

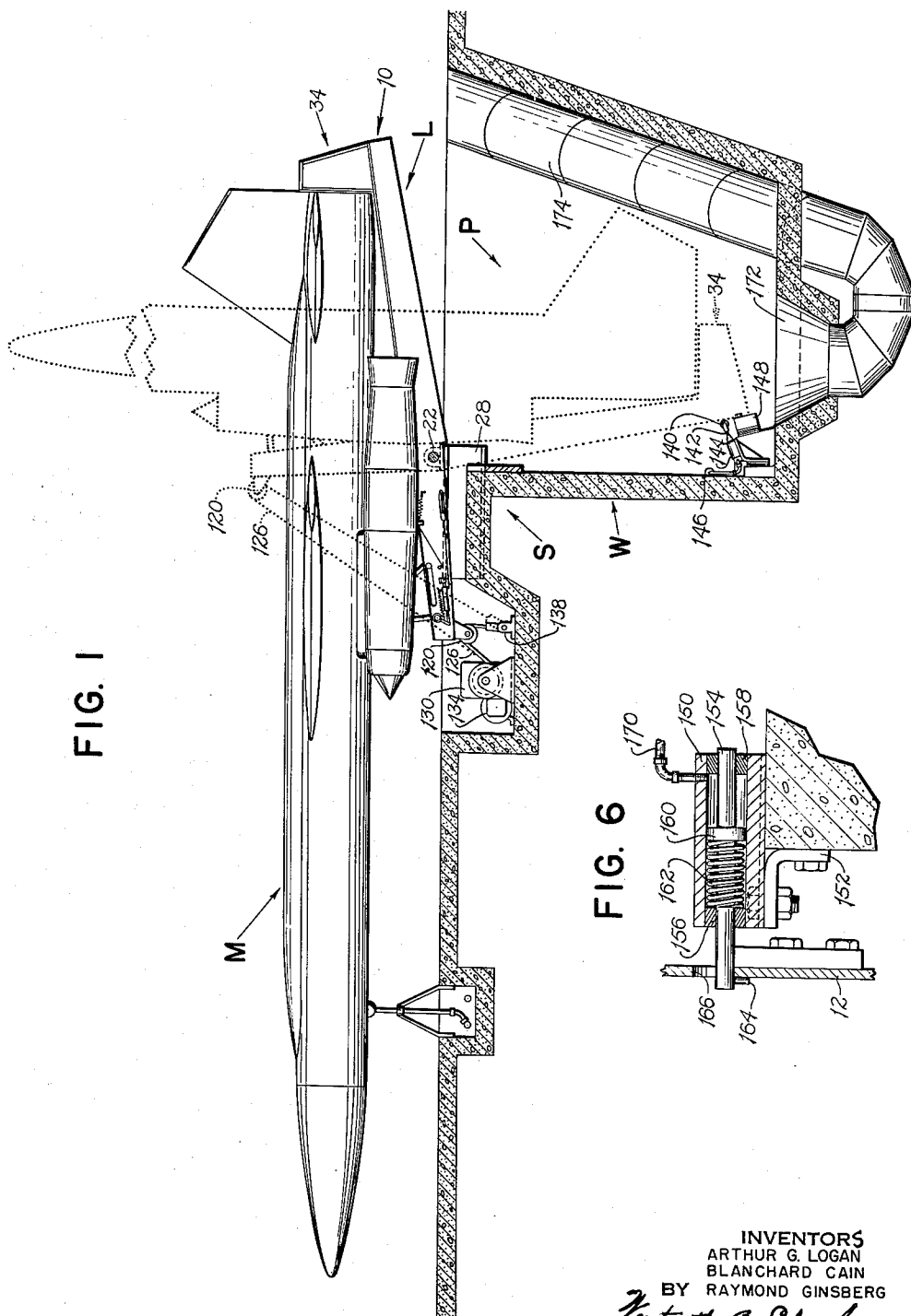
June 13, 1961

A. G. LOGAN ET AL
MISSILE LAUNCHER

2,987,964

Filed Dec. 2, 1957

5 Sheets-Sheet 1



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FIG. 3

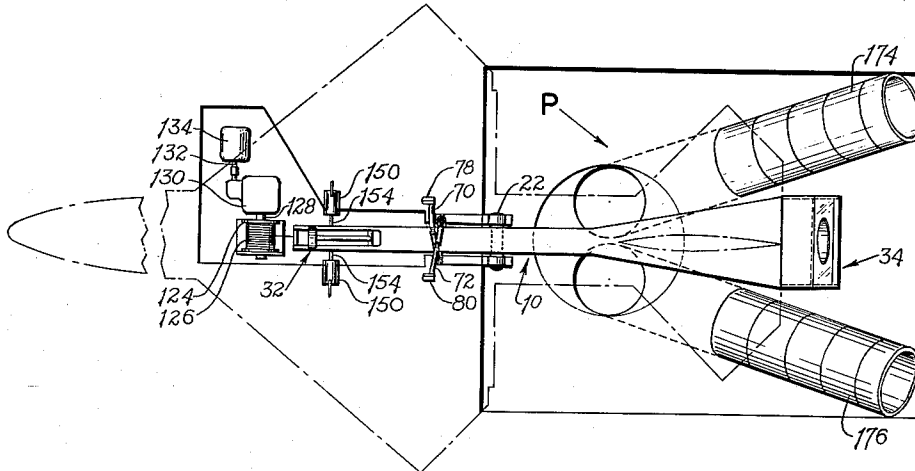


FIG. 4

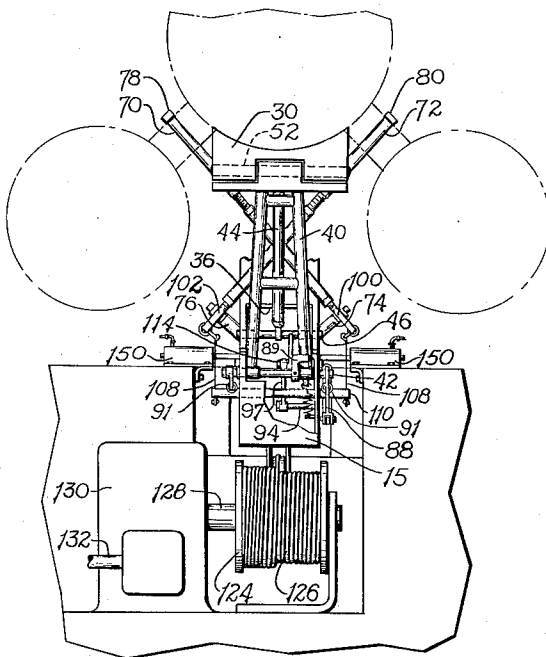
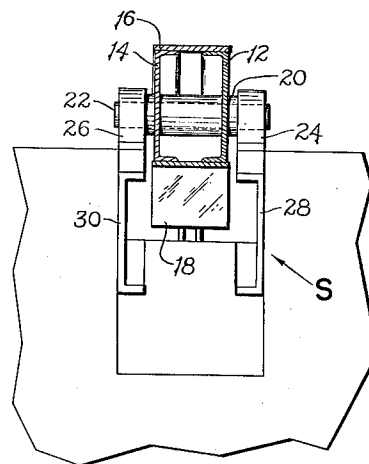


FIG. 5



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FIG. 7

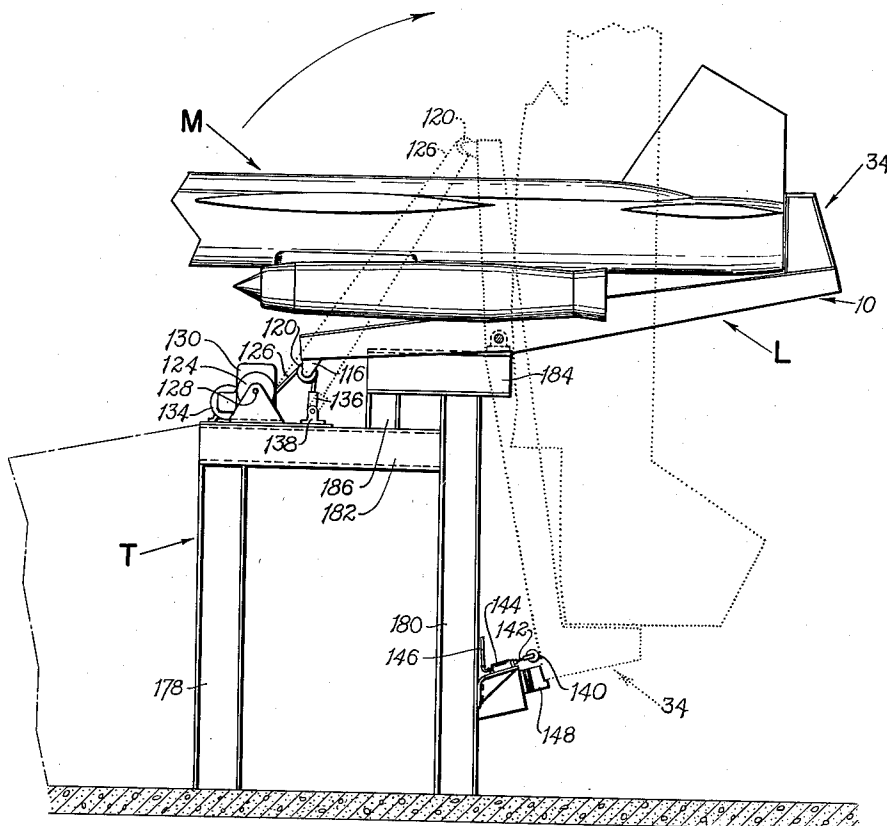


FIG. 8

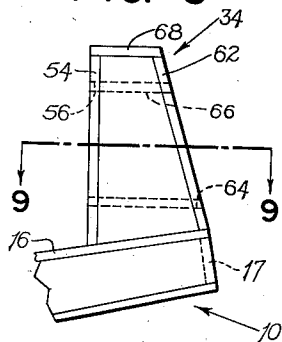
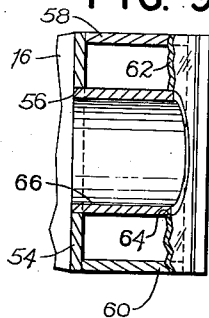


FIG. 9



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FIG. 10

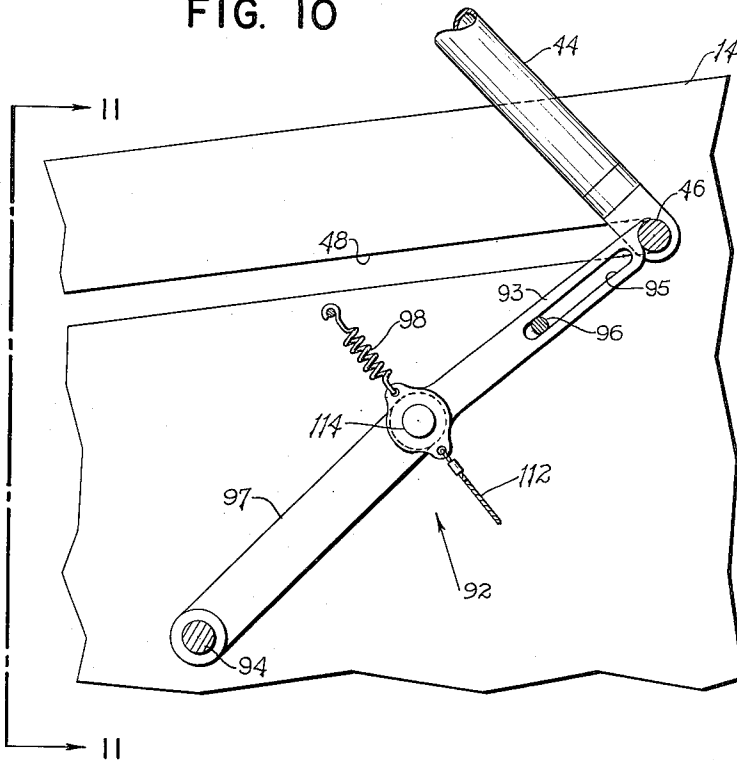
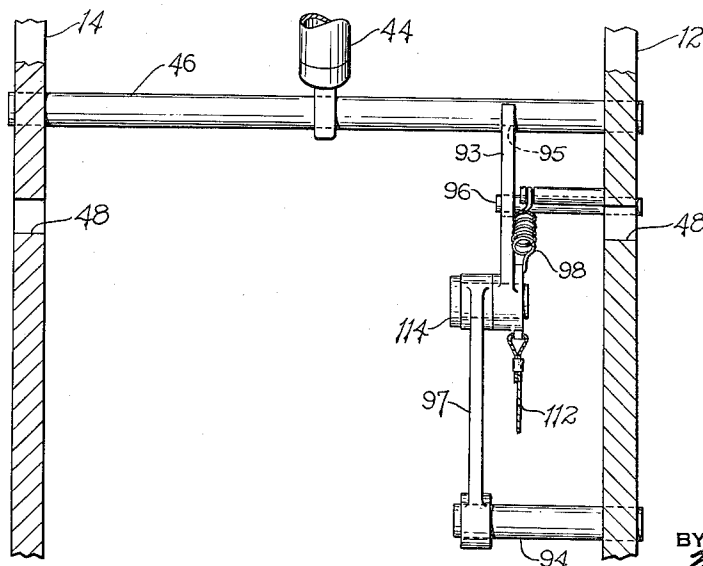


FIG. 11



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MISSILE LAUNCHER

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4 Claims. (Cl. 89-1.7)

This invention relates to missile launching apparatus and more particularly to improved mechanism for moving missiles from a generally horizontal servicing position into a generally upright firing position.

In launching devices heretofore available, the missile was raised into its generally upright firing position by external means without regard to any potential energy available from the missile's weight or the combined weight of the missile and its launcher carriage. Thus substantial lifting devices were required to overcome the resisting force of the missile's weight in moving the missile into firing position. These lifting devices included hydraulic jacks with banks of hydraulic accumulators to generate the required hydraulic pressure to raise the jack and missile into firing position, and hoisting cranes with lifting capacities sufficient to hoist the missile into vertical firing position. It will be readily apparent that these devices are at once expensive to operate and maintain and their operation subject to possible mechanical failure.

The present invention is characterized by the provision of novel launching apparatus for missiles which utilizes the potential energy available from the missile's own weight to accomplish the moving thereof into firing position. Mechanism is provided for swingably mounting the missile launcher such that when a missile is mounted thereon for firing, the weight of the missile and launching apparatus will operate because of the positioning of the combined center of gravity thereof, to rotate the missile and launching apparatus into firing position without the aid of other moving apparatus as heretofore required.

It is therefore an object of the present invention to provide missile launching mechanism wherein the potential energy of the missile's weight is employed to assist in moving the missile on its launcher or supporting carriage into a generally upright firing position.

An added object of this invention is to mount the launching device on bearings such that the combined center of gravity of the launching device and a missile supported thereon will cause the launching device and missile to rotate by gravity into launching position.

It is a further object of a modified form of the invention to mount the launching device on trunnions supported at an elevated position such that the launching device and a missile supported thereon will rotate by gravity only into a predetermined position.

It is also an object of this invention to mount the launching apparatus on bearings adjacent the top of a wall such that the launching apparatus and a missile supported thereon will be biased by gravity theretoward.

A further object of the present invention is to provide control means on the launching mechanism to regulate the gravitational rotation of the launching mechanism and a missile mounted thereon with a predetermined launching position.

It is also an object of the invention to provide novel means for mounting parts of the launching apparatus such that as the missile is fired, the parts will be moved out of the path of missile travel.

With these and other objects not specifically mentioned in view, the invention consists in certain combinations and constructions which will be hereinafter fully described and then specifically set forth in the claims hereunto appended.

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In the accompanying drawings which form a part of this specification and in which like characters of reference indicate the same or like parts:

FIG. 1 is a partial side elevation showing a preferred embodiment of the invention with a missile supported thereon.

FIG. 2 is a partial side elevation of a preferred embodiment of the invention.

FIG. 3 is a plan view of a preferred embodiment of the invention.

FIG. 4 is a view taken along line 4-4, FIGURE 2.

FIG. 5 is a view taken along line 5-5, FIGURE 2.

FIG. 6 is an exploded sectional view of the lock means.

FIG. 7 is a partial side elevation of a modified form of the invention showing the invention with a missile supported thereon.

FIG. 8 is a detail view of one of the missile supports.

FIG. 9 is a sectional view taken along line 9-9, FIGURE 8.

FIG. 10 is a detail view of a suitable front support lock mechanism.

FIG. 11 is a view taken along line 11-11, FIGURE 10.

Referring specifically to FIGURES 1 and 2, the launching mechanism, designated generally L, is shown with a missile M supported thereon mounted on platform S adjacent wall W of a pit P. In the embodiment of the invention selected for purposes of illustration, the launcher L comprises an elongated carriage 10 flared at one end and formed of substantially upright channel members 12 and 14. Cover plates 16 and 18 are attached on the top and bottom respectively of channels 12 and 14 and front and rear plates 15 and 17 attached to channels 12 and 14 and cover plates 16 and 18 complete the box-like assembly of carriage 10. Carriage 10 is further provided with a sleeve 20 preferably formed integrally therewith and supported on shaft 22 which passes through channels 12 and 14 and is rotatably mounted at each end in bearings 24 and 26. Bearings 24 and 26, in turn, are supported on suitable substantially vertical mounts 28 and 30, respectively imbedded in platform S as by being attached to the side walls of a well E formed therein. In this manner, carriage 10, with a missile M supported thereon, can be rocked or swung from a substantially horizontal position, shown in FIGURE 1, into the desired upright position for launching, as shown in dotted lines in FIGURE 1, pit P provides clearance for unobstructed rotation of carriage 10 and a missile M supported thereon.

Missile M is removably supported on two supports, designated generally 32 and 34, mounted on carriage 10 (FIGURES 2, 3, and 4). Support 34 is located at the rear of carriage 10 adjacent the flared end thereof over pit P while support 32 is positioned at the front of carriage 10 adjacent the end thereof remote from pit P as shown best in FIGURE 3.

Front support 32, shown in upright position in FIGURE 2, comprises a pair of front legs 40 and a rear leg 44. The upper ends of legs 40 and 44 are pivotally connected in common to block 38 by pin 52. Legs 40 are likewise suitably attached together by cross bars 42 and are pivotally mounted at their lower ends on shaft 42 which is freely supported at each end in channels 12 and 14. Rear leg 44 of front support 32 is pivotally mounted at its lower end on shaft 46 which in turn is slidably supported in substantially horizontal slots 48 and 50 provided in channels 12 and 14. The purpose of mounting support 32 as described will be set forth in detail hereinbelow.

Rear support 34 extends upwardly from carriage 10, as shown in FIGURES 1, 3, and 8. Referring specifically to FIGURE 8, front cross-plate 54 of support 34 is se-

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cured to top cover plate 16 and is provided with an opening 56 to accommodate the tail portion of missile M. Side plates 58 and 60 are secured to each side of front cross plate 54 and to cover plate 16. Rear cross plate 62 of support 34 is mounted on top cover plate 16 adjacent the end thereof and at each side to side plate 58 and 60. Rear cross plate 62 is likewise provided with an aperture 64 aligned and coaxing with aperture 56 in front cross-plate to mount sleeve 66.

Sleeve 66 operates to conduct the fumes generated by the firing of missile M through saddle 34 preventing blast damage thereto. Top plate 68 is mounted on the ends of front-cross plate 54, side plates 58 and 60 and rear-cross plate 62 remote from carriage 10 to complete the structure of support 34.

It will be understood that in order to mount carriage 10 and its associated mechanism for gravity bias relative to wall W when supporting missile M, it is only necessary to determine the respective weights and the location of centers of gravity of carriage 10 and its associated mechanism and of the particular type of missile for which the launching apparatus is to be used. Once these are determined, a simple calculation involving elementary physics will suffice to locate the position of cross-shaft 22 such that the combined center of gravity of carriage 10, its associated mechanism and missile M will be positioned to rotate carriage 10 and missile M into a substantially upright position through the force of gravity alone. Likewise, if desired, carriage 10 can be provided with removable weights to effect the combined center of gravity of the launching apparatus and a missile supported thereon, thereby adapting the launching apparatus for use with a variety of missiles.

Restraining means are provided on carriage 10 to prevent overturning of a missile by wind action when carriage 10, with a missile M supported thereon, has been allowed to rotate by gravity action into a substantially vertical firing position, as shown by the dotted lines in FIGURE 1. The restraining means comprises two extensible cross arms 70 and 72 pivotally mounted to studs 74 and 76 which are fixed to channels 12 and 14, respectively, and extend outwardly therefrom as shown in FIGURES 2, 3 and 4. Cross arms 70 and 72 are provided with grips 78 and 80 respectively, mounted thereon and extending substantially transverse thereto. Grips 78 and 80 engage missile M adjacent its external power units, as shown in FIGURE 4. For the purposes of illustration, missile M has been shown with external power units. However, cross arms 70 and 72 and grips 78 and 80 can be readily adapted for use with missiles employing self-contained power units.

It will be understood that as missile M is moved into a vertical firing position, cross-arms 70 and 72 and grips 78 and 80 operate to prevent missile M from overturning when brought to rest in a vertical position and to likewise prevent overturning when in this vertical position as the result of wind action by providing support for missile M in the directions opposing possible wind action.

To insure clearance between a fixed missile and the launching apparatus L, it is necessary to mount the front support 32 and cross arms 70 and 72 for full retraction out of the missile's path of flight upon the first independent motion of the fired missile since a fired missile is subject to possible drift from its intended path of flight due to wind drift and thrust misalignment drift. To accomplish this, front legs 40 of support 32 are pivotally mounted on shaft 42 with rear leg 44 thereof pivotally mounted on shaft 46 slidably positioned in slots 48 and 50, and cross arms 70 and 72 pivotally mounted on studs 74 and 76 as described hereinabove.

When in collapsed or retracted position, front support 32 rests on the edge of front plate 15 of carriage 10. Front plate 15 is provided with a notch or indentation 73 as shown in FIGURES 2, 3 and 4, to accommodate

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front support 32 when in collapsed position, and in this position, support 32 is completely withdrawn from the flight path of a fired missile.

To raise support 32 into the upright position shown in FIGURE 2, hydraulic hand pump 82, mounted on carriage 10 is actuated, causing rod 84 of hydraulic cylinder 86 to be extended. Hydraulic cylinder 86 is pivotally mounted at one end to bracket 87 on carriage 10 by stud 85. Rod 84 is pinned at its extremity to the lower end of cocking arm 88. Arm 88 is secured at its upper end on shaft 42. As rod 84 is extended, arm 88 is rotated against the action of spring 91 rotating shaft 42 in a clockwise direction as viewed in FIGURE 2. Lug 89, secured on shaft 42 adjacent the lower end of one of legs 40, is rotated when arm 88 is actuated engaging legs 40 above shaft 42 and causing legs 40 to pivot against the action of spring 90 bringing support 32 toward an upright position (FIGURE 2). Top cover plate 16 of carriage 10 is likewise provided with an aperture 75 which coacts with notch 73 of front plate 15 to accommodate the unobstructed passage of support 32 into and out of upright position. Thus support 32 will be raised from a collapsed position into its upright missile supporting position illustrated in FIGURE 2.

As support 32 is raised, shaft 46 pivotally attached to the lower end of leg 44 will slide in slots 48 and 50 to its rearmost position therein as shown in FIGURE 10. Next cross arms 70 and 72 are raised into the upright position illustrated in FIGURE 2 by any convenient means. Raising cross arms 70 and 72 into upright position causes connectors 100 and 102 mounted in common with arms 70 and 72 on studs 74 and 76 to be rotated against the action of springs 104 and 106. Connectors 100 and 102 are also attached to cables 108 which are in turn connected to each end of a pivot shaft 110 rotatably mounted in carriage 10. Pivot shaft 110 is joined by cable 112 to the upper link 93 of a double link 92 as shown in FIGURES 10 and 11.

Upper link 93 of double link 92 is provided adjacent its upper end with an elongated slot 95 slidably mounted on pin 96 attached to carriage 10. The lower end of upper link 93 and the upper end of lower link 97 of the double link 92 are pivotally connected in common by link pin 119. The lower end of lower link 97 is pivotally mounted on stud 94 secured to carriage 10.

When cross arms 70 and 72 are raised to an upright position, connectors 100 and 102 are so attached thereto that cables 108 will pivot shaft 110 to cause a slack to be developed in cable 112. When this occurs, spring 98 secured at one end to carriage 10 and at the other end of upper link 93 adjacent pin 114, draws double link 92 into an off-center lock position. In this position, the upper end of upper link 93 is rotated about stud 96 in slot 95 into position to bear against shaft 46 as it occupies its rearmost position in slots 48 and 50 locking front support 32 in upright position.

When missile M is in place on support 32 and cross-arm 70 and 72, the hydraulic pressure in cylinder 86 is released. This causes rod 84 to be retracted, pivoting arm 88, shaft 42 and lug 89 in concert with the action of spring 91, into nonoperative position, lug 89 being moved out of engagement with legs 40. The pivotal mounting of cylinder 86 will permit the rotation of arm 88 by rod 84 into a substantially horizontal nonoperative position. However, due to the locking effect of double link 92, support 32 will remain in upright position supporting missile M while missile M itself retains cross arm 70 and 72 in upright position also. As the fired missile moved off carriage 10, cross arms 70 and 72 are released and pulled forward into collapsed position by the action of springs 104 and 106 acting through connectors 100 and 102. As connectors 100 and 102 are rotated by springs 104 and 106 to collapse the cross arms 70 and 72, tension is established in cables 108, causing pivot shaft 110 to rotate, and by means of cable 112 to rotate double link 92 about pin 96 against the action of

spring 98, out of lock position against shaft 46 and out of the path of travel of shaft 46 in slots 48 and 50. By providing two cables 108, reliability of operation is assured since, if one cable 108 is accidentally rendered inoperative, the other cable 108 is capable of accomplishing the collapse of double link 92 alone. When double link 92 is collapsed, front legs 40 will be rotated by the action of spring 90 about shaft 42 into collapsed position until raised by the next engagement with lug 89. Rear legs 44 attached to front legs 40 by pin 52 will likewise be returned to collapsed position, sliding shaft 46 along slots 48 and 50. As a safety feature, front support 32 is connected by guy wire 115 to rear across arm 72 to ensure that both members are retracted together out of the missile's line of flight.

Control means is provided to regulate the rate of gravitational rotation of carriage 10 and missile M onto pit P described hereinabove. Two downwardly depending arms 116 and 118 are mounted on bottom cover plate 18 at the end of carriage 10 remote from pit P. Sheave 120 is rotatably mounted between arms 116 and 118 on stud shaft 122. Spool 124 mounting a supply of wire cable 126 is fixed to and rotates with shaft 128 of a suitable gear reducer 130. Gear reducer 130 is in turn connected to shaft 132 of a suitable motor 134. Since neither gear reducer 130 nor motor 134 forms a specific part of the present invention, further disclosure thereof is omitted.

The wire cable 126 is strung from spool 124 around sheave 120 and secured to one end of anchor 136, as shown best in FIGURE 2. Anchor 136 is pivotally connected at its other end to plate 138 which is suitably secured in place by any convenient manner.

When carriage 10 and missile M are to be rotated into pit P to assume the position shown by the dotted lines in FIGURE 1, as described hereinabove, motor 134 is energized which, by means of the connections described directly hereinabove, causes cable 126 to be slowly payed out at a predetermined rate, thus exerting a restraining influence on carriage 10 and missile M preventing a sudden, uncontrolled gravitational rotation of these members into pit P. Such uncontrolled movement thereof would result in damage to the missile and the launching mechanism through severe impact with wall W of pit P. In addition, it will be seen that until motor 134 is energized causing cable 126 to be payed out, carriage 10 and missile M will be retained in a substantially horizontal position against the force of gravity, ensuring that the gravitational rotation of the carriage 10 and missile M will occur as desired.

After missile M has been fired from the launching apparatus, motor 134 is reversed which through gear reducer 130, causes the direction of rotation of spool 124 to be reversed, winding cable 126 thereabout and returning carriage 10 to its substantially horizontal position to await the next missile. However, it would be entirely possible to design carriage 10 and its associated mechanism such that when missile M has been fired therefrom, the location of the center of gravity of carriage 10 and its associated mechanism standing alone without a missile therein would return carriage 10 to a substantially horizontal position by the force of gravity alone.

As a further precaution against damage from impact with wall W, a hydraulic stop device is mounted in pit P as shown in FIGURE 1. This device, mounted to engage the underside of carriage 10 at the flared end thereof, comprises a roller 140 mounted on arm 142 which projects from hydraulic cylinder 144. Cylinder 144 is, in turn, secured to bracket 146 fixed to wall W. As roller 140 is engaged by bottom cover plate 18 as carriage 10 and missile M swing into the position illustrated by the dotted lines in FIGURE 1, arm 142 is forced into cylinder 144 against the hydraulic pressure established therein by suitable hydraulic means (not shown). The forcing of arm 142 into cylinder 144 operates to decelerate carriage 10 so that it will come slowly to rest against bumper 148 secured in pit P adjacent wall W.

When carriage 10 is returned to a substantially horizontal position, as described hereinabove, the hydraulic means (not shown) operates to re-establish the retarding force in cylinder 144 extending arm 142 and roller 140 into operative position in pit P for their next engagement of carriage 10.

To assist in maintaining carriage 10 and missile M in a substantially horizontal loading and handling position, locking mechanisms are mounted adjacent each side of carriage 10 as shown best in FIGURE 4. Referring specifically to FIGURE 6, each locking mechanism comprises a housing 150 secured to a bracket 152 mounted firmly in place adjacent channels 12 and 14. Rod 154 is slidably mounted through plugs 156 and 158 inserted in each end of housing 150 and is provided with a collar 160 adjacent its mid-point. Collar 160 forms a fluid-tight fit inside housing 150. Coil spring 162 encircles the portion of rod 154 between plug 156 and collar 160 and is contained inside housing 150. The end of rod 154 adjacent carriage 10 is provided with a key 164 extending transversely thereto. Each channel 12 and 14 of carriage 10 is provided with an elongated aperture 166 and 168 respectively, through which rod 154 and key 164 can be inserted. Housing 150 is provided with a hydraulic coupling 170 mounted adjacent plug 158 and connected to a suitable hydraulic pump (not shown). All parts of the respective locking mechanisms are preferably aligned for coaction and are preferably connected to a common hydraulic source.

When the locking mechanism is to be actuated to retain carriage 10 and missile M in horizontal position, the hydraulic pump is operated causing hydraulic pressure to be established inside housing 150 against collar 160. This pressure on collar 160 will slide rod 154 against the action of spring 162 into operative position in aperture 166 of channel 12, aperture 166 being aligned with rod 154 when carriage 10 through the action of cable 126 is in a position of maximum rotation out of pit P. Once rod 154 and key 164 are inside aperture 166, cable 126 can be slackened. This causes carriage 10 to rotate slightly due to gravity until rod 154 bears against the bottom of aperture 166 and key 164 against the inside of channel 12. It will be apparent that by a suitable switching arrangement when spool 124 ceases winding cable 126 therearound, the hydraulic pump associated with the locking mechanism will be actuated. When the locking mechanism is to be released, cable 126 is made taut, causing a slight rotation of carriage 10 until rod 154 and key 164 are aligned for exit through aperture 166. The hydraulic pressure against collar 160 is then released and rod 154 returned to non-operative position in housing 154 by the action of spring 162 against collar 160.

To prevent the accumulation of noxious fumes in the confined area of pit P generated by the firing of missiles therefrom, an exhaust system is provided to conduct these fumes from pit P to points of eventual dissipation. A funnel 172 is mounted in the floor of pit P such that it will be adjacent saddle 34 and sleeve 66 when carriage 10 and missile M are in the vertical firing position illustrated in FIGURE 1. As missile M is fired, the noxious fumes thus generated will be driven by the firing process into funnel 172 and through the twin exhaust stacks 174 and 176 connected to funnel 172, as shown in FIGURES 1 and 3, to separate points outside pit P where these fumes will be discharged into the atmosphere. Since these fumes often attain high temperatures and are generally corrosive in nature, funnel 172 and stacks 174 and 176 are preferably constructed of a resistive material.

FIGURE 7 discloses a modified form of the invention in which launching apparatus L is shown mounted on an elevated firing tower T and pit P has been eliminated. Tower T comprises four column supports 178 and 180, only two of which are shown for convenience, secured conveniently in place at the ends thereof adjacent the

ground line and supporting adjacent their other ends each corner of platform 182. Two bearing supports 184, only one of which is shown, are mounted at each end on columns 180 and supports 186 which are secured to platform 182, as shown in FIGURE 7.

The launching apparatus L as modified above, is operative in the same general manner as the preferred embodiment. All like members function in like manner.

In the modified form of the invention, illustrated in FIGURE 7, the mounting means, tower T, for the launching apparatus L may be of prefabricated construction for rapid assembly and dismantling thereof, adding mobility to a missile launching installation employing the invention. Further, depending on the size of the missile to be fired, it would be possible to readily adapt the present invention for use with a conventional motor vehicle; preferably a truck, thereby permitting the greatest possible degree of mobility to a missile launching installation employing the invention.

What we claim is:

1. A self-collapsing missile mount comprising a missile carriage, a support, a shaft, means rotatably mounting said shaft in said carriage, means pivotally supporting one end of said support on said shaft, a link, means securing one end of said link to said shaft, a lug, means securing said lug to said shaft adjacent said support, a hydraulic jack, means pivotally connecting one end of said jack to the other end of said link, means pivotally connecting the other end of said jack to said carriage, a hydraulic pump mounted on said carriage for actuating said jack, said actuated jack being operative to rotate said link, said shaft and said lug, said lug engaging said support when said pump actuates said jack such that said support is rotated from a collapsed position adjacent said carriage into a substantially upright missile supporting position, said pump being operative to de-actuate said jack rotating said link and said lug to its non-operative position and out of engagement with said support when said support is in its substantially upright position with a missile supported thereon, spring means for maintaining said support in said collapsed position, lock means for maintaining said support in said substantially upright position, two elongated missile mounts, means pivotally mounting said missile mounts cross-wise on said carriage, connectors secured to each of said mounts and pivotally mounted in common therewith on said last-named means, a second spring means connected to each of said connectors to rotate said connectors and pivot said mounts from a substantially upright missile supporting position to a collapsed position adjacent said carriage when a missile is fired therefrom, means connecting said connectors to said lock means to release said lock means when said connectors are rotated by said second spring means whereby said first-named spring means is operative to return said support from said substantially upright missile supporting position to said collapsed position when a missile has been fired therefrom.

2. The invention as defined in claim 1 wherein said lock means includes a double link, means pivotally connecting one end of said double link to engage said support and the other end of said double link pivotally connected to said carriage, spring means attached to said link for maintaining said double link in locked position adjacent said support when said support is moved into said upright position, and means for releasing said double link from said locked position.

3. The invention as defined in claim 2 wherein the means connecting said rotors to said double link includes

a shaft, means pivotally mounting said shaft in said carriage, cables connecting one end of said shaft to each of said rotors and means connecting said shaft to said double link such that when said rotors are rotated by said second spring means, said cables pivot said shaft in said carriage, and said connecting means from said shaft to said double link effects the rotation of said double link away from said locked position and out of engagement with said support, whereby said first-named spring means is operative to return said support from said substantially upright missile supporting position to said collapsed position.

4. A missile handling and launching mechanism comprising a platform, a missile carriage, self-collapsing missile mounts on said carriage, means swingably supporting said carriage on said platform, means supporting said platform at an elevated position to allow said carriage with a missile supported on said mounts to swing from a substantially horizontal position in a vertical plane to a predetermined upright position, said means including pivotal supports for said carriage, means mounting said supports beyond one end of said platform with the center of gravity of said combined missile and carriage located beyond said supports whereby the swinging movement of said carriage and a missile held thereon is effected by gravity action, wherein said self-collapsing missile mounts include an elongated mount, a lug, a shaft pivotally connecting said mount to said carriage, means securing said lug on said shaft adjacent said mount, means for rotating said shaft to move said lug into engagement with said mount, said mount being raised thereby from a collapsed position adjacent said carriage to a substantially upright missile mounting position, said last-named means being operative to return said lug to non-operative position and out of engagement with said mount when said mount is in said upright position with a missile supported thereon, spring means for maintaining said mount in said collapsed position, lock means for maintaining said mount in said substantially upright position, elongated missile supports, means pivotally mounting said supports on said carriage, rotatable means secured to said supports and pivotally mounted in common therewith on said last-named means, a second spring means connected to each of said rotatable means to rotate said rotatable means and pivot said supports from a substantially upright missile supporting position to a collapsed position adjacent said carriage when a missile is discharged therefrom, means connecting said rotatable means to said lock means to release said lock means when said rotatable means are rotated by said second spring means, whereby said first-named spring means is operative to return said mount from said substantially upright missile supporting position to said collapsed position when a missile has been discharged therefrom.

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