Oct. 27, 1964 S. KONGELBECK 3,153,980

RETRACTABLE MISSILE SHOES

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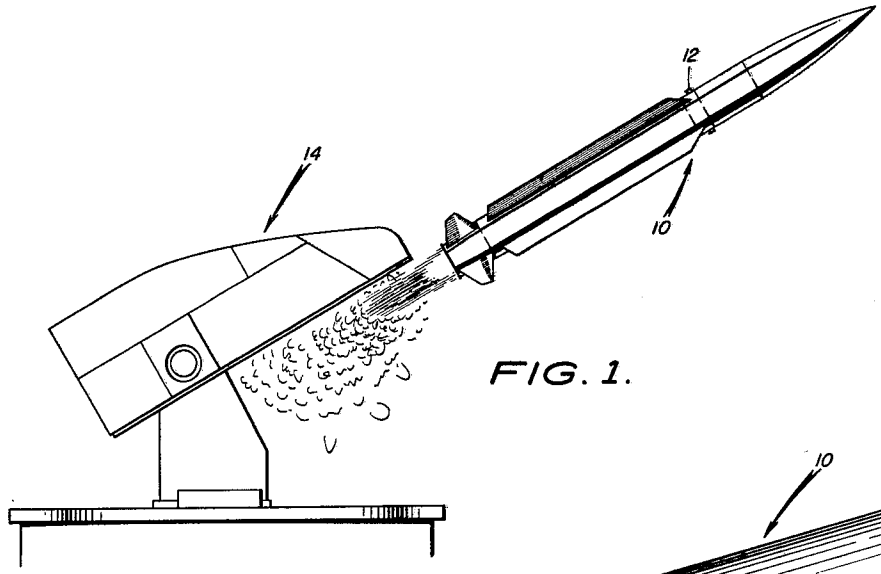

FIG. 1.

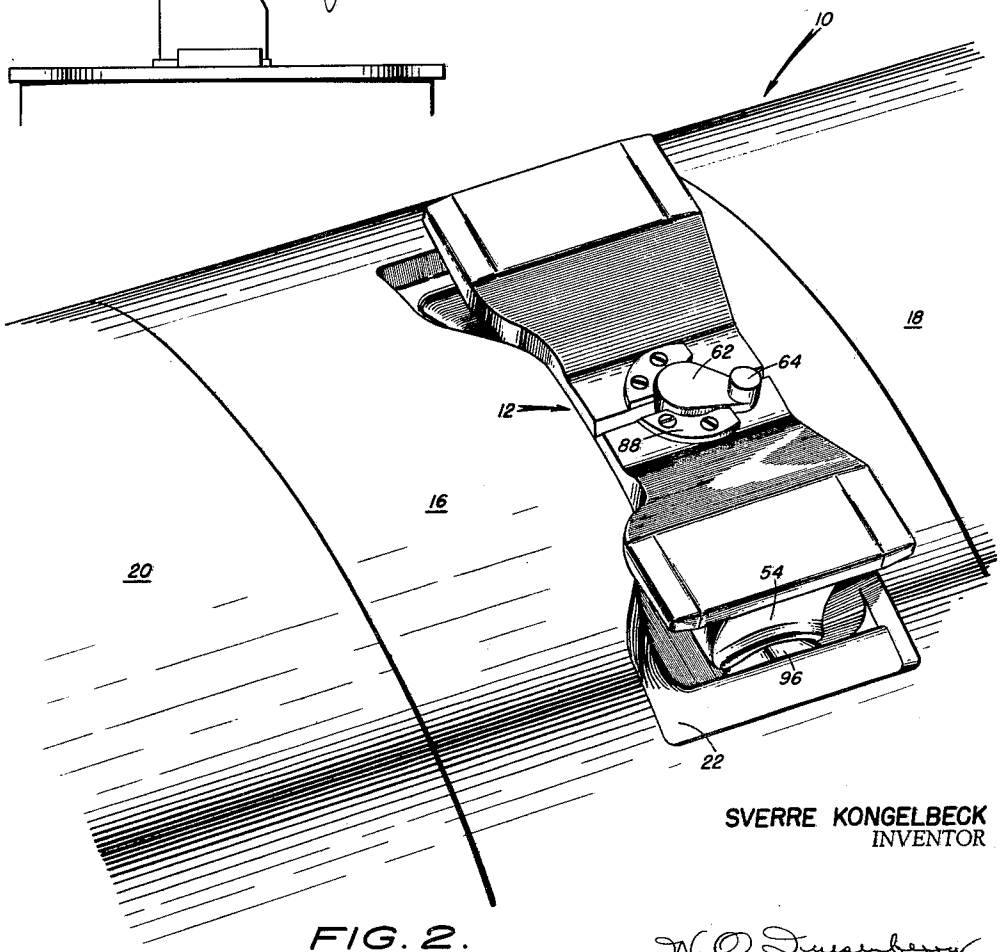

FIG. 2.

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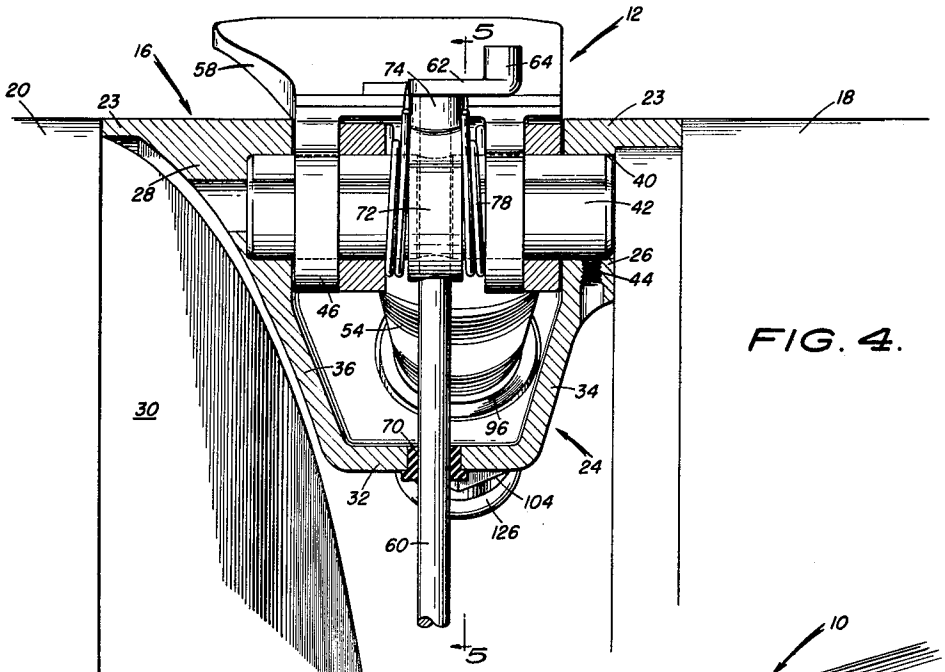

FIG. 4.

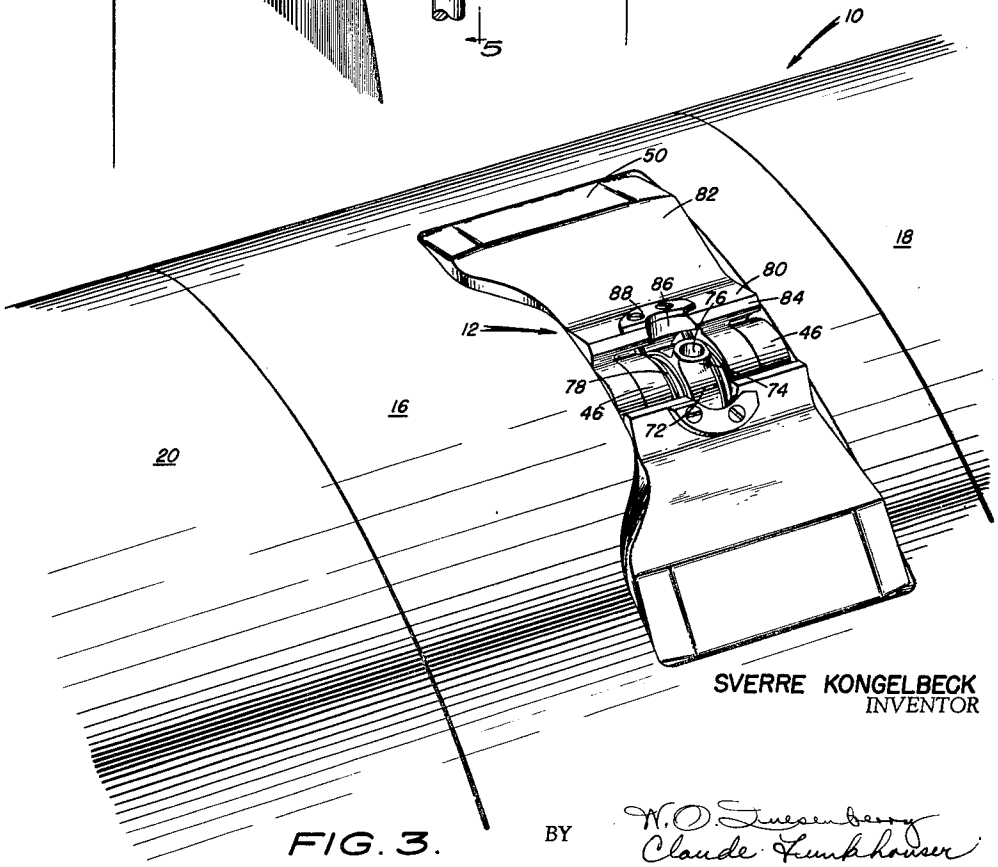

FIG. 3.

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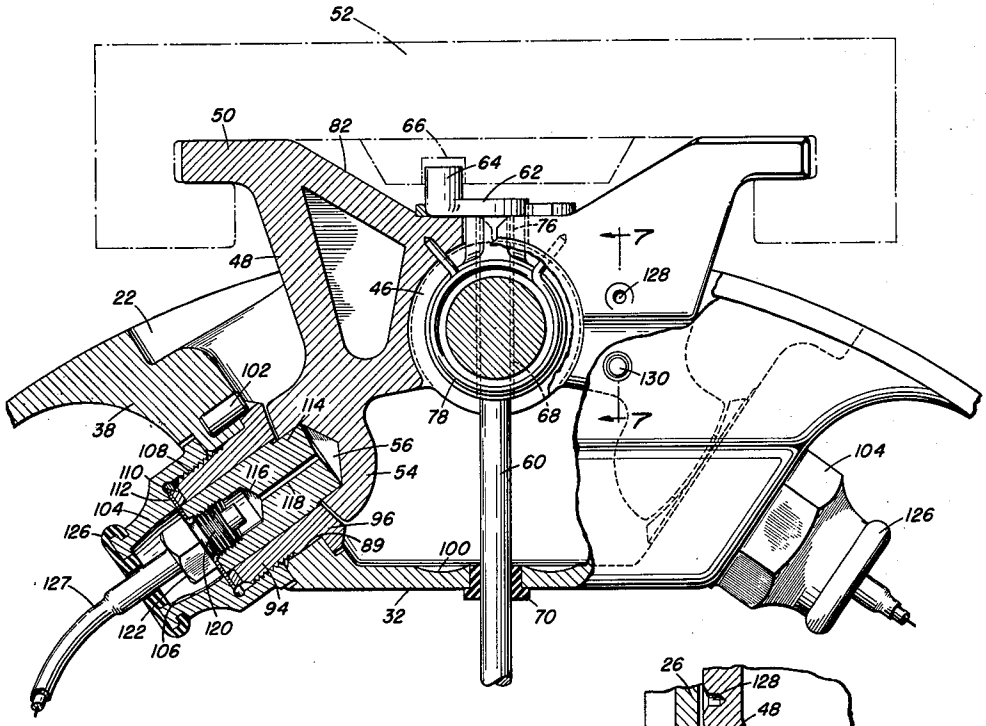
FIG. 5.



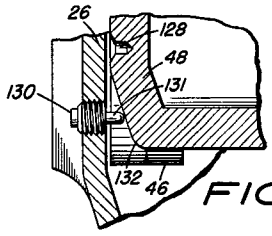
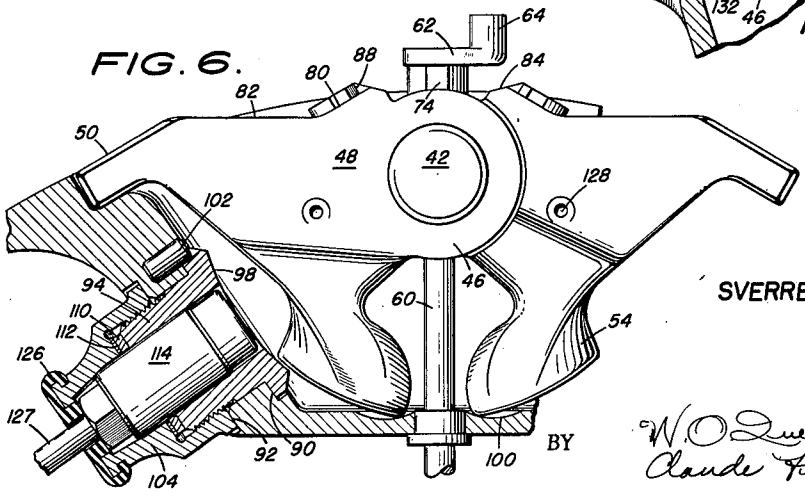


FIG. 7.

FIG. 6.



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RETRACTABLE MISSILE SHOES

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5 Claims. (Cl. 89—1.7)

This invention relates generally to missile supports; more particularly, it relates to retractable shoes for supporting an aerial missile on a missile launcher.

Aerial missiles stowed on shipboard are commonly provided with shoes by which they are supported from fixed rails on the missile launcher. These shoes project outwardly from the missile, and during flight create an undesirable aerodynamic drag which adversely affects the range, speed and control of the missile. It has heretofore been necessary to provide duplicate shoes diametrically opposite the supporting shoes in order to balance the drag effect during flight. Since present missile handling and launching equipment require shipborne missiles to utilize shoes, it is apparent that a missile shoe creating little or no adverse drag during flight would be desirable. The present invention is concerned with retractable missile shoes which protrude from the missile for supporting the same but which retract into the missile body upon launching.

It is therefore an object of the present invention to provide retractable shoes for supporting an aerial missile on a launcher.

Another object of the invention is to provide retractable missile shoes having sufficient strength to resist the supporting loads exerted thereon.

A further object of the invention is to provide a compact missile shoe assembly wherein a pair of shoes is pivotally mounted on a common pin.

Still another object of the invention is to provide normally raised missile shoes having automatically actuated means for initiating retraction thereof.

Yet another object of the invention is to provide retractable missile shoes having locking means for maintaining the shoes in retracted position after launching of the missile.

Other objects and many of the attendant advantages of the present 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 side elevation of a missile embodying the retractable shoes of the present invention and showing the missile immediately after launching;

FIG. 2 is a perspective view of the retractable shoes in raised position;

FIG. 3 is a view similar to FIG. 2 but showing the shoes in retracted position;

FIG. 4 is a longitudinal section of the pivot pin of the shoe assembly;

FIG. 5 is a partial section taken on line 5—5 of FIG. 4 showing the shoes in raised position;

FIG. 6 is a view similar to FIG. 5 but showing the shoes in retracted position; and

FIG. 7 is a section taken on line 7—7 of FIG. 6.

Generally, the invention comprises a pair of shoes pivotally mounted in a missile and spring urged toward retracted position. Locking pins engaging the shoes initially prevent their retraction and maintain them in raised position for engagement with the launcher rails. After launching, the pins are moved out of engagement with the shoes, thereby allowing them to move under the force of the springs to retracted position. A detent pin arrangement is provided to hold the shoes in retracted position to prevent them from overcoming the force of the springs and moving to raised position or vibrating during flight.

Referring to FIG. 1, an aerial missile 10, provided with retractable shoes 12, is shown immediately after being launched from a turret launcher 14. Generally, only a single pair of retractable shoes is necessary since the lack of aerodynamic drag associated with such shoes does not require a symmetrical shoe arrangement. But a turret launcher requires that missiles be provided with two pairs of shoes; hence two pairs are illustrated in this figure.

As shown in FIGS. 2 and 3, a pair of shoes 12 is pivotally mounted in a bulkhead or support ring 16 which connects the forward and aft missile sections 18 and 20 and which is an integral part of the missile air frame. An identical pair of shoes may be provided diametrically opposite the pair of shoes shown, as noted above, but only a single pair need be described. The support ring 16 is provided with recesses 22 for receiving the outer end portions of the shoes 12 when in retracted position, as shown in FIG. 3.

As more clearly shown in FIGS. 4 and 5, the support ring 16 is provided with annular flanges 23 at the forward and aft ends thereof for securing said ring by any suitable means to the forward and aft missile sections 18 and 20. An integral well 24 is formed in the support ring 16 and is provided adjacent the support ring forward flange 23 with a vertical forward closure 26 of uniform thickness having a flat outer surface for engagement with the forward missile section 18. Adjacent the support ring aft flange is an aft closure 28 of varying thickness, the outer surface thereof being shaped to conform to the curvature of the dome-shaped rocket combustion chamber headcap 30. A bottom wall 32 is connected to the forward and aft closures 26 and 28 by converging walls 34 and 36 respectively, the latter wall forming a continuation of aft wall 28. Identical converging side walls 38 connect the sides of the bottom wall 32 to the support ring 16 to complete the structure of the well 24. The well enclosure is shaped to conform to the outer contour of the shoes 12, which extend through the open end of the well when in raised position, as shown in FIG. 2.

The forward and aft walls 26 and 28 are provided with aligned bores 40 extending parallel to the longitudinal axis of the missile and located midway between the side walls 38. Fitted in the bores 40 are the ends of a pin 42, secured therein by a set screw 44 extending upwardly within the forward wall 26 adjacent to the juncture of said forward wall and the converging wall 34. Each shoe 12 is pivotally mounted on the pin 42 by two hinge loops 46 spaced such that the loops of the shoes are alternately arranged. By utilizing a common pivot pin of sufficient size, a compact shoe assembly is provided capable of withstanding the loading forces exerted thereon. Except for the location of the hinge loops, one shoe 12 is the mirror image of the other; therefore, only one shoe will be described in detail.

The left-hand shoe 12, shown in full in FIGS. 4 and 5, comprises an elongated body 48 having one hinge loop 46 at the aft end thereof. Spaced from the forward end of the body 48 a distance equal to the thickness of the hinge loop is another loop 46. The right-hand shoe, shown in section in FIGS. 4 and 5, has one hinge loop at the forward end thereof and an identical loop spaced from the aft end a distance equal to the thickness of a loop. The side of the shoe body 48 opposite the hinge loops 46 is provided with a flange 50 beveled at each edge in order to slide easily in a fixed launcher rail 52, shaped to receive said flange. Subjacent the hinge loops 46 and disposed approximately midway between the ends of the body 48 is an arcuate protrusion or boss 54 having a bore 56

therein for a purpose to be described hereinafter. The forward end of the shoe body 48 extends at right angles to the missile axis, but the aft end of said body is arcuately formed as at 58 in order to permit utilization of a relatively long shoe flange while permitting said body to lie within the confines of the well 24. The distance between the forward and aft closures 26 and 28 is slightly greater than the length of the shoes in order to permit said shoes to have a certain amount of slidable motion along the pin 42 for a purpose to be disclosed hereinafter. As shown in FIG. 5, the shoe body 48 is hollow in order to reduce the weight thereof.

The missile 10 is provided within the support ring 16 with an arming shaft 60 extending radially outwardly thereof, the inner end of which shaft is connected to an arming mechanism (not shown) for actuating the same at a predetermined position of the missile on the launcher. The outer end of the shaft is connected by an arm 62 to a pin 64, which pin rides in a cam track 66 (FIG. 5) in the launcher. To eliminate any interference with the operation of the shoes or the arming shaft, the pin 42 is provided with a transverse bore 68 midway between the ends thereof, through which bore the shaft 60 rotatably extends. Aligned with the bore 68 is a journal bearing 70 fixed in the bottom wall 32 of the well 24 for receiving the shaft 60. Between the aft hinge loop 46 of the right-hand shoe and the forward hinge loop of the left-hand shoe is an annular ring 72, of lesser thickness than the distance between said loops, slidably mounted on the pin 42, said ring having aligned transverse bores for receiving the shaft 60. A neck 74 is integrally formed on the ring 72 and is provided with a bore 76 aligned with the transverse bores in the ring so that the shaft 60 has a passageway from the open end of the well 24 to the interior of the supporting ring 16. The outer end of the neck 74 provides a bearing for the arm 62 and extends outwardly of the missile a distance sufficient to prevent said arm from interfering with the retraction of the shoe 12.

In the area between opposite faces of the ring 72 and the adjacent hinge loops 46 are two identical torsion springs 78 surrounding the pin 42. The ends of each spring 78 are secured in the bodies of opposite shoes 12 to continuously urge said shoes toward retracted position.

As best shown in FIGS. 5 and 6, the side of the shoe 12 opposite the flange 50 is provided with a flat upper surface 80 connected to the flat upper surface of said flange by a surface 82, and to the inner end of the shoe by a bevel 84. When the shoe 12 is in raised position, the shoe structure immediately above the hinge loops 46 almost abuts that of the opposite shoe. The surfaces of the shoe are so arranged with respect to each other and to the hinge loops 46 that there is little shoe structure extending radially outwardly of the missile body when the shoes are in retracted position. The recesses 22 in the supporting ring 16 are of sufficient depth to receive the flanges 50 and the arcuately curved body portion 58 of the shoes 12 when so retracted. Each shoe is provided with an arcuate recess 86 opposite the neck 74 to enable the shoes to be raised without being obstructed by said neck. An arcuate plate 88 is fixed to each of the shoes 12 concentric with the recesses 86 to limit the pivotal movement of the link 62 and the arming shaft 60.

Each side wall 38 of the well 24 is provided with a bore 89, the center of which lies substantially in a transverse plane through the center of the bore 56 in the boss 54. The bore 89 is counterbored at both ends to form shoulders 90 and 92. Fitted in the bore 89 and extending through the wall 38 is a bushing 94 having external threads on the outwardly extending portion thereof, the inner end of which bushing has an annular flange 96 abutting the shoulder 90. The inner end of the bushing 94 extends into the well 24 and is provided with a curved surface 98 concentric with the pin 42 and hinge loops 46. The outer surface of the boss 54 is provided with a like

curvature to allow said boss to move freely past the bushing 94 as the shoe 12 pivots about the pin 42. A recess 100 is provided in the bottom wall 32 adjacent the journal bearing 70 to receive the boss 54 as the shoe pivots into retracted position. The bushing 94 is doweled to the wall 38 as indicated at 102 to prevent rotation of said bushing, since such rotation would misalign the curved surface 98 with respect to the outer curved surface of the boss 54 and would hinder movement of said boss past the bushing.

An end cap 104 having a bore 106 and a counterbore 108 is threadedly secured to the bushing 94, the inner end of the end cap abutting the shoulder 92. The end of the bushing 94 abuts a shim washer 110 which in turn abuts a frangible annular retaining disk 112 lying on the shoulder connecting the bore 106 and the counterbore 108, said disk normally holding the pin in inwardly extended position. The inner end of the bore 106 has the same diameter as the inside diameter of the bushing 94 and is aligned therewith. Slidably but tightly received in the bushing 94 is a cylindrical locking pin 114, the inner end of which normally extends into the well 24 and the outer end of which bears against the disk 112. The inwardly extending end of the pin 114 is slightly reduced in diameter and is slidably received in the bore 56 of the shoe boss 54 to hold the shoe 12 in raised position against the force of the torsion springs 78. If the pin 114 had a uniform diameter, vibration could cause a burr to form thereon at the point where it enters the bore 56 of the boss 54. This would be undesirable since it would cause the pin to bind in the bushing 94 and could prevent withdrawal of said pin from the bore 56, but a burr formed on the smaller diameter portion of the pin will not affect slidable movement thereof through the bushing 94. The outer end of the pin 114 is provided with a partially threaded centrally located recess 116 connected to the inner end of said pin by an axial conduit 118. An electrically actuated explosive squib 120 is threadedly secured in the recess 116, and an integral nut 122 abuts the disk 112 to aid said disk in retaining the pin 114 in extended position. The bore 106 is constricted toward its outer end to provide a stop for limiting movement of the pin 114 away from the boss 54. An elastic grommet 126 seals the outer end of the cap 104 to prevent moisture from entering therein, and receives therethrough the electrical connection cable 127 for the squib 120.

Referring now to FIG. 7, the lowermost portion of the flat forward surface of each shoe 12 is provided with a socket 128. A spring-biased detent pin assembly 130 is threadedly secured in the forward wall 26 and lies in substantially the same vertical plane as the socket 128. The forward shoe surface immediately beneath the socket 128 is sloped away from the wall 26 to form a cam surface 132 which is disposed opposite the pin assembly 130 when the shoes are in raised position. Retraction of the shoes will cause the cam surface 132 to retract the pin 131 of the assembly 130 until the socket 128 is positioned opposite thereto, which occurs when the shoes are fully retracted. The pin 131 will be urged into the socket 128 to hold the shoes in their retracted position.

In operation, the shoes 12 are held in raised position against the force of the springs 78 by engagement of the pins 114 in the bores 56 of shoe bosses 54. Movement of the shoes in any direction is prevented by the pin 42 and the locking pins 114. The relatively loose axial fit of the shoes on the pin 42 permits the pins 114 to be quickly and easily engaged in the bores 56 of bosses 54. At a predetermined time after launching of the missile, each squib 120 will be automatically actuated by means well known in the art, and gases produced thereby will flow through the conduit 118 and into the tapered bottom of bore 56. Since the pin 114 has a tight fit in the bore 56 the gas pressure in the tapered bottom of said bore cannot escape and will consequently increase until sufficient to force said pin out of the bore, shearing the frangible disk 112. Movement of the pin is limited by the tapered portion of the bore 106. With the pin 114 no longer holding

the shoes in raised position, the springs **78** will immediately retract and hold said shoes in retracted position with the aid of the detent pin **131** which will engage in the socket **128**.

The squibs **120** need not be arranged as shown in the drawings but may be disposed in any convenient manner so long as the gases produced upon actuation thereof are connected by a conduit to the chamber formed by the tapered bottom of the bore **56** in the shoe bosses **54**.

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. A support for an aerial missile, comprising a pin mounted within said missile parallel with the longitudinal axis of the missile, a pair of shoes oppositely mounted on said pin for limited pivotal movement between a raised position and a retracted position, flange means on the outer extremity of each said shoe adapted for engagement with a fixed support when the shoes are in raised position, said missile having recess means for receiving said shoes when in retracted position, means urging said shoes toward retracted position, a pair of pins slidably mounted within said missile, each of said shoes having socket means for receiving one of said pins when in raised position, and means for retracting said pins from said socket means to permit said shoes to be moved to retracted position by said urging means.

2. Retractable missile shoes including, in combination with a missile having a support ring provided with forward and aft closures, a bottom wall, and converging side walls, said closures and walls defining a well, said side walls terminating in spaced relation to the surface of the ring to define recesses, a pin journaled by the closures near their corresponding upper ends and extending transversely of the well, shoes pivotally mounted on the pin and having bodies formed with bosses and at their opposite ends with flanges, said shoes being movable from extended positions with the flanges projecting above the surface of the ring for engagement by launcher rails to retracted positions with the flanges lying within the recesses, means engageable with the bosses for initially retaining the shoes extended, said means being shiftable by explosive forces for permitting movement of the shoes, and a spring surrounding the pin and engageable with the shoes for shifting said shoes to retracted positions upon initiation of said explosive forces and consequent shifting of said first-mentioned means.

3. In an arrangement for supporting an aerial missile from a missile launcher having fixed rails thereon, a pair of shoes pivotally mounted within said missile about a common axis parallel with the longitudinal axis of the missile, said shoes lying in a common transverse plane and having limited pivotal movement between a raised position and a retracted position, flange means on the outer extremities of said shoes for engaging said fixed rails, means for normally holding said shoes in raised position, means urging said shoes toward retracted position, means for disengaging said holding means and said shoes at a predetermined time after launching of said missile whereby the shoes will be retracted at such time, the means for holding said shoes in raised position comprising a pair of pins slidably mounted in said missile, and a socket in each shoe for receiving one of said pins.

4. The arrangement as recited in claim 3, wherein the means for disengaging said pins and said shoes includes a pressure means connected to each of said pins, actuation of said pressure means moving said pins from said sockets.

5. The arrangement as recited in claim 3, including additionally a recess in the missile, said recess receiving said shoes in retracted positions, and means in the recess for retaining the shoes in retracted positions in said recess, whereby a smooth aerodynamic surface will be provided for the missile.

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