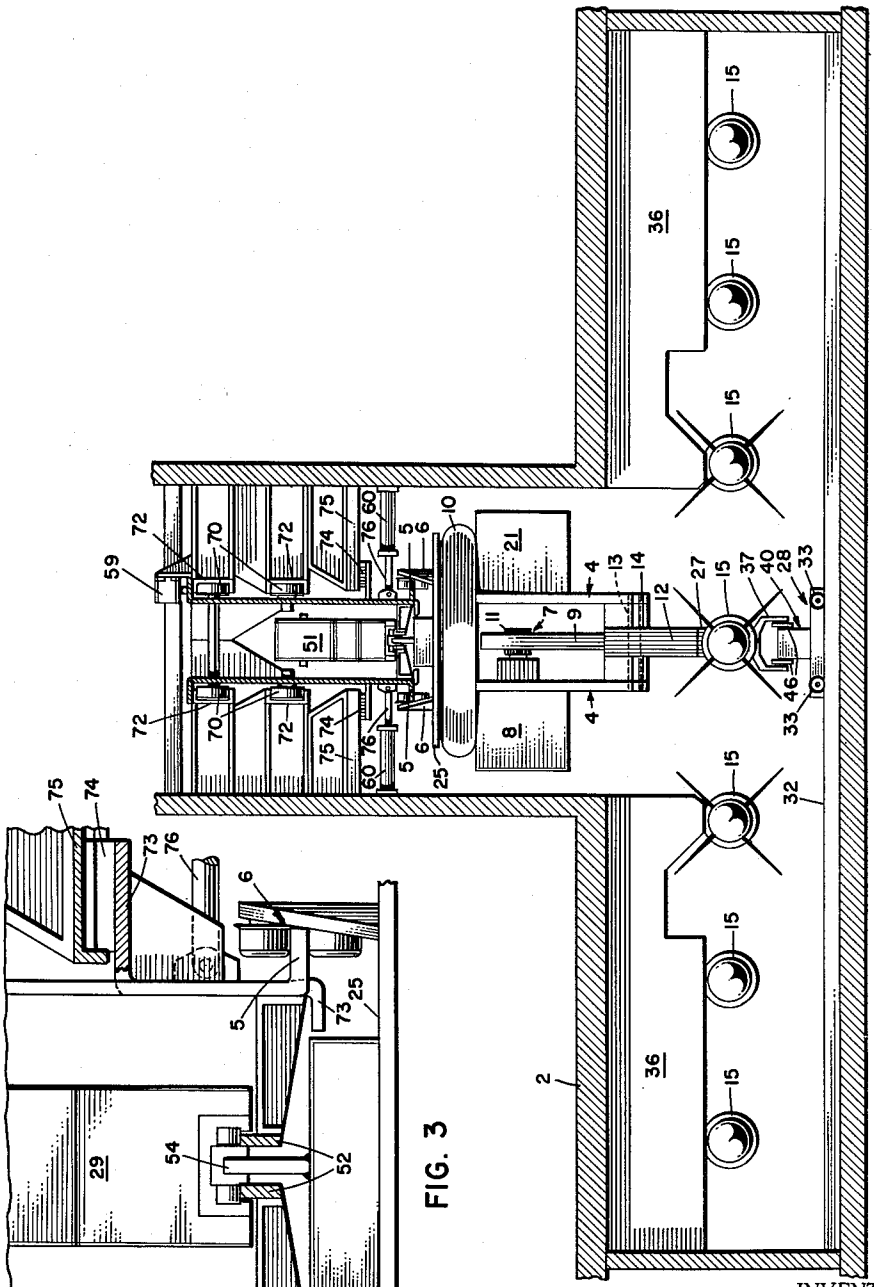

FIG. 2

FIG. 3

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BELOW DECK SHIPBOARD MISSILE LAUNCHING SYSTEM

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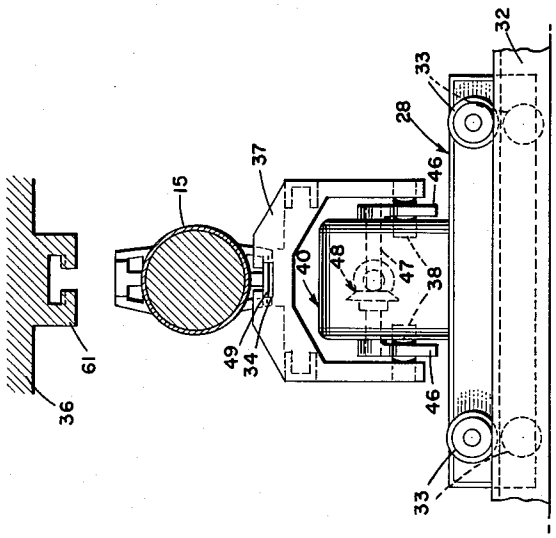

FIG. 6

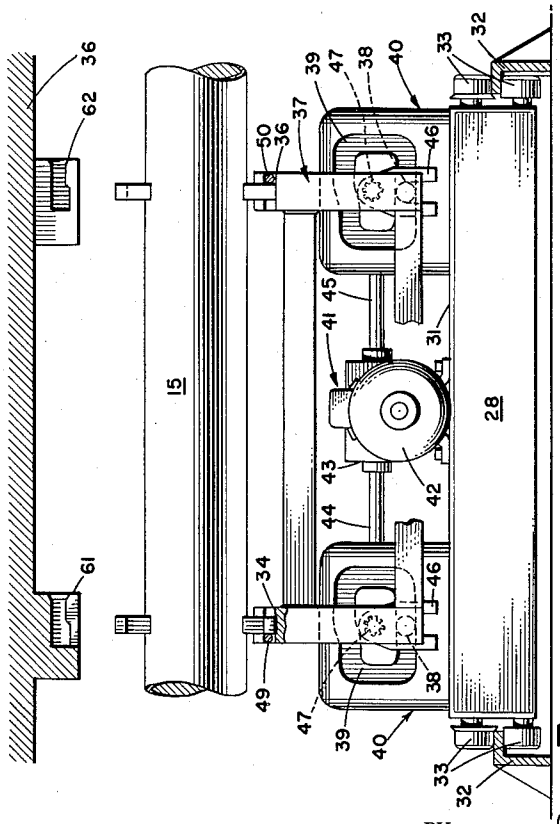

FIG. 5

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FIG. 7

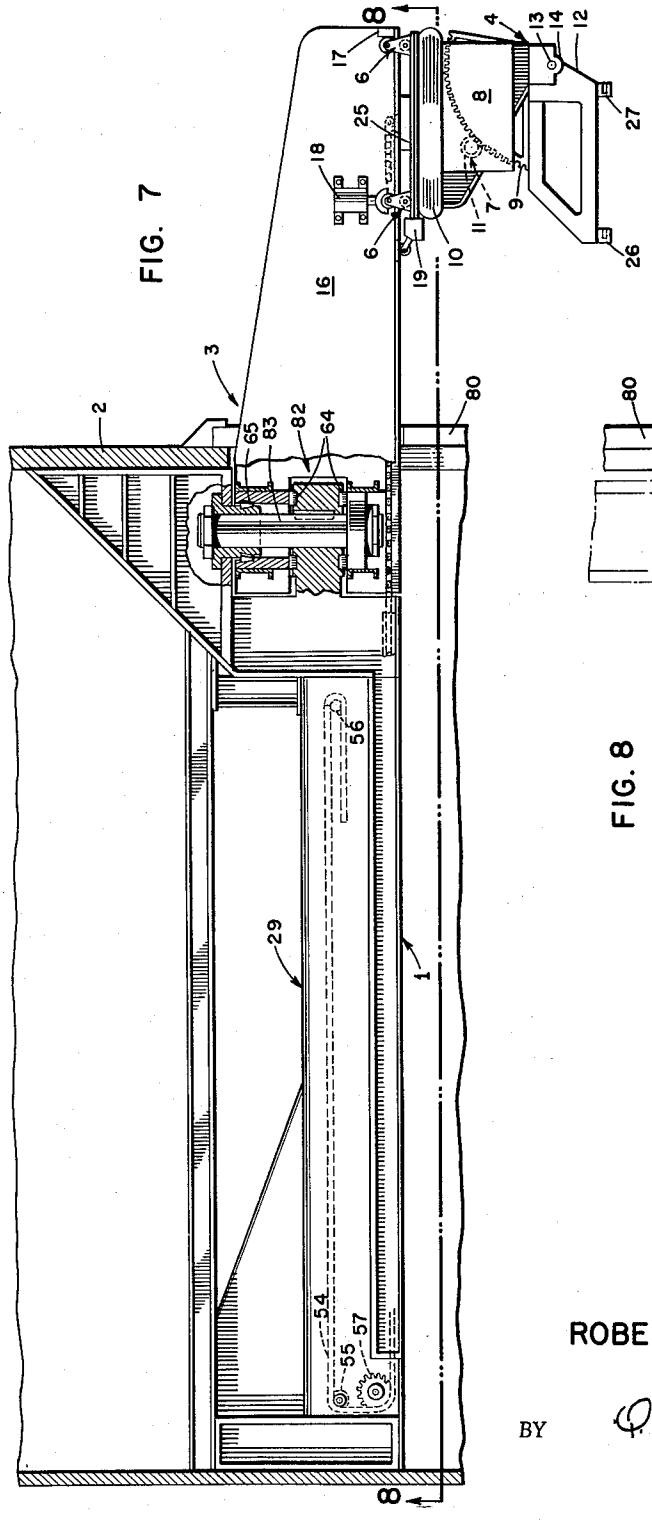
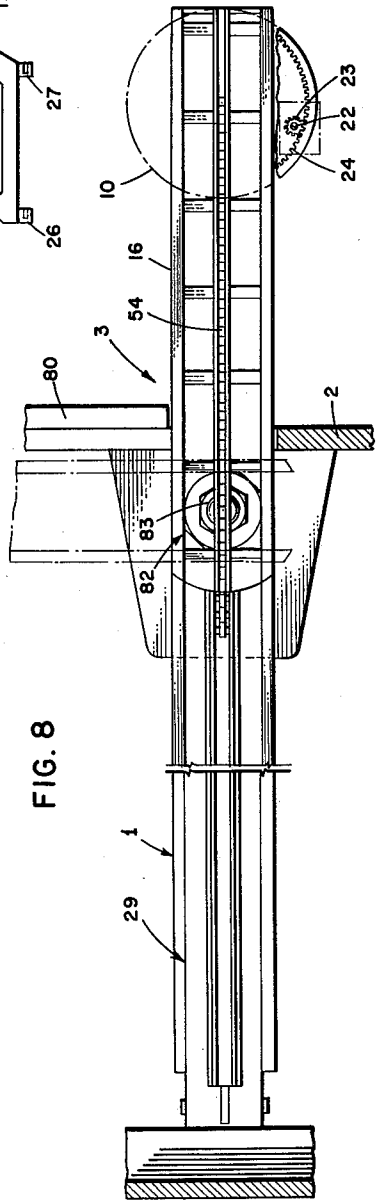


FIG. 8



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3,044,362
BELOW DECK SHIPBOARD MISSILE LAUNCHING SYSTEM

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Filed Dec. 29, 1958, Ser. No. 783,624
8 Claims. (Cl. 89—1.7)
(Granted under Title 35, U.S. Code (1952), sec. 266)

This invention relates to a shipboard missile launching system, and more particularly to a stowable launcher arrangement for use with aircraft carrier type vessels.

More specifically this invention is directed toward the provision of a missile launcher for incorporation below the flight deck of an aircraft carrier to provide a missile launching capability for this type of vessel without materially interfering with the normal aircraft take-off, landing and stowage facilities thereof, and without any interference whatsoever to operations on the flight deck of the vessel.

Prior types of missile launchers have incorporated above deck mounted launcher heads wherein the stationary portion of the launcher mount is affixed to the ship's deck and provided with mechanisms for imparting movement in train and elevation with respect to the moveable fixed portion of the mount. The handling and loading mechanisms of these prior art launching systems are disposed either below the launcher head to feed up through the deck to the launcher arms or the loading mechanisms are disposed to feed from a magazine and a deck mounted handling system adjacent thereto which advances the missile in a linear relation onto the rails of the launcher arms. Such launchers whether of a single or multiple arm launching type are in all instances superimposed on the upper deck of the vessel.

The instant launcher mechanism is advantageously rigged below deck to project from the side of the vessel in overhanging relationship thereto. By such an arrangement, a greater number of launching mechanisms can be used in the instant below deck type of installation since the total number of such launchers capable of installation on a vessel of the aircraft carrier type is limited substantially only by the linear dimension of the hull.

A similar launching system is disclosed in my copending application Serial No. 783,623 filed December 29, 1958, now U.S. Patent No. 2,995,986 for Overhanging Shipboard Missile Launching System wherein the cantilever supported beam arm is fixed. The arm assembly of the instant invention is of a stowable nature which may be either of a pivotally mounted variety or of a linearly retractable nature.

The incorporation of a launching system of the type to be described herein obviates the shortcoming of the prior system wherein the use of a plurality of launching systems having the head units thereof mounted on the flight deck present a severe service inconvenience and limit the capabilities of the flight deck for aircraft usage. Such above deck launchers limit the space available for take-off and landing of aircraft and materially reduce the airplane stowage capacity of the flight deck.

Although the embodiment of the instant invention, as herein described, is directed to a single launching system with a ready service magazine disposed adjacent thereto, it will be apparent as the description proceeds that such an arrangement is readily adaptable to some degree of interchange of missiles between adjacent launching heads if desired and wherein a plurality of

units may be mounted about the periphery of the ship's hull. Thus, in the event one launcher is disabled, the missiles assigned to and stowed in the ready service area immediately adjacent to this launcher could be readily transferred to another launcher which preferably has the ready service magazine thereof in some sort of aligned relationship with the first such launching system.

It is a feature of the instant invention to provide a missile launching capability for aircraft carriers which is well adapted for installation below the flight deck of the vessel.

It is an object of the instant invention to provide a missile launcher for aircraft carrier type vessels wherein the launching takes place from a short length launching arm disposed in an outboard relationship to the periphery of the vessel's hull.

In correlation with the immediately preceding object it is a further object to provide a missile launcher which advantageously provides for train and elevation movement of a missile when disposed on the launcher arm prior to missile firing.

Another object of the instant invention resides in the provision of a launcher installation for aircraft carriers in which a portion of the launcher from which the missile is fired is disposed in projecting relationship with respect to the exterior of the vessel's hull during the launching operation but which is readily adapted for movement to a stowed position adjacent or within a compartment therefore in the ship's hull to provide a minimum of a projection from the surface of the ship's hull when not in use and further to provide a high degree of protection from the elements when so stowed.

Another object of the instant invention resides in a launcher installation wherein a high degree of simplicity of operation is provided while maintaining a feasibility for a high degree of safety and maneuverability in handling missiles prior to launching.

Another object of the instant invention resides in the provision of a launching system for aircraft carrier type vessels which provides substantially all of the desirable features of shipboard launching systems heretofore or now in general use while obviating substantially all of the aforementioned shortcomings thereof and yet providing a high degree of efficiency and reliability.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a view in elevation of a shipboard missile launching system for one embodiment of the instant invention with portions of the vessel structure shown in section;

FIG. 2 is an end elevation of the launching system of FIG. 1;

FIG. 3 is an enlarged fragmentary end elevation view of a portion of FIG. 2 with certain portions thereof broken away and other portions in section of the upper part of the missile transfer car and ramming mechanism incorporated in the launching car rail of the system of FIG. 1.

FIG. 4 is an enlarged fragmentary perspective view of the launcher car rail of FIG. 1 showing certain features of construction and operation thereof in greater detail;

FIG. 5 is an elevation view of a typical missile transfer cart with a fragmentary portion of the missile booster mounted thereon.

FIG. 6 is a side elevation view with portions thereof broken away and with the missile booster body portion in section of the mechanisms of FIG. 5;

FIG. 7 is an elevation view with parts, thereof broken away and other portions shown in section of a launching

car rail of a modification of the launching system of the instant invention wherein the protruding cantilever portion of the launching beam is pivotally mounted; and

FIG. 8 is a plane view taken along the line 8—8 of FIG. 7 with portions thereof broken away.

Referring now to the drawings wherein like reference numerals refer to like parts throughout the several drawings, a launching system according to the instant invention is generally indicated at **1** for incorporation in the hull **2** of an aircraft carrier type of vessel. The launcher comprises a protruding generally cantilever type beam arm arrangement **3** for carrying a launcher car mechanism **4** thereon. The launcher car mechanism **4** is mounted on a track **5** as by a set of conventional type hanger and roller assemblies generally indicated at **6** for traverse between the launching position shown in solid line outline and the missile pickup position shown in broken outline.

The launcher car mechanism **4** of FIGS. 1 to 3, 7 and 8 is provided with an elevation gear mechanism at **7** which is driven by a suitable prime mover generally indicated at **8**, FIG. 2, and coupled to elevation arc gear segment **9** by a pinion **11**. The missile carrying portion **12** of the launcher car **4** is pivotally mounted for movement about the axis of trunnions **13** for movement in journals **14** to elevate the missile by the booster portion **15** thereof. The booster which is carried by suitable lugs thereon substantially as shown is aimed with movement of the elevation arc **9** in a conventional manner. In the event an electric motor is utilized for drive **8**, a plurality of suitable movable contactors are utilized for supplying power thereto. If desired, roller or spring finger type contactors may be incorporated as shown at **19**.

The outer portion **16** of the hanger rail **5** is provided with fixed stops at **17** and a retractable stop or stops at **18** when the launcher car mechanism is disposed against the stops **17** and stops **18** are engaged, azimuth rotation of the lower portion **10** of the launcher car is accomplished by means of the train drive **21**. This drive mechanism is preferably carried by the portion **10** for movement with respect to the portion **25** which is fixed to the beam structure proper at **3** to provide training movement for the missile launcher car mechanism **4** carried thereby.

The train drive **21** as shown in a generally diagrammatic manner in FIGS. 2 and 8 includes an output shaft **22** for train pinion **23** which in turn drives the internally cut training gear **24**. The train drive **21** comprises a prime mover of any suitable type such, for an example, as a hydraulic or electric motor and suitable conventional regulator type control arrangements.

After launching of a missile the rotatable lower portion **16** of the car **4** is returned to an aligned relationship with the fixed portion thereof for retraction of the launching car mechanism **4** over track **5** to a loading station at **20** within the ship for stowage, or for pickup of the next subsequent missile to be launched.

The geometric arrangement of the elevatable missile engaging portion **12** of the launcher with respect to the trunnion bearing **14** therefor is such that the missile T-lug and U-lug or shoe engaging portions **26** and **27** are disposed below and to the rear of the trunnion axis at **13**. This asymetrical arrangement advantageously provides for the desirable function of imparting a lifting motion thereto along an arcuate path with counter clockwise rotation as viewed in FIG. 1. This action is accomplished by rotation of the elevation arc gear by the drive means therefor and functions in a desired manner to permit passage of the missile engaging portions **26** and **27** of the launcher car over a missile which is disposed in pickup position at the loading station **20** on the ship's deck.

In a preferred mode of operation, the foregoing action occurs as the car is moved rearwardly along the beam rail or track **5** by the inclusion of multiple contact, longitudinal bar type trolley rails, not shown, along and between a portion of the fixed track **5**. This provision is made in order that the missile lug engaging portions **26** and **27** of the elevatable car portion **12** will be clear of the launcher lugs when the launcher car **4** approaches the point of travel wherein interference would otherwise occur. This permits launcher car **4** to be moved further back along the beam to a position somewhat behind the position of the launcher T-lugs and U-lugs or shoes on a missile in its ready to load position on the lateral transfer cart **28**. Thereafter, the pivotally mounted portion **12** of launcher car **4** may be rotated in a reverse or counter clockwise direction as viewed in FIG. 1, to a position in alignment with the missile lugs and slightly rearward thereof. Thereupon, a slight forward motion of the launcher car will provide engagement by the matingly configured engagement portions **26** and **27** with the T-lug and shoe of the missile booster and function as it is then advanced, to pick up the missile from the cart **28**. The launcher car **4** is moved or rammed forwardly to the launching position at the forward or outermost end of the launching beam.

While one type of mechanism for accomplishing advancement of the launcher car out on the beam is shown, it is considered to be within the scope of the invention to provide such modification of this means as may be desired for this purpose. This ramming function is preferably accomplished by use of a chain rammer device **29** of the character disclosed herein or it may be accomplished by the use of a differential pulley arrangement or any other suitable mechanism disposed on the beam and operable from adjacent control stations. Alternatively, the ramming function may be accomplished by a self-contained motor driven pinion or sprocket mechanism mounted on the launcher car **4** and a rack or fixed guide chain arrangement provided on the beam for engagement by the pinion or sprocket member carried on the missile launcher car. In the latter case a drive motor would be mounted opposite elevation drive **8** and such additional contactors incorporated at **19** as required to provide power energization therefor.

Referring now to FIG. 2, the stowage facilities for the launcher are shown as disposed on both sides of the launcher. However, it is to be understood that the launcher could be arranged with the stowage area disposed on one side thereof.

The arrangement of the stowage or magazine area immediately adjacent the launcher may be of the character illustrated wherein facilities are provided for stowing a plurality of missiles in side-by-side relation. The spacing of the missiles is such as to provide for assembly of the wing and fin elements on the missile at each of the two stations immediately adjacent the pickup station whereby these two missiles may be made ready for checkout. This may be accomplished at any desired time prior to missile transfer and loading on the missile launcher car. This same spacing may be used for all of the missiles if desired. However, the arrangement of the stowage area, as shown in FIG. 2, may be readily adapted for storing a greater number of missiles in laterally spaced adjacency in the same type of supporting structure when the missiles are stored with only the bird and booster sections in an assembled relationship. In this latter instance an individual missile is moved to a vacant wing and fin assembly station in the assembly area immediately adjacent the pickup position of the launcher car. At this station the wings are installed and the missile is checked out and made ready for transfer to the loading or pickup station for ultimate transfer to the launcher car for outboard launching therefrom.

It is highly desirable to accomplish all stowage and

transfer of the missile with the bird portion connected to the missile booster and without any additional support for the bird portion. This is accomplished by utilizing both the upper and lower sets of missile lugs and shoes. The transfer cart shown at **28** in FIG. 2 is provided with lug and shoe engagement elements for releasable mating engagement with the lower lugs of the missile booster. The transfer cart **28** is arranged for lateral movement by means of a track **32** and wheel arrangement **33** to a position immediately beneath any one of the stowed or ready service missiles which is desired to be moved to an adjacent vacant position. It is provided with means of any suitable nature such for example as the carriage illustrated generally at **37** for providing longitudinal displacement of the missile engaging elements **34** and **35** of the cart along the axis of the missile to effect missile disengagement of the upper shoe and the upper lug of the missile from the stowage rack **36** therefor and effect engagement with the transfer cart **28**.

In the arrangement of FIGS. 5 and 6, the carriage portion **37** may be moved rearwardly in an upward motion as determined by the path of the cam follower **38** in the internal cam slots **39** in the fixed base or housing portion of the camming mechanism **40** which is attached to the fixed portion **31** of cart **28**. This movement of carriage **37** in a longitudinal direction is accomplished by a suitable actuator mechanism comprising a drive unit at **41**, having a motor **42** and a dual output right angle gear reduction box **43**, connected by shafts **44** and **45** to the camming mechanisms at **40**. The camming mechanisms at **40** comprise a slotted crankarm **46** which is rotated by splined shaft **47** and connected in driven relationship with shaft **44** or **45**, as the case may be, by means of bevel gearing at **48**. The carriage **37** is of rigid framed construction and comprises a pair of mutually spaced bifurcated yoke like members which carry the cam followers **38** at the lower end thereof and the missile lug engaging elements **34** or **35** at the upper portions thereof. Releasable stops **49** and **50** of any suitable design prevent movement of the missile in the lug engaging elements **34** or **35** until released. When this engagement movement takes place the missile booster becomes disengaged from the fixed storage rack structure **36** which, similarly, is provided with longitudinally aligned lug and shoe engagement elements **61** and **62** for engagement with the upper lugs and shoes of the missile. The missile and cart assembly are then free for lateral movement to the next adjacent station.

The particular structural and kinematic details of the disclosed device which may be used for this purpose form no part of the instant invention since such details will become apparent to one skilled in the art from the foregoing description. Also, it is considered a matter of mechanical skill to adapt the system disclosed hereinafter to the lug arrangement on any particular type missile. For example, the relative movement required for missile transfer to the cart may be provided by movable supporting elements for the T-lug and U-lug or shoe for the missile with suitable actuators therefor.

In an alternative arrangement, the transfer cart is preferably mounted on wheels or roller members similar to the showing of FIGS. 5 and 6, and which engage a portion of a track channel for linearly guided movement from the missile pickup position to a transfer position for the missile launching cart. In such an arrangement this member is provided with a missile supporting frame having fixed lug and shoe engaging portions. In the operation of this alternative arrangement, the cart is moved under the missile which is normally out of interfering alignment with the missile lower lug and shoe engagement portions of the cart. Thereafter, this member is axially aligned with the missile lugs and either the missile moved longitudinally with respect to the cart or vice versa. In the event the missile retaining member on the retaining rack is fixed as a part of the stowage structure the missile itself is moved longitudinally in suitably provided slots to permit the missile to engage the lower lug and shoe elements thereof with the mating parts on the transfer cart and subsequently disengage the upper lug and shoe of the missile from the supporting member on the fixed stowage structure. The missile is then transferred by the cart with movement along the tracks to a position directly below the pickup position in alignment with the mating portions of the launcher car. A transfer cart of this type is shown at **28** on FIG. 1.

It will be noted in FIGS. 2, 3 and 4 that a cutout portion terminates in two upstanding rails **52** to provide a way for the rammer chain device as shown generally at **53** in FIGS. 1 and 4. As aforementioned a folder J-chain type of chain rammer **54** is utilized in the instant system for advancing and retracting the missile launching car **4** from the missile pickup position to the launching position therefor. It is of a roller link character having a limited degree of movement in only one plane such that it may be folded about idler sprockets **55** and **56** and driven by drive sprocket **57** in a rigid linear path along rails **52**.

The forward end of chain **54** is attached to the launcher car **4** at connection **58**. Additionally, by maintaining the engagement of retractable latch **18** between the launcher car **4** and the retractable portion of beam **3** the rammer may be utilized to extend and retract the extendable portion of beam **3**. This occurs after release of latch **59** and operation of actuators **60** hereinafter described.

Referring now to FIGS. 7 and 8, a modification is shown generally at **3** whereby the launcher beam for the launcher car **4** is hingedly mounted at **82** about a pivot pin **83** in any suitable arrangement providing anti-friction bearing elements of the general character indicated at **64** and **65**. After the missile launcher car **4** has been retracted to its stowed position the pivotal boom portion of the beam **3** may be pivoted to a stowage position such that it no longer projects from the side of the vessel.

Referring more particularly to the embodiment of FIGS. 1 to 4, there is illustrated a novel arrangement for collapsible telescopic stowage of the overhanging or cantilever portion of the beam arm **3**. In this arrangement the beam arm **3** is provided with guide rollers **70** which are mounted for rolling engagement with the flange or rail portions **71** of the guideway channels **72**. The diameters of the rollers **70** are slightly less than the internal spacings of the flange rails in order to permit rolling movement and yet limit the degree of rotation thereof as a couple. In this manner tendencies toward misalignment of the track surfaces **5** are maintained within allowable limits. If desired the projecting end of beam **3** may be counterweighted to insure against rocking tendencies of the beam as the launcher car **4** is retracted. The inner portion of track **5** comprises a pair of transversely movable rail members **73** which are normally maintained in longitudinal alignment with the track portion **5** of beam **3**. When it is desired to stow the launching system these members **73** are moved laterally to permit telescopic entry of beam **3** therebetween. The inner portions of these sections are configured to provide support for the beam **3** in its retracted position. The manner of guiding the transverse movement of the members **73** is provided by such structure as the T-lugs **74** and the mating channelways **75**. Actuation for this movement is provided by the movable piston rods **76** of the push pull type hydraulic cylinders **60** which are connected to a suitable controlled source of pressurized hydraulic fluid.

Referring again to FIG. 1, the launching system is additionally provided with structure for supporting and providing movement of the blast doors **80** to permit movement of the launcher car with a missile thereon to the end of the beam. The blast doors are then closed prior to missile firing. These doors may be of a sliding nature for closure prior to missile firing, and to provide a weather closure for the access opening when the

launcher car of the system is stowed. The details of the drive and hinged mechanisms in the case of a swinging door, not shown, or the guide rail 84, as the case may be, for a sliding door 80 to move the same along rollers or on a longitudinal rail or track are not shown since they form no part of the instant invention. In order to minimize the length of boom overhang in the event that a swinging type door is desired, the door may be of a contoured configuration such that the opening is substantially sufficient only for passage of the missile, with the fins thereon, and the launcher car through the opening. This type of configuration will minimize the size of the blast doors which are necessarily heavy to hinge and yet effectively absorb the blast. Obviously, if a single or dual longitudinally slidable door is provided the boom overhang may be brought to a minimum dimension correlative to satisfactory design of the blast door for absorbing the blast as a missile is fired.

The instant boom is merely a structural supporting element, although communicating means and/or means of providing the aforementioned power supply from any suitable source for the drives may be incorporated therein. In the event B-end servo type hydraulic train and elevation drive units are carried by the cart the A-end units may be incorporated on the fixed beam structure. Moreover, it is within the scope of this invention to include on the boom rail support, mechanisms or means for dispensing either hydraulic or electrical cables in the event it is desired to avoid use of contactors or mating type fluid coupling communicating mechanisms. Also certain connections to the electrical mechanisms in the missile when disposed on the cart may be incorporated in the system without departing from the scope of the instant invention. This latter situation is highly desirable in that a contact mechanism of a character known in the art may be incorporated in conjunction with the missile suspension mechanism for engagement with the mating or contacting portion therefor on the missile for external electrical power transfer thereto wherein warm-up of the internal mechanisms of the missile may continue as the missile is moved along the beam to the outer end of the launcher boom. Such a contactor arrangement further provides a means of arming and firing the missile. Also, though not shown since it forms no portion of the instant invention, in the event a cable payout system is utilized the cable may be carried by a reel on the launcher car and dispensed in and out in a Cordomatic type manner, if desired.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In an aircraft carrier type of vessel, a shipboard missile launching system comprising means for storing a plurality of missiles to be launched in a stowage area below the flight deck of said aircraft carrier vessel and wholly enclosed within the hull of said vessel, launcher supporting means, means for maintaining said launcher supporting means permanently and entirely below said flight deck of said aircraft carrier vessel, said launcher supporting means having a movable portion which is extendable outwardly through the hull of said vessel for the firing position and retractable to a position within the hull of said vessel for storage purposes, missile launcher means for moving a missile from the missile stowage area along said launcher supporting means to a position at the outer end of said launcher supporting means, and means carried by said missile launcher means providing a zero length launching rail from which a missile may be launched.

2. The structure of claim 1 further including training means and elevating means mounted on said missile launcher means for providing relative train and elevational movement of said means from which the missile is launched with respect to the outer end of the launcher supporting means, and ramming means for reciprocating said missile launcher means along said launcher supporting means.

3. In an aircraft carrier type of vessel, a shipboard missile launching system comprising missile launching means, missile storage means contained wholly within the hull of said aircraft carrier vessel and below the flight deck thereof, means for transferring a missile from said storage means to said missile launching means, launcher supporting means, means maintaining said launcher supporting means permanently and entirely below said flight deck of said aircraft carrier vessel, said launcher supporting means including a stowable cantilever beam member for transporting said missile launching means from a position enclosed by the hull and decks of the vessel to a position at the protruding end of said stowable beam member and means carried by said missile launching means for providing relative movement in train between said launching means and the protruding end of said stowable beam member.

4. The structure of claim 3 further including hinging means for pivotal mounting of the protruding end of said stowable beam member.

5. The structure of claim 4 further including ramming and retracting means for linear movement of said missile launching means along said beam member from a missile loading position to a missile launching position.

6. A system of the character of claim 3 further including means carried by the missile launching means for providing elevational movement of the missile when said missile launching means is disposed at the outer protruding portion of said beam member.

7. A system of the character of claim 3 further including means providing telescopic extension and retraction movement for said protruding end of said stowable beam member.

8. In an aircraft carrier type of vessel requiring an unimpeded flight deck expanse, a below deck shipboard missile launching system maintained wholly within the hull of said ship when not in use, said missile launching system comprising means for storing a plurality of missiles in aligned side by side relationship in a stowage area below the flight deck of said aircraft carrier vessel and wholly enclosed within the hull of said vessel, launcher supporting means including a stowable and telescopically extendable cantilever beam member, means for maintaining said launcher supporting means permanently and entirely below said flight deck of said aircraft carrier vessel, said telescopic cantilever beam being extended outwardly through the hull of said vessel for the firing position and retracted to a position wholly within the hull of said vessel for storage purposes, track means extending the length of said cantilever beam member, a launcher car mechanism, a hanger and roller assembly cooperating with said track means to enable said launcher car to move a missile from said stowage area within the hull of said vessel along said cantilever beam member to a position at the protruding end of said cantilever beam member extended to its firing position, means carried by said launcher car for providing a zero length launching rail for a missile to be launched, and means for providing train and elevation movement of said launching rail.

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