April 25, 1961 A. H. MILLER, JR 2,981,150

LAUNCHER

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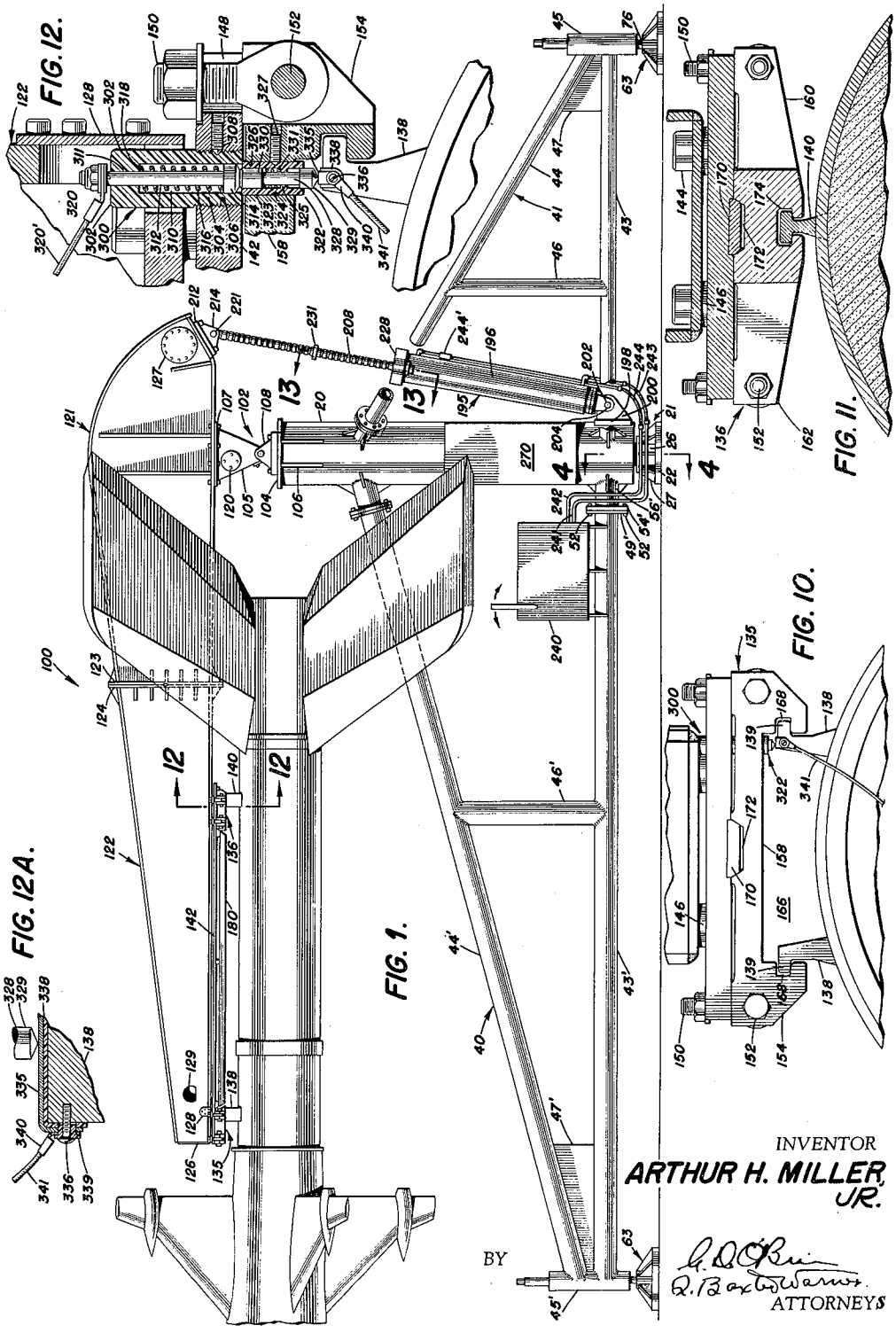

FIG. 12.

FIG. 11.

FIG. 10.

FIG. 12A.

FIG. 1.

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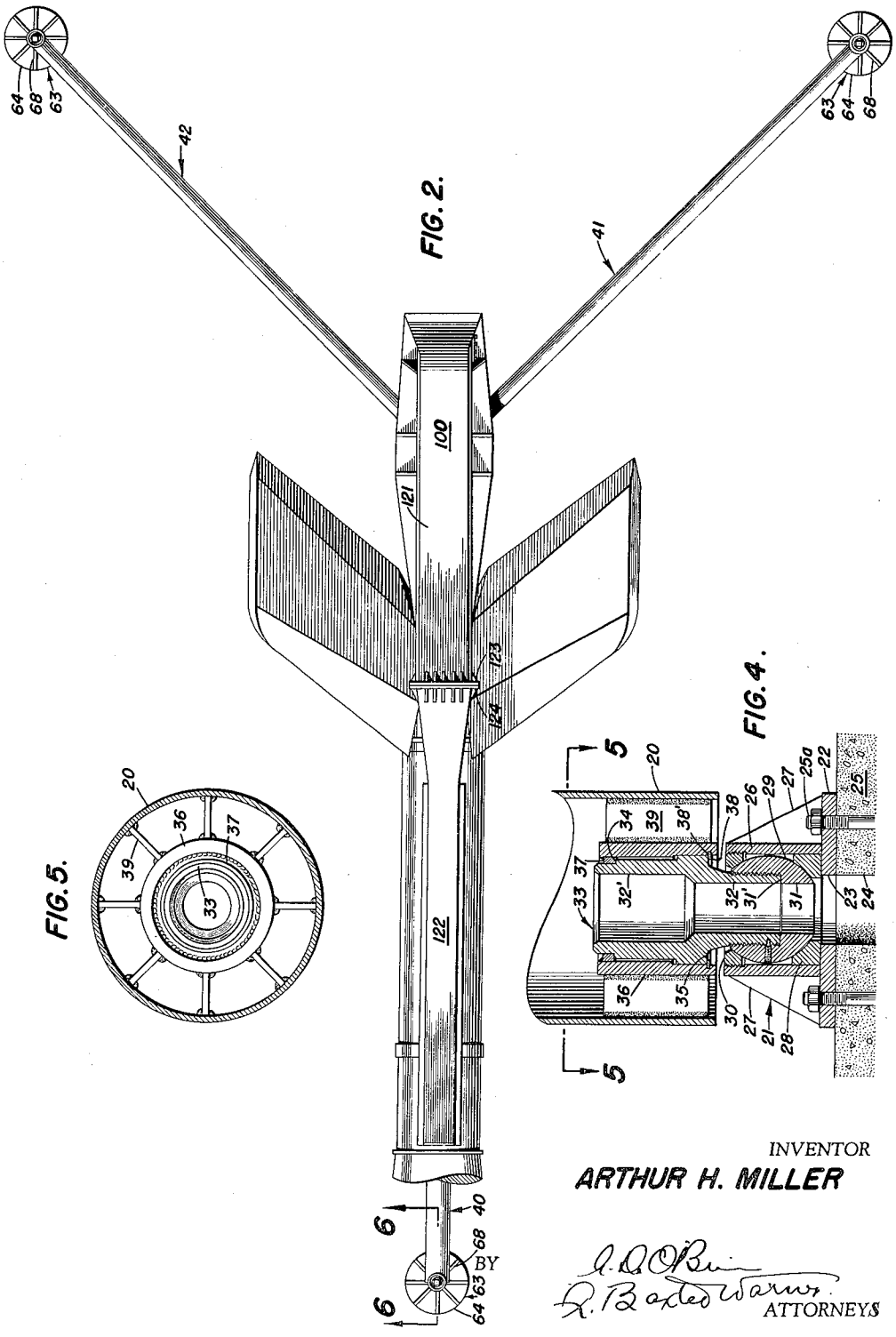

FIG. 2.

FIG. 5.

FIG. 4.

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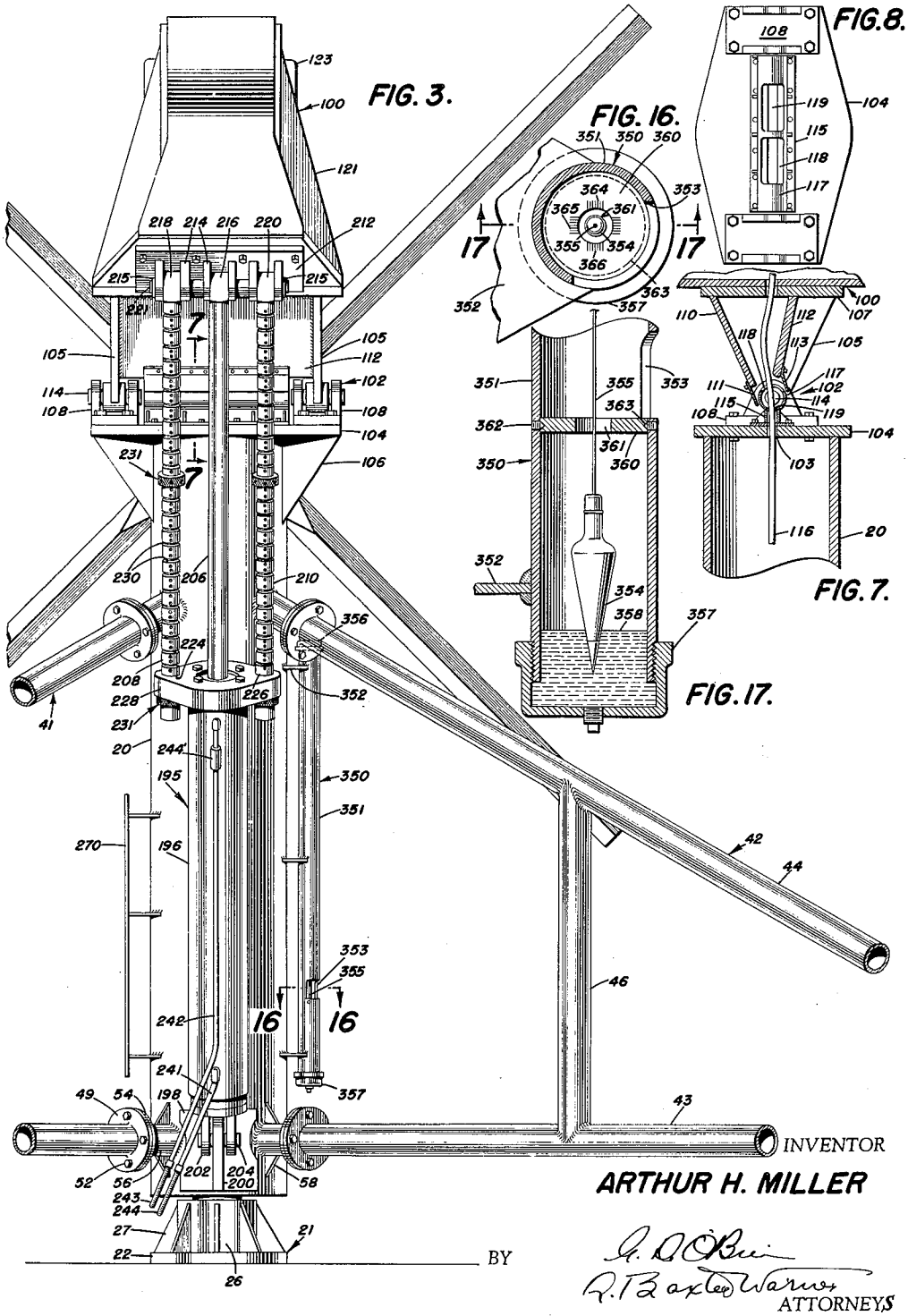

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LAUNCHER

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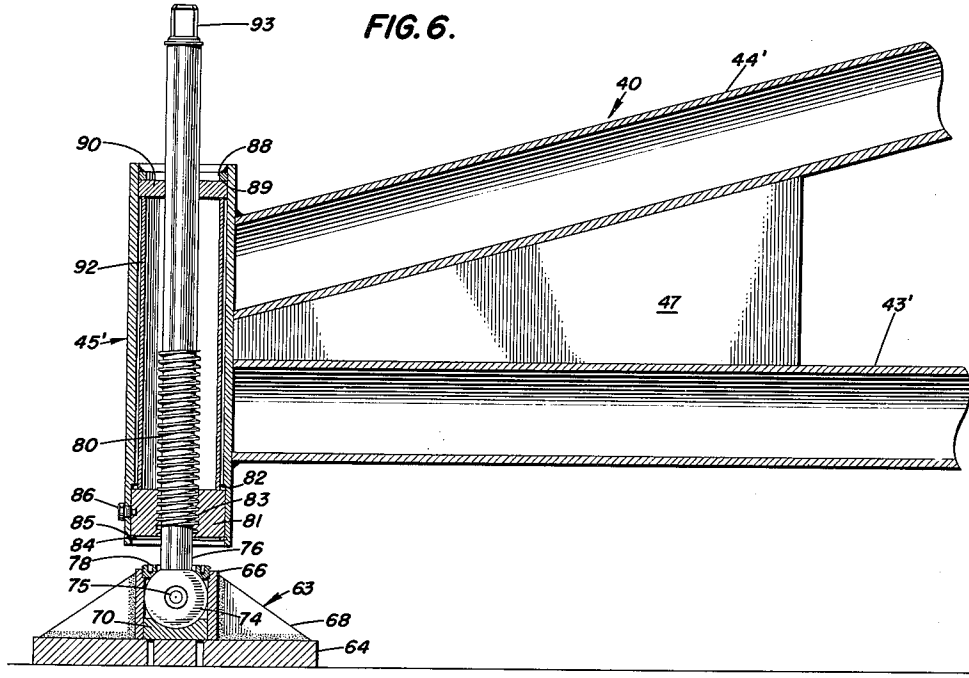
FIG. 6.



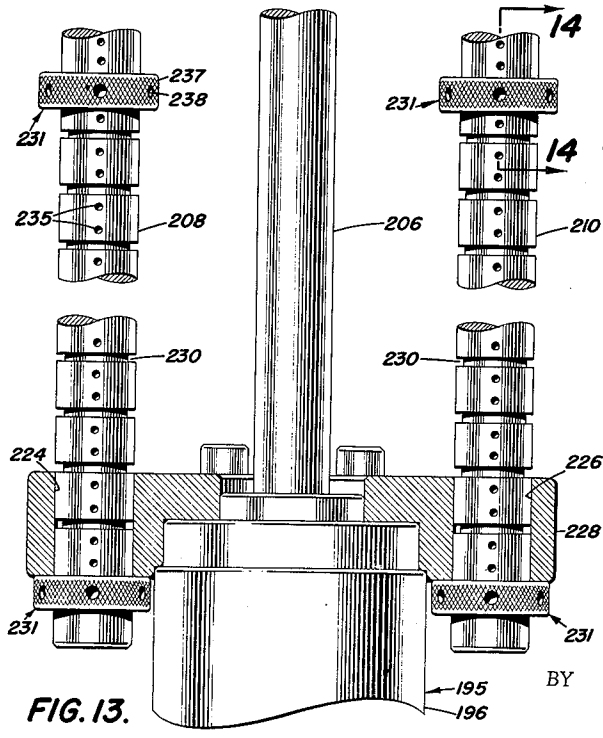


FIG. 13.

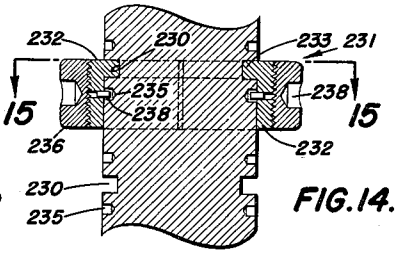


FIG. 14.

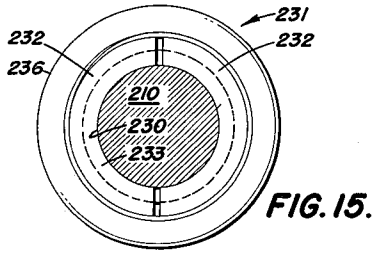


FIG. 15.

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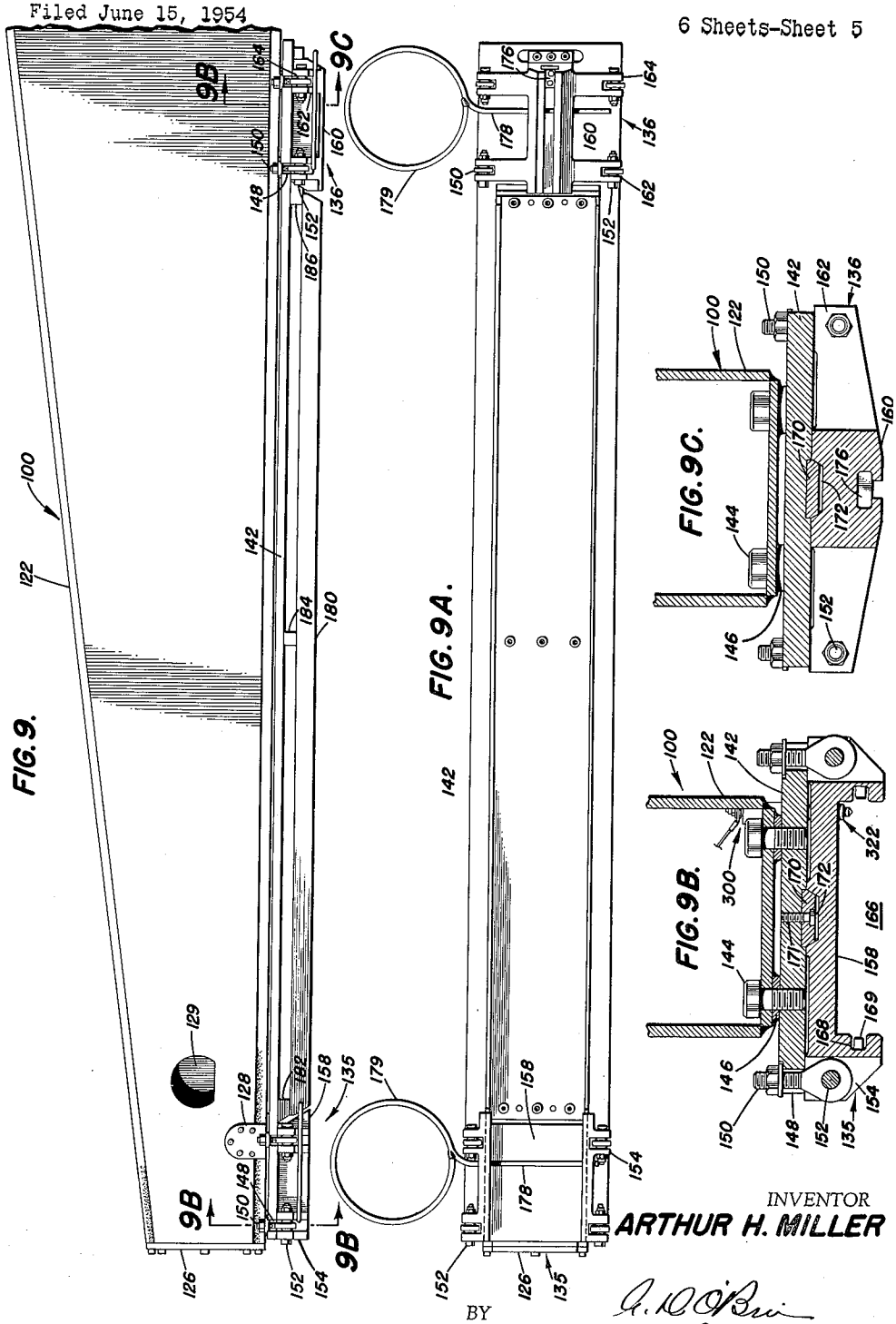

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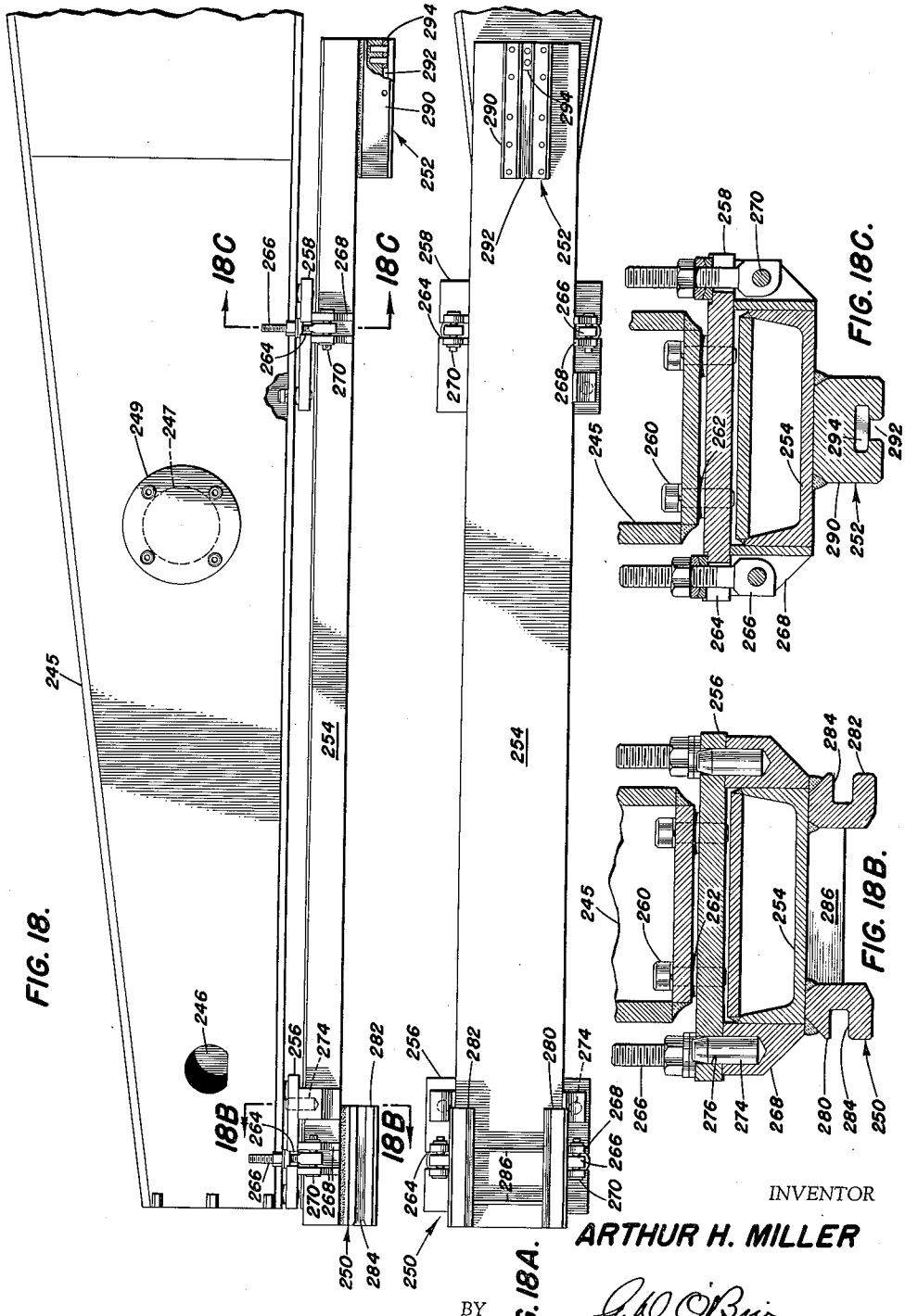

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United States Patent Office 2,981,150 Patented Apr. 25, 1961

2,981,150

LAUNCHER

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Filed June 15, 1954, Ser. No. 437,016

4 Claims. (Cl. 89—1.7)

The present invention relates to launching devices for aerial vehicles and, more particularly, to launchers for aerial vehicles propelled by reaction type motors.

Guided missiles presently undergoing design and development, and intended for tactical use, usually include rockets or ramjet vehicles which are propelled at launching and during the first flight stage by separable booster rockets. The combination of a vehicle and its booster has a weight of several tons. Furthermore, the thrust developed by the rocket amounts to many thousand pounds. The weight of the missile and the blast accompanying the launching thereof require a very substantial launching structure. In addition, the launching structure must be capable of raising the combination of the vehicle and booster to the desired launching angle.

Another requirement for a launcher intended for tactical use is that provision be made for mounting the aerial vehicle and booster on the launcher quickly and in such a position that it will immediately clear said launcher upon ignition of the booster rocket. Obviously, if the missile were deflected from its intended course by striking a part of the launcher, the results might be disastrous in terms of probable injury to personnel, missile failure and damage to the launching structure.

An additional requirement for the launching structure is that the electrical cables interconnecting the missile electrical equipment and a ground control and test station be protected from the blast accompanying launching. To accomplish the required protection, the cables must be completely shielded from the heat and flame accompanying the takeoff of the missile.

Accordingly, an important object of the present invention is the provision of a launcher structurally suitable for launching guided missiles propelled by reaction type motors.

Another object of this invention is the provision of a missile launcher which is adjustable in elevation.

A further object of the invention is the provision of means by which a guided missile can readily be mounted in firing position on the launcher so that it will quickly clear the launching structure upon ignition of the booster rocket.

Other objects and many of the attendant advantages of the 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, in which:

Fig. 1 is a side elevation of the launcher of the present invention, with a missile mounted thereon shown fragmentarily;

Fig. 2 is a plan view of the launcher shown in Fig. 1;

Fig. 3 is a rear elevation of the launcher shown in Fig. 1;

Fig. 4 is a section along line 4—4 of Fig. 1;

Fig. 5 is a section along line 5—5 of Fig. 4;

Fig. 6 is a section along line 6—6 of Fig. 2;

Fig. 7 is a section along line 7—7 of Fig. 3;

Fig. 8 is a plan view of the top of the launcher central column with the boom and parts of the trunnion removed;

Fig. 9 is an enlarged side elevation of a part of the boom of the launcher;

Fig. 9A is a bottom plan view of the part of the boom shown in Fig. 9;

Fig. 9B is a section along 9B—9B of Fig. 9;

Fig. 9C is a section along line 9C—9C of Fig. 9;

Figs. 10 and 11 are fragmentary views showing the details of the arrangement in which the forward and aft missile shoes, respectively, are received in the rails on the launcher arm, Fig. 10 being an elevation and Fig. 11 a section;

Fig. 12 is a fragmentary section showing the details of the contacts by which electrical connection is made to the booster igniter lead;

Fig. 12A is a fragmentary view of a detail of the connection shown in Fig. 12;

Fig. 13 is an enlarged section along line 13—13 of Fig. 1, some parts being shown in elevation;

Fig. 14 is an enlarged section on line 14—14 of Fig. 13;

Fig. 15 is a section on line 15—15 of Fig. 14;

Fig. 16 is a section on line 16—16 of Fig. 3;

Fig. 17 is a section on line 17—17 of Fig. 16;

Fig. 18 is an elevation, corresponding to Fig. 9, of a modification of a section of the boom;

Fig. 18A is a bottom plan view of the modification of the boom section shown in Fig. 18;

Fig. 18B is a section along line 18B—18B of Fig. 18; and

Fig. 18C is a section along line 18C—18C of Fig. 18.

Briefly, the invention comprises a central tubular column adapted to be fastened to the ground or a deck surface. A plurality of supporting legs are provided which hold the column in a vertical position and also assist in restraining the column from lateral motion. A boom adjustable in elevation is pivotally mounted on the upper end of the central column and a hydraulic actuator is provided for adjusting the boom. Leveling means are provided on each leg and may be used to adjust the legs with respect to the central column, thereby pre-stressing the launcher for assisting in withstanding the launching forces. Means carried on the boom cooperate with means carried on the missile so that the missile can easily be mounted on the boom, and the mounting arrangement is such that the missile is immediately freed of the launcher upon firing. Two embodiments of this mounting arrangement are disclosed for use with different types of missile boosters.

Referring to Figs. 1 and 2 of the drawings, the launcher is shown as comprising a central tubular column 20 supported by a base at its lower end, generally indicated by reference numeral 21. As best seen in Fig. 4, base 21 comprises a plate 22 provided with an aperture 23 aligned with an aperture 24 in a block of concrete 25 or similar material to which the base 21 is attached by bolts 25a. A sleeve 26 abuts the plate 22, and is fastened thereto by a plurality of webs or gusset plates 27 welded to both the sleeve 26 and said plate. A ball seat 28 is carried in the bottom of the sleeve 26 and supports a ball 29, which is retained in the sleeve 26 by a retainer ring 30 screwed into the upper end of said sleeve. The ball 29 is drilled to provide an aperture 31 which is counterbored, forming a shoulder 31'. The counterbored portion of aperture 31 is internally threaded to receive the threaded lower end portion 32 of sleeve 33, which has spaced shoulders 34 and 35 formed on the outside surface thereof. The upper end portion 32' of sleeve 33 is received in a cylindrical housing 36, the shoulder 34 being held in abutting relation with a thrust ring 37 on the inside surface of said housing by a snap ring 38 carried in a groove 38' and bearing against the shoulder 35. The cylindrical housing 36 is mounted inside the

lower end of tubular column 20 by webs 39 which are secured to the inside surface of said column. The central aperture extending through the base 21 permits electrical cables (not shown) to be inserted into the column 20 from the opening 24 in the concrete block 25 on which the base rests. It will thus be seen that the ball 29 and the sleeve 33 cooperate with the base 21 and column 20, respectively, to provide a pivotal connection between said base and column.

The central column 20 is held in vertical alignment and restrained from lateral motion by an arrangement of legs generally resembling that of a tripod and including a relatively long forwardly extending leg 40 and two relatively short rearwardly extending legs 41 and 42. Because of the position of the missile on the launcher, the elements of the forward leg 40 are made larger and structurally stronger than those of the rearwardly extending legs; in other respects all of the legs are identical. Each leg 40, 41 and 42 is in the form of a simple truss, and legs 41 and 42 each comprise spaced tubular members 43 and 44 interconnected by an end sleeve 45 and cross-members 46 and 47, the cross member 47 being a web or gusset plate welded to members 43, 44 and sleeve 45. Leg 40 comprises spaced tubular members 43' and 44' interconnected by an end sleeve 45', a cross-member 46' and a gusset plate 47', all of these elements being structurally stronger than the corresponding members of legs 41 and 42. As best seen in Figs. 1 and 3, the lower tubular members 43 and 43' of the respective legs 40, 41 and 42, are provided with flanges 49 and 49' at their inner ends, which are removably attached by bolts 52 to corresponding flanges 54 and 54' carried on short tubular sections 56 and 56', welded to the column 20, the weld joints being reinforced by welded plates 58. The upper truss members 44 and 44' of the respective legs 40, 41 and 42 are similarly provided with flanges at their inner ends, likewise attached by bolts to flanges carried on tubular sections welded to the column 20.

As best seen in Figs. 2 and 6, the sleeves (45, 45') at the outer ends of the legs carry adjustable feet 63, the details of which differ somewhat from those of the base 21. Each sleeve and adjustable foot assembly includes a plate 64 having a sleeve 66 mounted thereon, the sleeve 66 being reinforced by gusset plates 68. A ball seat member 70 is mounted at the bottom of the sleeve 66 for supporting a ball 74, which is fastened on the lower end of a post 76 by a pin 75 and is retained in the sleeve 66 by a retainer ring 78 screwed into the upper end of said sleeve. This construction provides a ball and socket connection between each foot and post, 63 and 76, respectively, at the outer end of each of the legs. The post 76 has a threaded portion 80 screwed into a threaded aperture 83 in a bushing 81, said bushing being carried in the lower end of the supporting sleeve. The bushing 81 is retained in a space formed below a shoulder 82 provided on the inside surface of the supporting sleeve, said bushing being held against downward displacement by a snap ring 85 received in a groove 84 in member 45', and being locked against rotation by a set screw 86. A ring 88 is welded on the inside surface of the supporting sleeve adjacent the upper end thereof to provide a shoulder 89, and an apertured guide disk 90, in which the upper portion of post 76 is journaled, is retained against the shoulder 89 by an elongated cylindrical spacer 92 extending between the bushing 81 and said disk 90. The upper end 93 of shaft 76 is squared to receive a wrench for adjusting the foot 63 in the supporting sleeve.

Referring to Figs. 1, 3, 7 and 8, a tapered boom 100, of rectangular cross-section, is mounted on the upper end of the column 20 by a pivotal connection generally indicated by reference numeral 102. A plate 104 having an aperture 103 therein is carried on the upper end of the column 20, being attached to said column by a plurality of gusset plates 106 which are welded to the column 20 and said plate. The pivotal connection 102

comprises a pair of spaced trunnion mounts 105 attached to a plate 107 which is bolted to the underside of the boom 100, near the larger end thereof, and a pair of laterally spaced yokes or pillow blocks 108 bolted to the upper surface of the plate 104. Pins 114 are inserted in the aligned apertures provided in the trunnion mounts 105 and pillow blocks 108 to complete the pivotal connection 102.

For protecting electrical control cables, one of which is shown at 116, two spaced shield plates 110 and 112 extend between the trunnion mounts 105 and are welded thereto and to plate 107. L-shaped brackets 115 are bolted to the top plate 104, on each side of aperture 103. A tube 117 having pairs of longitudinally spaced apertures 118 and 119 on its top and bottom sides, respectively, is fastened to the brackets 115 with said apertures 118 and 119 in alignment with the aperture 103 in plate 104. Relatively thin-walled plates 111 and 113 are attached along corresponding edges to the shield plates 110 and 112, respectively, and are arranged so that the opposite edge of each plate may be bent to frictionally contact the surface of tube 117. This arrangement completely shields electrical cables, as 116, which are brought up through the interior of column 20, aperture 103 in plate 104, the apertures 118 and 119 in tube 117 and passed through aligned holes provided in plate 107 and the underside of the boom 100 and into the hollow interior of said boom. As seen in Fig. 1, a hand hole 120 is provided in one of the trunnion mounts 105 to permit access for threading the cables into the boom.

As best seen in Fig. 1, the boom 100 is composed of an inner section 121 and outer section 122 having flanges 123 and 124, respectively, which can be joined as indicated by any desired means. The boom 100 is fabricated from plate stock and, as previously stated, is hollow and rectangular in cross section. As best seen in Fig. 9 an end plate 126 is bolted to the outer end of boom 100, and an opening, covered on one side by a suitable plate 128, is provided adjacent the outer end to accommodate an electrical contact, to be described hereinafter. An access hole 127 and a cable hole 129 (Fig. 1) are also provided in the boom 100, the former adjacent the inner end of the boom and the latter adjacent the outer end thereof.

Forward and aft track assemblies 135 and 136, which cooperate with forward and aft booster shoes 138 and 140, respectively, are best shown in Figs. 9 through 9C and are supported on the section 122 of boom 100. The track assemblies 135 and 136 are removably mounted on a plate 142 which is attached by bolts 144 (Figs. 9B and 9C) to the underside of boom section 122, suitable spacers 146 being inserted between the plate 142 and said boom section. The plate 142 is provided along its longitudinally extending edges with a plurality of spaced notches 148 adapted to receive eye-bolts 150 which, as to the forward track assembly 135, are pivotally mounted on bolts 152 journaled in spaced yokes 154 projecting from opposite sides of a rail 158, said rail being a part of said forward track assembly. The aft rail 160, which is a part of the aft track assembly 136, is similarly provided with spaced yokes defined by lugs 162 for journaling bolts 152 which pivotally mount eye-bolts 150. As seen in Figs. 9B and 10, the forward rail 158 is provided with a rectangular recess 166 for receiving the spaced forward booster shoes 138. Each side wall of the recess 166 is provided with a groove 168 into which a lip 139 on the corresponding forward booster shoe projects. A stop pin 169 (Fig. 9B) is provided adjacent the aft end of each groove 168 to limit rearward movement of the booster. To assist in centering the track assemblies 135 and 136 with respect to the plate 142 and thereby facilitate positioning the eye-bolts 150 in the notches 148, a key 170, having tapered edges and attached to said plate by screws 171, is arranged to cooperate with a keyway 172 formed in the upper surface of the rails 158 and 160.

The aft track assembly 136 is generally similar to the forward track assembly 135 except for the details of the rail 160. In the aft track assembly 136, the single aft booster shoe 140 is T-shaped in cross section and is received, as shown in Fig. 11, in a correspondingly shaped recess 174. A single stop 176 (Figs. 9A and 9C) is provided in the recess 174 near its aft end. The mode of attachment of the aft track assembly 136 to the plate 142 is identical to that of the forward track assembly 135, as explained hereinabove.

The details of the electrical connections to the booster igniter lead are shown in Fig. 12. A spring loaded contact assembly, generally indicated by reference numeral 300, is mounted on the plate 142, being suitably positioned so that when said plate 142 is on the boom section 122 part of said contact assembly extends into a cutaway portion formed in said boom section and covered by the plate 128. The contact assembly 300 comprises a cylindrical housing 302 of insulating material provided with a threaded end portion 304 received in a threaded aperture 306 in the plate 142. A set screw 308 prevents rotation of the housing 302 with respect to said plate.

A chamber 310 having an end wall formed with an axial aperture 311 is provided in the housing 302, and an elongated contact stem 312 having an enlarged element or head 314 formed on one end thereof is slidably carried in said aperture. A coiled spring 316 surrounds the stem 312 and is interposed between said head and the top wall 318 of the chamber 310. At its upper end, the contact stem 312 receives a terminal lug and nut assembly 320 which is carried on the end of an electrical lead 320' which conducts current from a source provided at a remote control station (not shown).

A second spring loaded contact assembly shown at 322, is mounted on the rail 158 for providing electrical connection between the contact 312 and a strap 335 of conducting material, carried on the missile shoe 138. The contact assembly 322 includes a sleeve 323 of insulating material having a groove 324 on its outer surface and a shoulder 325 on its inner surface. The sleeve 323 is retained in an aperture 326 in rail 158 by a set screw 327 threaded into an aperture in said rail and having its inner end received in the groove 324. A contact 328 having an enlarged head 329 at one end and a sleeve 330 press fitted onto its other end is slidably carried in the insulating sleeve 323. A spring 331 is interposed between the shoulder 325 and the lower edge of sleeve 330 for yieldably positioning the contact 328 in the housing 323 so that said contact can engage both contact head 314 and contact strap 335.

As seen in Fig. 12A, the strap 335 is shaped to fit over the top surface of shoe 138, and is attached to said shoe by screws 336, only one of which is shown. A layer of insulation 338 similar in shape to strap 335 separates said strap from the missile shoe 138, and shouldered bushings 339 of insulating material are provided between the strap 335 and the screws 336. A terminal lug 340, insulated from the shoe 138 and screw 336 by one of the shouldered bushings 339, is held in electrical contact with strap 335. The terminal lug 340 is carried on one end of an electrical lead 341 which has its other end connected to the booster rocket igniter (not shown). The igniter circuit is completed through a common ground connection to the remote control station (not shown).

Referring again to Figs. 9 and 9A, both the forward track assembly 135 and the aft track assembly 136 are provided with removable stops 178 to prevent forward displacement of the missile from the boom 100. The removable stops 178 are formed of heavy wire and are received in suitable apertures provided in the forward and aft rails and can be readily withdrawn from the path of the booster shoes by circular handles 179.

A channel member 180 is mounted on the underside of the plate 142, being attached by bolts to suitably spaced bosses 182, 184 and 186 on said plate. The channel member 180 is provided as a guide and to prevent the aft booster shoe 140 (Fig. 1) from striking the forward track assembly 135, upon launching of the missile.

As best seen in Figs. 1 and 3, a hydraulic actuator, generally indicated by reference numeral 195, is used to elevate the launcher boom 100 to the desired firing angle. The actuator 195 is of conventional type and includes a cylinder 196 which is pivotally mounted on the column 20 near its lower end. This pivotal mounting includes a plate 198 attached to the column 20 and having an apertured lug 200 integral therewith. A yoke 202 is carried on the lower end of the cylinder 196 and a pin 204 is inserted through aligned apertures provided in the lug 200 and the yoke 202. The piston rod 206 of the hydraulic actuator is pivotally attached at its upper end to the inner end of the boom 100, as are the upper ends of a pair of stop rods 208 and 210.

The pivotal connection between the rods 206, 208 and 210 and the boom 100 includes a plate 212 attached by bolts to the end of boom section 121. The plate 212 has three pairs of suitably spaced apertured lugs 214 formed integral therewith. The upper ends of the rods 206, 208 and 210 are provided with sleeve bearings 216, 218 and 220, respectively, and a shaft 221 is inserted through aligned apertures in said bearings and the lugs 214, the shaft being retained in position by snap rings 215 provided adjacent its outer ends.

The stop rods 208 and 210 are slidably carried in spaced apertures 224 and 226 provided in a stop block 228 on cylinder 196, and are provided along their lengths with a plurality of spaced circumferential grooves 230. A pair of stop rings 231 is carried on each of the rods 208 and 210, and as said rings are identical in construction, a description of one will suffice for all. As best seen in Figs. 14 and 15, a typical stop ring 231 includes a split inner element 232 having a threaded outer wall and an inwardly directed lip 233, said lip being engageable in a selected one of the grooves 230. Each half of the ring element 232 carries an inwardly directed pin 234 which is engageable in a socket 235 in the rod 210. As will be seen in Figs. 13 and 14, sockets 235 are arranged in vertically spaced, diametrically opposed pairs between adjacent grooves 230. The lip 233 and the pin 234 and socket 235 cooperate to retain the ring element 232 in position on the rod 210 during installation of the stop ring 231. The halves of the ring element 232 are retained in locked operative positions by an outer ring element 236 which is screwed on the threaded outer wall of said element, and the outer ring element 236 is provided with a knurled outer surface 237 and spanner wrench sockets 238. The ring 231 can be moved to any desired position on the rod 210 by simply removing the outer element 236 and disengaging the parts of the split element 232, when the lips 233 can be engaged in another of the grooves 230. Attention is directed to the fact that a relatively fine adjustment of the ring 231 can be obtained by inverting the element 232 so that the lips 233 will appear at the bottom of said element (in Fig. 14) rather than at the top, in which instance the pins 234 would engage in the sockets 235 above the groove 230 in which the lips are anchored, rather than in the sockets below said grooves as shown.

As stated hereinabove, the stop rods 208 and 210 are each provided with an upper and lower stop ring 231. The grooves 230 and holes 232 are arranged along the respective rods 208 and 210 so that the boom 100 can be set at desired angles of elevation, up to approximately 85°.

Referring again to Fig. 1, the operating mechanism for the hydraulic actuator includes a pump driven by an electric motor, a valve, and a tank for the hydraulic fluid, and is mounted in a housing 240 on the lower member 43' of the forward leg 40. A control handle is provided on said housing. Since these elements are conventional, no detailed description is given herein.

A pair of hydraulic leads 241 and 242 interconnect the pump housing 240 and the hydraulic cylinder 196, lead 241 being connected to the lower end of said cylinder and lead 242 being connected to the upper end thereof. Flexible sections 243 and 244 are provided in the leads 241 and 242, respectively, to permit bending as the cylinder 196 moves about its lower end. A flow limiter 244' is inserted in the lead 242 to limit the flow out of the cylinder in the event of a power failure stopping the pump. The flow limiter 244' prevents a loaded boom from moving rapidly to its lowermost position.

As can be seen in Figs. 3, 16 and 17, an indicator 350 for assisting in vertically aligning the center column 20 is mounted on said column. The indicator 350 includes a tube 351 attached to the column 20 by mounting brackets 352. The tube 351 has a sight opening 353 intermediate its ends. A plumb bob 354 is suspended within the tube 351, said plumb bob being attached by a steel wire 355 to a top cap 356 on the upper end of said tube. The lower end of tube 351 is closed by a cap 357 and a supply of damping fluid 358 is provided in the bottom of the tube into which the pumb bob 354 extends. A gauge plate 360, having an aperture 361 through which the steel wire 355 extends, is mounted in tube 351 adjacent the lower end of sight opening 353 by set screws 362 having their inner ends received in a peripheral groove 363 provided on said plate. Two series 364 and 365 of opposed sighting markings 366 are provided on the top surface of said plate. By sighting along the markings thus provided and adjusting the feet 63 of the launcher until the wire 355 moves to the center of the aperture 361 in gauge plate 360, the central column 20 can be brought into vertical alignment. As can be seen in Fig. 3 a panel 270 is also provided on the central column 20 for mounting such controls as may be needed.

It is believed that the general mode of operation of the launcher will be apparent from the foregoing detailed description. To facilitate mounting the missile and its booster on the boom 100, the forward and aft track assemblies 135 and 136 are removed from the plate 142 and are mounted on the booster, the forward booster shoes 138 being received in the grooves 168 of the forward track assembly and the aft booster shoe 140 received in the T-shaped recess 174 in the aft track assembly. The missile and booster are then raised in a position near the boom 100 and in alignment therewith, so that the eye-bolts 150 can be swung into their respective notches 148. The removable stops 178 are then inserted in the apertures provided in the forward and aft track assemblies. With the missile in position, the central column 20 can be aligned vertically by adjusting the feet 63, if necessary, and pre-stressing of the launching structure can also be accomplished, if desired, by adjusting the feet with the central column fixed. The stop rings 231 are then adjusted along stop rods 208 and 210 to positions corresponding to the desired angle of elevation of the boom 100, and the hydraulic actuator is energized to raise or lower the boom 100 to said angle. Firing is accomplished by the ignition of the booster from a remote point through the medium of an electric current applied through the leads 320' and 341, which pass through the interior of column 20 and boom 100. Because the tracks 158 and 160 are extremely short, the missile and booster are quickly freed from the launcher.

The modified boom shown in Figs. 18 through 18C is interchangeable with the boom 100; that is, the modified boom section 245 can be substituted for the section 122 to provide greater ease of missile attachment. A cable hole 246 and a hand hole 247, provided with a cover plate 249, are suitably located along the boom section 245. The boom section 245 carries forward and aft track assemblies 250 and 252, respectively, interconnected by a channel member 254. To support the channel member and track assemblies on the boom section 245, a pair of plates 256 and 258 is arranged in spaced relationship along said boom section, being fastened thereto by means of bolts 260, spacers 262 being interposed between the underside of said boom section and said plates. Each of the plates 256 and 258 is provided with notches 264 on two opposite sides thereof for receiving pivotally mounted eye-bolts 266 carried on the channel member 254. For pivotally mounting the eye-bolts 266, yokes comprising pairs of spaced lugs 268 are provided on the channel member 254 and have apertures therein for receiving pins 270 which are also inserted through the apertures in the eye-bolts 266. Thus, the eye-bolts normally retain the channel member 254 attached to boom section 245.

A pair of tapered dowels 274 is carried on channel member 254 adjacent the forward end thereof, said dowels being received in apertures 276 provided in the plate 256 to align the channel member and the plate. The forward track assembly 250 includes a pair of spaced rails 280 and 282 attached to the underside of channel member 254 and interconnected by reinforcing plates 286. Each of said rails has a groove 284 therein for receiving correspondingly spaced shoes carried on the booster.

The aft track assembly 252 includes a single central rail 290 provided near the aft end of channel member 254 and having a recess 292 therein which is T-shaped in cross section to receive a correspondingly shaped aft missile shoe, as in the first described embodiment of the invention. A stop 294 is provided in the aftermost part of recess 292 to prevent rearward displacement of the missile.

The operation of attaching the missile to the boom when boom section 245 is used differs slightly from the operation described above in connection with the boom section 122. The assembly including channel member 254 and the track assemblies 250 and 252 is detached from the boom section 245 and positioned so that the forward and aft missile shoes, generally similar to those shown in Figs. 10 and 11, are received in the grooves 284 and the recess 292, respectively. The missile and booster combination can then be lifted, by attachment of a suitable hoist to the channel member 254, and raised to a position adjacent the boom section 245, when the eye-bolts 266 may be engaged in notches 264 for mounting the missile and booster on the boom.

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 a launcher for an aerial vehicle, a central column having a base at the lower end thereof, supporting legs projecting from said column generally resembling that of a tripod and including a relatively long forwardly extending leg and two relatively short rearwardly extending legs, each of said legs being formed of a simple truss, each of said legs being provided with an adjustable foot at its outer end, a boom pivotally mounted on the upper end of said central column, a pair of spaced plates attached to the underside of said boom, each of said plates being provided with notches along its edges, a pair of spaced track assemblies, means interconnecting said track assemblies, pivotal means carried by said means interconnecting said track assemblies and adapted to engage in said notches, rails carried by said track assemblies and adapted to releasably receive mating parts on said aerial vehicle, means between said boom and column for elevating said boom about its pivot including a hydraulic actuator having a cylinder attached at one end to said central column and a piston rod working in said cylinder, said rod being attached to one end of said boom, a stop rod slideably carried in said cylinder and having one end pivotally connected to said boom, and adjustable stop members carried in said stop rod.

2. An arrangement as recited in claim 1, wherein said

legs are adjustable with respect to said central column for pre-stressing said launcher with said aerial vehicle in position on said boom, thereby enabling said launcher to withstand the forces accompanying launching of said aerial vehicle.

3. An arrangement as recited in claim 1, wherein each adjustable foot includes a plate, a sleeve carried in said plate, a ball seat in said sleeve, a ball supported in said ball seat, and means attaching the ball to its supporting leg.

4. An arrangement as recited in claim 1, and means for indicating vertically of said column including a tube mounted on said central column and having its longitudinal axis parallel to the longitudinal axis of said central column, said tube being provided with a sighting opening intermediate its ends, a gauge plate having a central aperture therein, said gauge plate being positioned horizontally in said tube near said sighting opening, a plumb bob suspended within said tube, a wire for suspending said plumb bob, said wire being attached at

one end to the upper end of said tube and passing through said aperture in said gauge plate, and means on said gauge plate for indicating when said wire is in the center of said aperture.

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