May 7, 1963 J. L. GUYANT ETAL 3,088,374

INCHING AND CENTERING SYSTEM

Filed Nov. 28, 1960 3 Sheets-Sheet 1

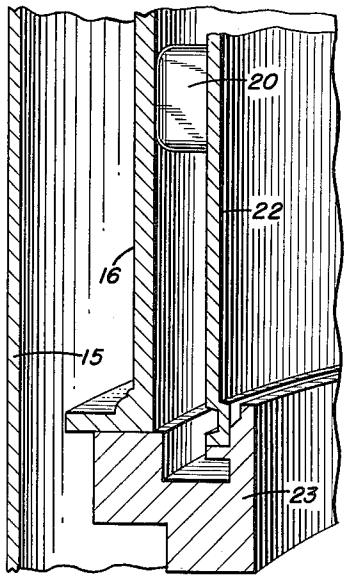


FIG. 2a

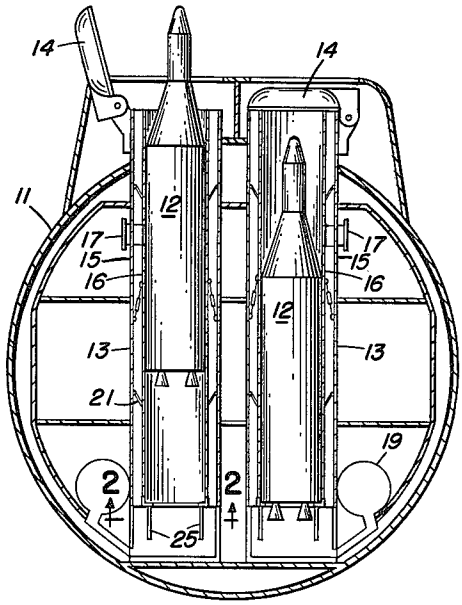


FIG. 1

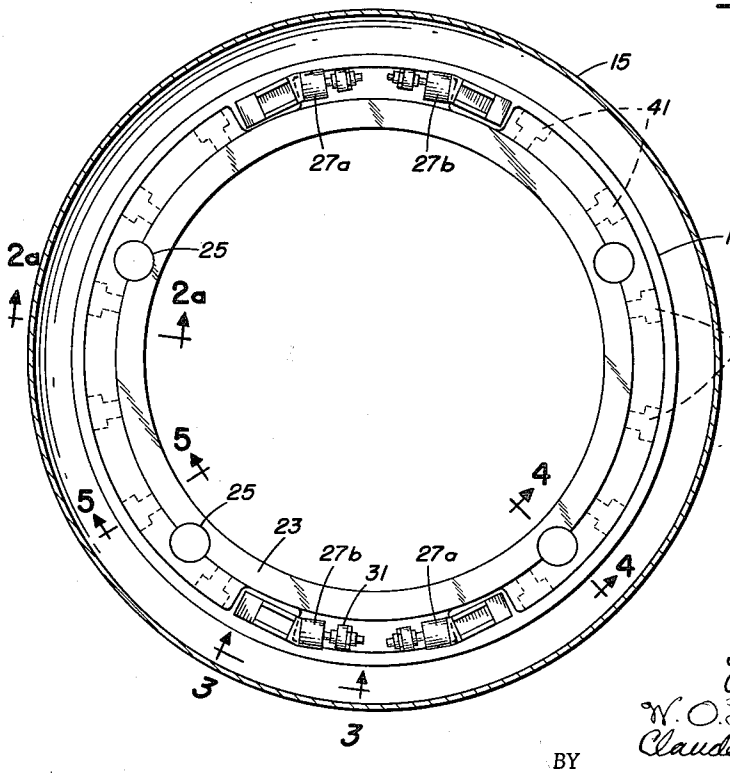


FIG. 2

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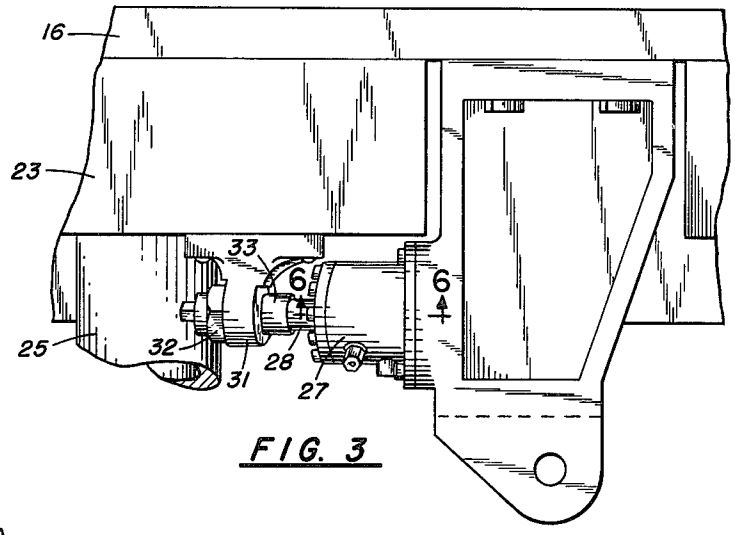


FIG. 3

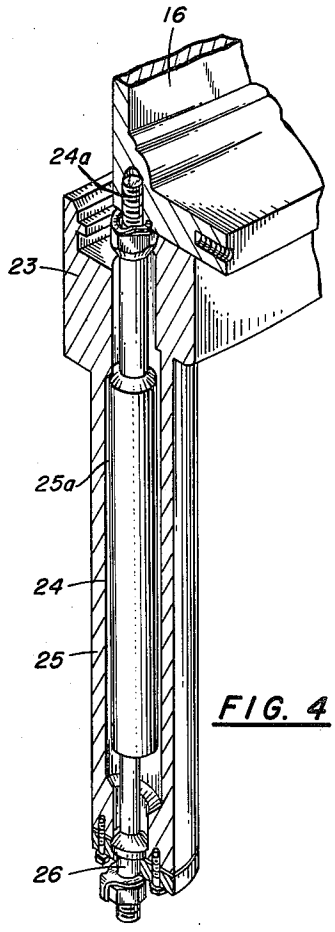


FIG. 4

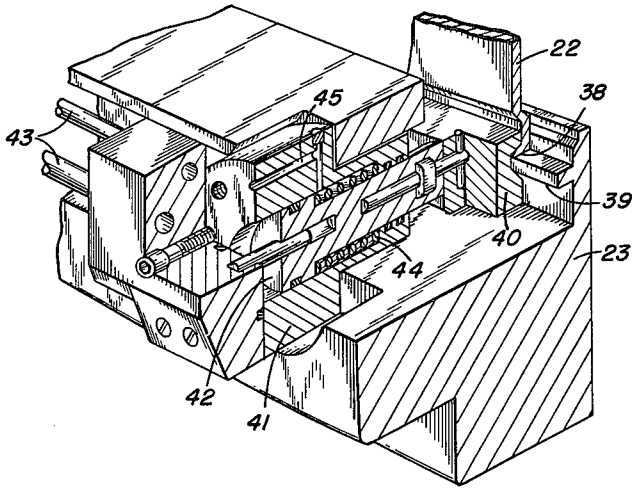


FIG. 5

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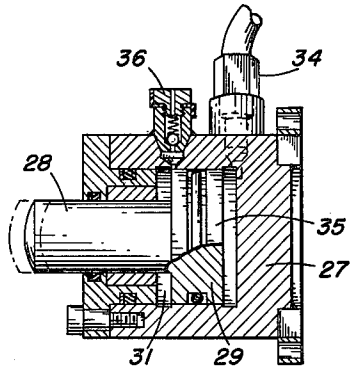


FIG. 6

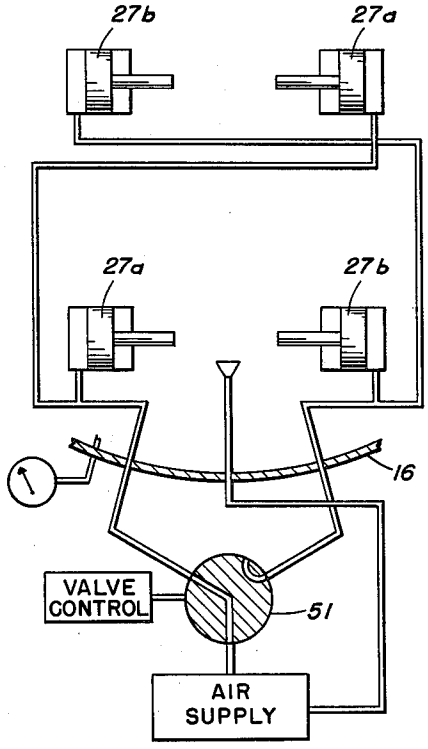


FIG. 7

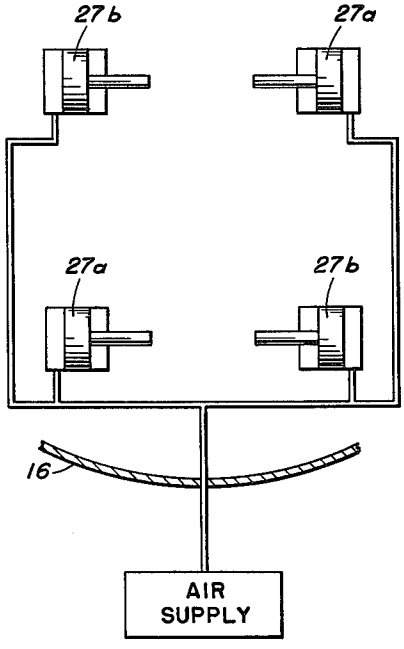


FIG. 8

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INCHING AND CENTERING SYSTEM

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5 Claims. (Cl. 89—1.7)

The present invention relates generally to missile launchers and more specifically to means for positioning the missile with respect to its launcher.

With the advent of ballistic missiles came the need for a method of making the missile launching complex invulnerable to surprise attack by enemy missiles and aircraft. Without such invulnerability it would be possible for a ballistic missile capability to be completely destroyed before its missiles could be launched in a counter-offensive action. Further, without means to protect these launching complexes from destruction by enemy attack, they would be much less efficient in their primary role of a deterrent to a possible enemy surprise attack.

Several expedients have been the subject of extensive research and development. Three most prominent methods are firstly, the hardening of launching sites, for example, building concrete silos below the ground level; secondly, by launching the missile from an airborne aircraft; and thirdly, by launching the missile from a moving ship or land vehicle. This invention finds use primarily in missile launchers of the third category. However, it cannot be said that this invention is inapplicable to the other two categories of launchers as it is possible that such a device could be utilized in conjunction with the launching or handling of any ballistic or guided missile.

The missile launching systems of category three, that is, moving vehicles, usually are provided with a supply of missiles stored in a position which permits rapid launching. These vehicles may have a tube-type launching system which includes one or more launcher tubes, each having a missile positioned therein. The tube acts as a storing and conveying means as well as a launcher. Because these vehicles are subjected to substantial structural stresses and consequent structural flexing, the tube systems generally are provided with an outer tube which resiliently supports an inner tube in which the missile is positioned. During the loading of a missile into the inner tube, it is often necessary to rotate the missile in order that it will be properly orientated in order that access doors in the tubes will align with similar openings on the missile. Further, when the vehicle in which the tube is mounted is subjected to structural flexing the missile is often misorientated. Since there is some clearance between the missile skin and the inner tube it is often necessary to center the missile within the inner tube.

Accordingly, one object of the present invention is to provide a means to orient a ballistic missile within its launching tube.

Another object of the present invention resides in the provision of a means which will rotate a ballistic missile within its launching tube.

Still another object of this invention is to provide a means which will center a ballistic missile with respect to its launching tube.

Yet another object of the herein disclosed invention is to provide an inching and centering means for positioning a missile within its launching tube.

A further object of this invention is to provide a rotating and centering mechanism for a missile launching

tube system which is simple in operation and relatively inexpensive.

An additional object of this invention is to provide a mechanism which can be used both in loading and under normal operating conditions to correct rotational misalignment between missile and its launching tube and to keep the missile support means centered with respect to its launching tube.

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 transverse cross sectional view of a typical ballistic missile launching vehicle;

FIG. 2 is a sectional view substantially along the line 2—2 of FIG. 1;

FIG. 2*a* is a sectional view substantially along the line 2*a*—2*a* of FIG. 2;

FIG. 3 is a sectional view substantially along the line 3—3 of FIG. 2;

FIG. 4 is a sectional view substantially along the line 4—4 of FIG. 2;

FIG. 5 is a sectional view substantially along the line 5—5 of FIG. 2;

FIG. 6 is a sectional view substantially along line 6—6 of FIG. 3; and

FIGS. 7 and 8 schematically illustrate inching and centering hydraulic circuits, respectively of the present invention.

FIG. 1 illustrates the cross section of a ballistic missile submarine **11**. Missiles **12** are positioned in missile launching tubes **13** which are closed by the hatches **14**. The missile launching system consists of an outer tube **15** which has resiliently mounted therein an inner tube **16**. The outer tube **15** is provided with an opening **17** and the inner tube **16** has an opening **18**. These openings are utilized to gain access to the missile guidance package, not shown. The missile is ejected from the inner tube **16** by high pressure air from the flask **19**. This air pressure is controlled by a fluid valve system, not shown. Hydraulic springs **21** resiliently support the inner tube within the outer tube **15** thereby isolating the missiles from any sudden shocks, e.g. depth charges.

As illustrated in FIGS. 2 through 6 of the drawings, the missile skirt **22** is vertically supported by the support ring **23**. This support ring **23** is resiliently secured to the lower portion of inner tube **16** by flexure rod **24**, as best shown in FIG. 4. More specifically, the flexure rod **24** is securely fastened at **24***a* to the lower portion of the inner tube **16**. The other end of flexure rod **24** is fastened to the lower portion of flexure rod housing **25** by fastening means **26**. A small amount of clearance exists at **25***a* between the flexure rod **24** and the housing **25**. The purpose of this clearance is to permit relative rotation between the inner tube **16** and the supporting ring **23**. It is to be noted that the increments of movement will be in the order of 200–300 thousandths of an inch at a time. Therefore, it can readily be seen that although the device rotates the missile only a fraction of an inch per move, the device is capable of rotating a missile within its tube a full 360 degrees.

Missile guide shoes or stowage adapters **20**, FIG. 2*a*, are positioned between the missile and the inner tube at upper, lower, and intermediate points. These shoes are utilized to laterally support the missile in the inner tube as well as to reduce friction during launching of a missile. The flexure rods **24** suspend the support ring **23** in a flexible manner which permits the guide shoes to support the missile laterally, thus minimizing the lateral

bending loads applied to the missile skirt. When shock causes momentary misalignment between the support ring **23** and the inner launcher tube **16**, the missile is not restrained laterally by the support ring **23**. Normally this misalignment is obviated by the flexure rods **24** but should these rods not reposition the support ring the centering system, as hereinafter described, is used to realign the ring **23** with the tube **16**.

Fluid motors **27** are securely mounted on the lower portion of the inner tube **16** as shown in FIGS. 2 and 3. These fluid motors **27** are of the single acting type. Four of these motors are positioned around the circumference of the innter tube in the manner shown in FIG. 2. Each motor has a piston rod **28** which is rigidly connected to piston **29**. This piston rod **28** contacts the adjustable abutment means **31** as shown in FIG. 3. Adjustable abutment means **31** is mounted on the support ring **23** and is adjusted by rotating the nut means **32** which causes the head portion **33** of the abutment means **31** to be moved relative to the piston rod **28**. The fluid motor **27** has a pressurized fluid input **34** which conducts fluid to and from the face **35** of piston **29**. Relief valve **36** permits fluid in the chamber **37** to be vented to the atmosphere.

FIG. 5 of the drawings illustrates a means for clamping the missile skirt **22** to the support ring **23**. The clamping element **40** clamps the projection **38** on the extreme lower portion of missile skirt **22** to the flange **39** of the support ring **23**. The fluid motor **41** is operable to position the clamping element **40** when fluid is applied to the piston **42** through fluid conduits **43**. This fluid motor is of the single acting type and spring means **44** are operable to return the piston **42** to the unlocked position when fluid pressure is relieved from the piston **42**. Conduit **45** connects the spring bias side of the piston **42** with the atmosphere to relieve any pressure generated on the spring side of the piston **42**.

FIG. 7 illustrates schematically a hydraulic inching circuit of the present invention. This circuit will be described in more detail in connection with the following operation of the present system. When it is desired to rotate a missile **12** within the inner tube **16** the fluid motors **41** are actuated thereby clamping the missle skirt rigidly to the support ring **23**. Then the motors **27*a*** are actuated thereby rotating the support ring, with the missile clamped thereto, relative to the inner tube **16**. The flexure rod **24** permits this relative movement of several thousandths of an inch as explained hereinbefore. Flow of pressurized fluid to the fluid motors **27*a*** is controlled by the valve means **51**, FIG. 7, which is positioned to permit the air supply to be communicated with these motors while the fluid motors **27*b*** are vented to the atmosphere and therefore are, in effect, inactive during this portion of the rotating cycle. Once the motors **27*a*** have rotated the support ring with respect to the inner tube **16**, the fluid motors **41** are released. Then the valve **51** is rotated counter clockwise 120° thereby actuating motors **27*b*** which effects return of the support ring to its original position with respect to the inner tube **16**. Because the missile **12** is extremely heavy and due to the friction between the launch stowage adapters or guide shoes **20** between the missile and the inner tube the quick movement of the support ring back to its original position permits the missile to remain stationary with respect to the inner tube. The net result of this action is that the missile **12** is rotated very slightly with respect to the inner tube **16**. However, a series of these cycles will result in the desired rotation, in either direction, of the missile **12**. While FIG. 7 illustrates one embodiment of a hydraulic inching circuit which could be used in combination with the present invention it is not meant to be a limitation thereon. It is believed to be within the ability of one skilled in the art to design any number of hydraulic circuits which will operate the present invention. These circuits, of course, could be automatic, semi-automatic or manually operated and could have the clamping means hydraulically connected therewith.

As mentioned hereinbefore, due to the structural flexing of the vehicle the support ring **23** is often misoriented or misaligned with respect to the inner tube **16**. Normally the flexure rods **24** will reorient or realign the support ring **23** providing the misorientation is not severe. However, if this misorientation is severe and permanent the fluid motors **27*a*** and **27*b*** are simultaneously operated to reorient or recenter the missile with respect to the inner tube **16**. This centering action is performed when the air supply is communicated directly to all four motors **27*a*** and **27*b***, as shown in FIG. 8, thereby actuating all four motors simultaneously to exert equal forces from opposing directions against the stops **31** on the support ring **23**. This corrects lateral displacement of the ring **23** with respect to the launcher tube. Again it must be understood that the hydraulic circuit, as shown in FIG. 8, illustrates a conventional hydraulic circuit and it is believed to be within the scope of one skilled in the art to provide a different hydraulic circuit for accomplishing the same result.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is threfore 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 a missile launcher for launching a long range ballistic missile from a submerged or surfaced submarine wherein said launcher comprises an outer tube vertically mounted in said submarine, an inner tube resiliently and concentrically mounted in said outer tube, said inner tube having a lower end, a muzzle hatch operably mounted to close and open the top of said outer tube; the improvement comprising an annular support ring positioned adjacent the lower end of said inner tube and having an inner diameter less than the inner diameter of said inner tube, the portion of said support ring which projects inwardly from said inner tube having a flange mounted thereon which is operable to seat and support said missile, said missile having a skirt portion which is adjacent said support ring and which supports the remainder of the missile, clamping means operably positioned in said support ring in a manner to releasably clamp said missile skirt to said support ring to thereby prevent relative movement therebetween, said clamping means comprising a fluid motor which is operable to drive a piston in response to fluid pressure, and means operable to rotate and center said missile in said tube.

2. An assembly comprising a first tube having an opening at each end thereof, a second tube concentrically disposed within said first tube, resilient means operatively supporting said second tube within said first tube, a supporting ring located at the lowermost end of said second tube, suspension means operatively connecting said supporting ring to said lowermost end of said second tube, said suspension means consisting of a plurality of flexure rods each having its upper end fixedly secured to said second tube, a housing for each of said rods integrally mounted to the underside of said supporting ring, a bore in each of said housings, attachment means at the lower end of said rod for securing it to the lower end of said rod housing, said rod being of lesser diameter than the diameter of said bore leaving a clearance between said rod and said housing wall, said suspension means permitting limited relative rotational movement between said second tube and said supporting ring, and rotation means connected to said supporting ring and said second tube to rotate said supporting ring in a first and second direction about the axis of said second tube.

3. The assembly set forth in claim 2 where said rotation means comprises motors mounted on the lower end of said tube, said motors having output shafts, adjustable abutment means mounted on said ring and operable to

receive said output shaft, said motor and said abutment means being operable to impart forces therebetween in a direction tangential to said ring in a manner to cause relative rotation about the tube axis and between said ring and said tube.

4. The assembly set forth in claim 3 wherein said motors and said adjustable stops are arranged in pairs, and wherein each pair has a first motor operable to act in said first direction and a second motor operable to act in said second direction, said first and second directions being opposite to each other, whereby when said first motor is actuated said ring is rotated about said tube axis in said first direction and when said second motor is actuated said ring is rotated about said tube axis in a direction opposite to said first direction.

5. In combination with a missile launcher comprising an outer tube, an inner tube concentrically mounted within said outer tube, resilient means supporting said inner tube within said outer tube, a missile positioned within said inner tube, a support ring positioned adjacent the lower end of said inner tube a plurality of rod housings, each having a bore therein and extending downwardly from said support ring, a flexure rod mounted in

each of said bores in said rod housings, said rods connected at one end to said inner tube, the other end of said flexure rod connected to the lower end of said housing, said rod being of lesser diameter than the diameter of said bore leaving a clearance between said rod and said housing wall, said support ring having a flange portion which is capable of supporting substantially the entire weight of said missile, a plurality of motors suspended from said inner tube for rotating said support ring with respect to said inner tube, locking means attached to said support ring for locking said missile to said support ring thus insuring that said missiles will rotate simultaneously with said supporting ring, adjustable abutment means for each motor mounted on said support ring whereby the actuation of said motors permits said missile to be rotated with respect to said inner tube and aligned to its proper position for launching.

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