July 15, 1958 V. B. BERTAGNA ET AL 2,843,020

ZERO-LENGTH LAUNCHER

Filed June 22, 1953 2 Sheets-Sheet 1

Fig. 1

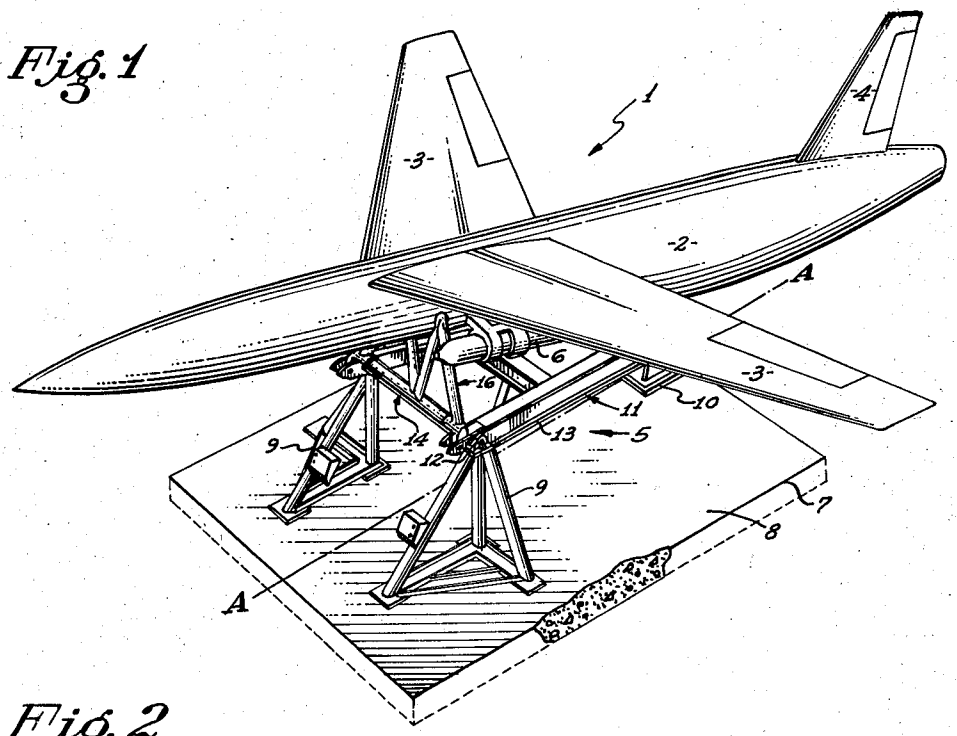
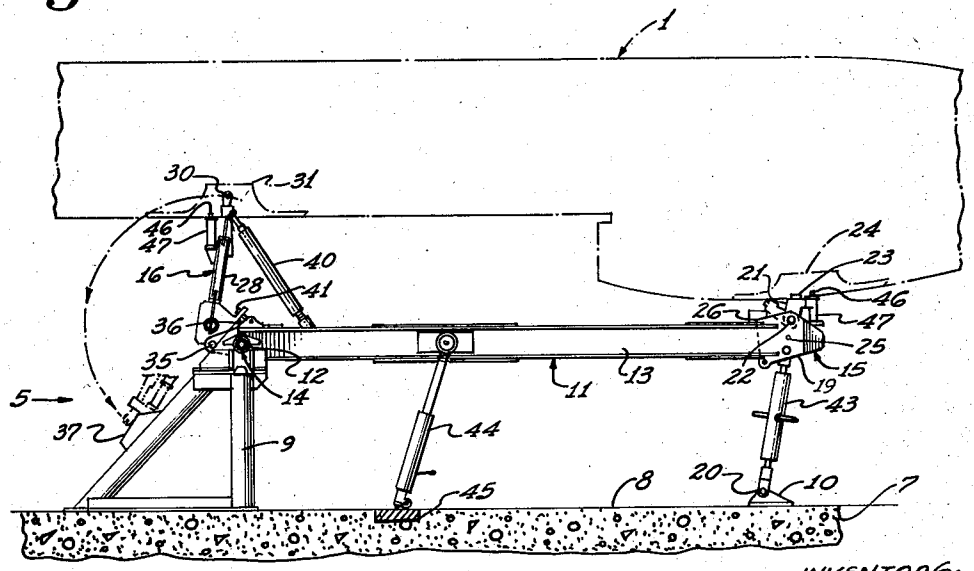


Fig. 2



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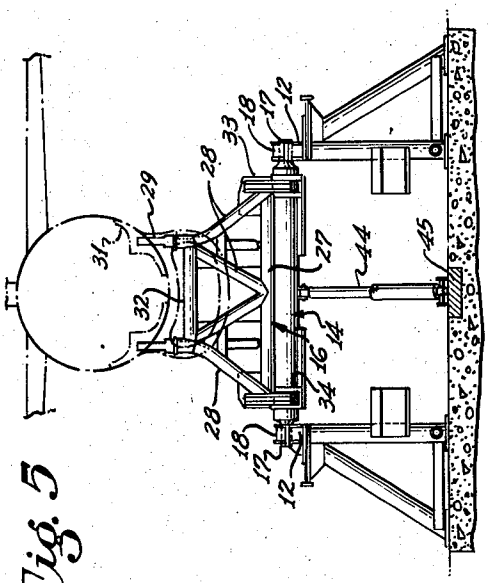


Fig. 5

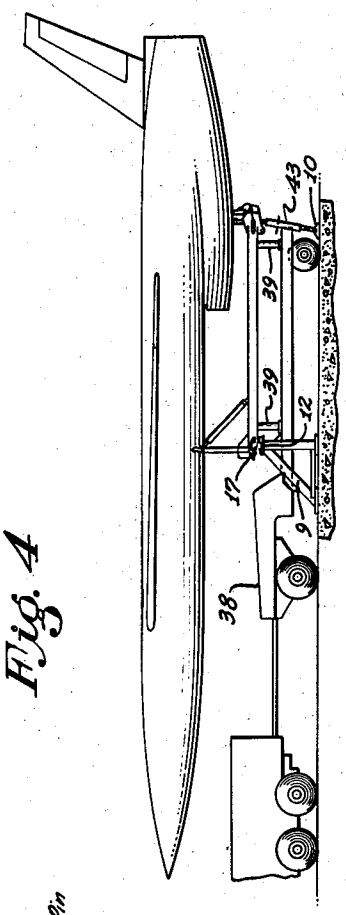


Fig. 4

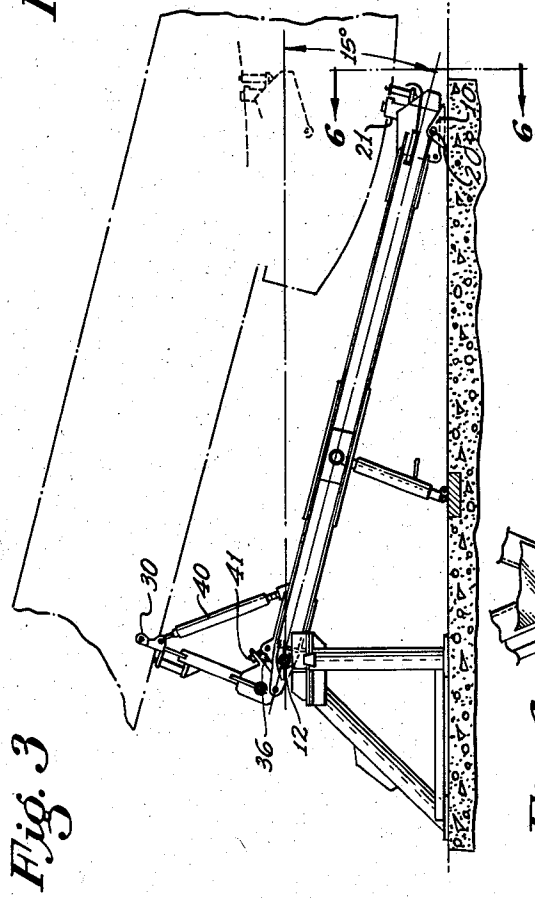


Fig. 3

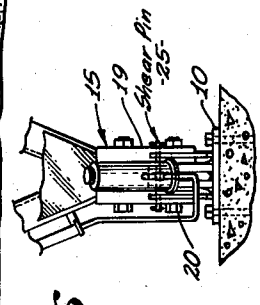


Fig. 6

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ZERO-LENGTH LAUNCHER

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Application June 22, 1953, Serial No. 363,184

2 Claims. (Cl. 89—1.7)

This invention relates to apparatus for launching and transporting aircraft and more particularly to a zero length launcher for pilotless missiles in which a portion of the launcher functions as a storage and transportation fixture prior to a launching operation.

Throughout this specification and appended claims wherever the term "zero length launcher" appears a launcher of the trackless or stationary type is referred to unless otherwise indicated. "Rockets" referred to in this specification are of the type commonly known as "jato."

The launching of a missile from a zero length launcher is accomplished by rockets directly attached to the missile, rockets so utilized provide the missile with additional thrust or boost during its initial flight period, i. e. from the time the rockets are ignited until they have expended their energy and the missile has attained sufficient flight speed to render its control surfaces effective. After the rockets have expended their energy they are ejected in a manner disclosed in co-pending U. S. applications 361,542 and 361,544, dated June 15, 1953.

A missile theoretically travels a predetermined course during its initial flight period which is extremely critical, failure to follow such a course will materially influence its future behavoir which may prove disastrous if it is not able to right itself in a later phase of its flight.

The course followed during this period may be likened to that of a projectile fired from a gun as the control surfaces are ineffective at this time due to the missile's relative slow air speed. The predetermined course is determined by the angle at which the launching equipment is positioned and the vertical component of rocket thrust. Also the predetermined course may be materially affected if a missile does not separate cleanly from its launching equipment or if unsymmetrical thrust forces are applied, either of the later defects may result in a deviation from which a missile may not recover.

In using presently known launching equipment considerable difficulty and delay is experienced at the time a missile is transferred from its transportation gear to its launching equipment at a launching site. With presently known equipment this operation is time consuming requiring extensive personnel and auxiliary equipment, such as, especially constructed skids, block and tackles, and etc. In accordance with the present invention a missile launching device is provided having a base portion so constructed that it provides means on which a missile may be stored, transported, and later function as a launching base, thereby eliminating the majority of the transfer difficulties enumerated above.

Accordingly it is an object of the present invention to provide a launcher for a missile, or the like, in which initial non-symmetrical rocket thrusts, if present, will not affect the missile's initial predetermined course.

Another object is to provide a launcher for a missile, or the like, having support members which permit clean separation of the missile from its launcher.

Another object is to provide a launcher for a missile,

or the like, in which a portion of the launcher also functions as a storage and transfer fixture.

These and other objects will become more apparent from the following description and drawings in which like reference characters denote like parts throughout the several views. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and not a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings:

Figure 1 is a perspective view of a missile supported in a zero length launcher constructed as disclosed in the present invention.

Figure 2 is a side view of the launcher shown in Figure 1 but in a horizontal attitude.

Figure 3 is a side view of the launcher shown in Figure 1 in its launching attitude.

Figure 4 is a side view of the launcher similar to Figure 2, the figure also shows missile transportation equipment and illustrates the manner of transfer at a launching site.

Figure 5 is a front view of the launcher shown in Figure 1 in its launching attitude.

Figure 6 is a fragmentary view of the launcher viewed from the line 6—6 of Figure 5.

Referring to the drawings for a detailed description of a preferred embodiment of the present invention, Figure 1 shows a pilotless missile 1 comprising a fuselage 2, a pair of sweptback wings 3, and a rudder 4, supported in a zero length launcher 5. Attached to each side of the fuselage, approximately opposite the missile's center of gravity, is a pair of rockets 6 (only one being shown) which are adjusted prior to launching to provide desired directional thrust in a manner presently disclosed.

The launcher comprises a supporting base 7 having a relatively large horizontal plane surface 8, the base may be a concrete slab or if the missile is to be launched from a ship it may be a portion of the ship's deck. Secured to the base 7, by means of anchor bolts or the like, are two forward supports 9 and an aft support 10 adapted to support a triangular frame assembly 11. The two forward supports are generally of pyramidal configuration having parallel vertical sides facing each other when in their assembled position on base 7. The forward supports are located an equal distance on each side of a line A—A extending longitudinally with respect to base 7 and are provided with bearings 12 at their apexes, the supports are further located so that the axes of bearings 12 coincide with a common line which is parallel to surface 8 and at right angles to line A—A. The aft support 10, also secured to base 7 by any suitable means, comprises a U-shaped member symmetrically positioned longitudinally with respect to line A—A with its leg portions extending upwardly.

The triangular frame assembly 11 comprises two structural side members 13, a shaft member 14, an aft fitting 15, a missile arm support assembly 16 and necessary plate members for attaching and securing the various frame elements in their proper relation with respect to each other. If the frame assembly 11 is viewed from above, as shown in Figure 2, it has the general configuration of an isosceles triangle in which members 13 form the equal sides of the triangle and shaft 14 its base. The end portions of shaft 14 extend beyond the base portion of the triangular frame assembly, these end portions constitute trunnions 17 which are spaced so that they seat themselves in bearings 12, bearing caps 18 maintain the trunnions in their respective bearings. Positioned between the adjacent ends of the side members 13 is the aft fitting 15 which is also symmetrically located in a longitudinal direction with respect to line A—A.

The aft fitting 15 is U-shaped having plates 19 constituting leg members which extend generally in the plane of the triangular frame assembly a short distance beyond the adjacent ends of the side members. In the lowered or launching position of frame 11, shown in Figure 3, plates 19 contact the base portion of the aft support and span its upwardly extending leg portions, the fitting 15 and accordingly the frame 11 are maintained in this position by means of a removable pin 20 which passes through aligned apertures in the leg portions of the aft support and plates 19. Also positioned between plates 19 of the aft fitting is a missile support 21 mounted to pivot on a pin 22. The missile support extends slightly above the top edges of plates 19 terminating in a cylindrical end 23 adapted to fit in a recess formed in fitting 24 of the missile. The missile support is maintained in a fixed position, shown by solid construction in Figure 2, prior to the launching of a missile by means of a shear pin 25; upon the launching of a missile, pin 25 is sheared allowing the support to rotate to a position, shown by dotted construction in Figure 2, at which time its pivotal movement is arrested by thrust block 26.

The missile arm support assembly 16 comprises a truss like member fabricated from steel tubing and machined steel fittings. A plurality of tubular members 28 are rigidly secured to a tubular base member 27, the axes of all members lie in a common plane and are positioned so that they form two equilateral triangles equally spaced on each side of a line which is perpendicular to the axis of member 27 at its midpoint. Rigidly secured to and extending beyond the adjoining ends of members 28 is a pair of forward missile support arms 29, the free ends of arms 29 terminating in steel machined fittings 30 adapted to mate with a surface of missile support fittings 31 located equal distances on each side of the longitudinal axis of the missile near its center of gravity. The rigid character of the missile arm support assembly is further enhanced by a tubular member 32 extending between the adjoining ends of members 28, also numerous gusset plates placed at the intersections of the various tubular members comprising the assembly. The assembly 16 is pivotally mounted to the triangular frame assembly, adjacent its base portion, with base member 27 extending parallel to shaft member 14. Plate members 33 and 34 secured to base member 27 of the arm support assembly and the frame assembly, respectively, together with hinge pins 35 provide means for pivotally mounting assembly 16 so that it may pivot between a first or pre-launching position, shown by solid construction in Figure 2, and a second position shown by dotted construction which it assumes after launching. The pre-launching position of the missile arm support assembly is determined by the location of missile support fittings 24 and 31, its angular position being adjustable so that fittings 30 mate with missile fittings 31 by means of an adjusting screw 36 and a tie-down member 40, its second position being determined by a crash pad 37, alternatively its angular movement may be cushioned and arrested by a conventional pneumatic or hydraulic snubbing device (not shown).

The triangular frame assembly 11 serves as a missile storage and transportation fixture as well as a component part of the launcher. Accordingly a missile is placed on the frame assembly at a convenient time prior to the launching operation, preferably at a location where proper handling equipment is available. In Figure 4 a missile is shown supported on frame assembly 11 just prior to being transferred to supports 9 and 10, the missile and frame assembly having been transported from a loading or storage area to the launching site by means of a trailer 38. At this time the longitudinal axis of symmetry of the missile is horizontal and the frame assembly is supported on the bed of the trailer by three triangularly positioned jacks 39, two of these jacks being positioned adjacent shaft 14 and the third adjacent fitting 15. During missile transportation the relative position of the missile arm support assembly, with respect to frame 11, is maintained by tie-down members 40 and 41.

To transfer the missile and assembly 11 to prepositioned supports 9 and 10 the trailer is positioned between the two forward supports, the missile and assembly 11 is then raised by means of jacks 39 sufficiently to allow the trailer to be rolled forward to the position shown in Figure 4. The frame assembly is then lowered until trunnions 17 seat themselves in bearings 12. A prop assembly 43, positioned between the aft end of the frame assembly and the supporting base, maintains the missile and frame assembly in a horizontal position and assumes a portion of the missile's weight upon removal of the jacks 39. The trailer may now be removed, bearing caps 18 secured in position, and tie-down members 40 removed. Thus it is seen a missile may be quickly and efficiently transferred to its supporting members at the launching site with a minimum of personnel and auxiliary equipment. With the trailer removed a hydraulic jack 44 is positioned between frame assembly 11 and base 7, one end of the jack is pivotally attached to the frame assembly at a point intermediate supports 9 and 10 while its other end rests on a thrust pad 45 in the supporting base 7. This jack 44 is so located that it will maintain the missile in a horizontal position and also support a portion of its weight if prop assembly 43 is removed, upon removal of the prop assembly, jack 44 may be utilized to lower the triangular frame assembly and missile into its launching attitude, as shown in Figure 3. The triangular frame assembly is secured in its launching position by means of pin 20, in this position the longitudinal axis of symmetry of the missile is inclined at approximately 15 degrees with the horizontal.

The missile is fueled and the rockets 6 attached at the aforementioned assembly station which in most instances is remotely removed from the launching site. The entire assembly is then weighed to determine its center of gravity, preliminary rocket adjustments are also made at this time to insure the resultant thrust exerted by the rockets and missile power plant passing as nearly as possible through the center of gravity of the combined assembly. The center of gravity of the combined assembly must be rechecked at the launching site as it may shift during its storage period and subsequent transportation due to various reasons.

Weighing the combined missile assembly at the launching site is accomplished by means of electric weighing cells 46 and hydraulic jacks 47. One of the jacks is attached to each forward missile support arm 29 and aft fitting 15, respectively, the jacks being adjustably mounted so that their axes may be vertically positioned regardless of the angle of the missile being weighed. A weighing cell is positioned on the free end of the plunger of each jack 47 so that they contact the fittings 24 and 31, accordingly the cells support the missile's weight when the jacks are extended. The weight of the missile thus determined its longitudinal center of gravity may be calculated. The vertical location of the center of gravity can not be determined at the launching site, therefore, its location as previously determined is used in making final rocket adjustments. If the combined thrusts do not pass through the center of gravity of the combined missile assembly a dive or climb may result which may prove disastrous for reasons outlined above. Assuming all adjustments are correctly executed the theoretical trajectory of the missile during its initial flight or boost period should be a straight line determined by the inclination of the launcher. However, other factors which will affect the missile's initial flight or boost course are the application of unequal rocket thrusts and faulty separation from its launching gear if either or both are present.

Malfunctioning of the launching gear, due to unequal rocket forces or faulty separation, are practically eliminated in the launching equipment disclosed in the present application. Should the rockets ignite unevenly or one

slightly before the other, thereby exerting unequal thrust, these thrusts will be transmitted through the rigid missile arm support assembly and be applied equally at each side of the missile. The missile arm support assembly **16** and missile support **21** are both mounted to pivot with respect to frame assembly **11** as the missile moves forward so that a clear separation is provided, the missile arm support assembly pivoting forward sufficiently to provide clearance for the missile rear structure. Thus it is seen missile launching gear is provided which insures equal distribution of thrust forces, clean separation, and a storage and transportation fixture. Also a missile supported on the frame assembly **11** is readily accessible for repair or replacement of any of its component parts, installation and adjustment of rockets, and etc.

While in order to comply with the statute, the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise a preferred form of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

What is claimed is:

1. A device for launching a missile comprising: a base having an upper plane surface extending in a horizontal direction; a frame structure for supporting said missile and having opposite side edges spaced with respect to each other; first and second means pivotally mounted on said frame in spaced relation adapted to receive and support a missile to be launched from said device; a pair of axially aligned trunnions extending outwardly from the side edges of said frame; forward supporting means for said frame consisting of a pair of individual supports mounted on said base; upwardly facing bearings for receiving said trunnions mounted at the top of said supports, said bearings provided with bearing caps to maintain the trunnions in their respective bearings; said supports being spaced apart a distance exceeding the greatest distance between the opposing side edges of said frame in a direction normal to a longitudinal reference line, and extending above said upper plane surface to provide an unobstructed passageway therebetween, whereby a vehicle carrying the frame with a missile supported thereon can be advanced within said passageway, and the frame lowered to position its trunnions on said bearings.

2. Apparatus as set forth in claim 1, wherein said axially aligned trunnions and the said first pivotally mounted means are located adjacent one end of said frame, and said second means is located adjacent the other end of said frame; said first means including lower spaced aligned portions pivotally attached to said frame at respective equal distances on opposite sides of said reference line, and a pair of upper axially aligned fittings adapted to support a portion of said aircraft and which are located at respective equal distances on opposite sides of said reference line; said second means being pivotally mounted on said frame and comprising an upper bearing adapted to support the remaining portion of said aircraft and which is also located symmetrically with respect to said reference line.

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