Feb. 23, 1960 S. KONGELBECK 2,925,966

FOLDING FIN OR WING FOR MISSILES

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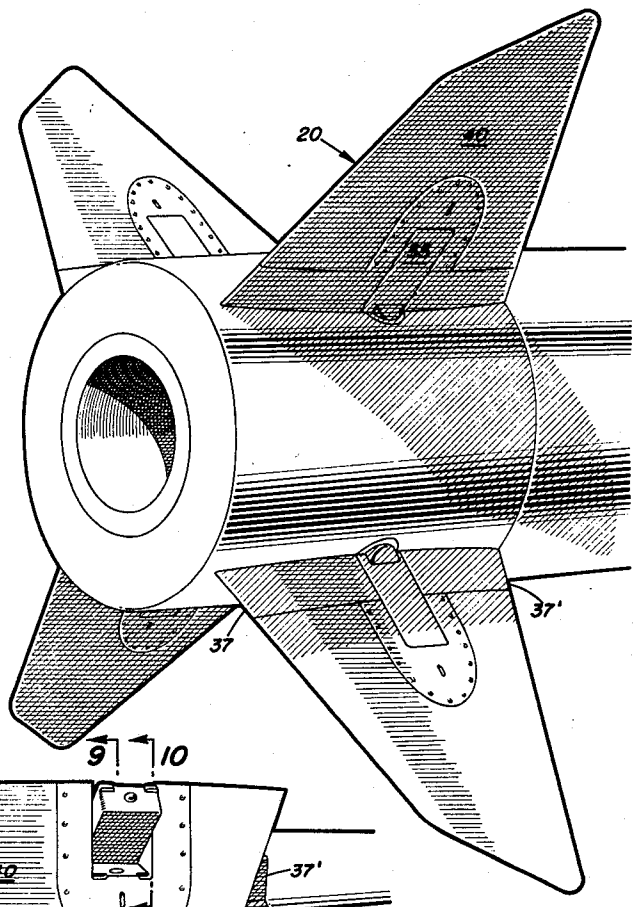
FIG. 1.



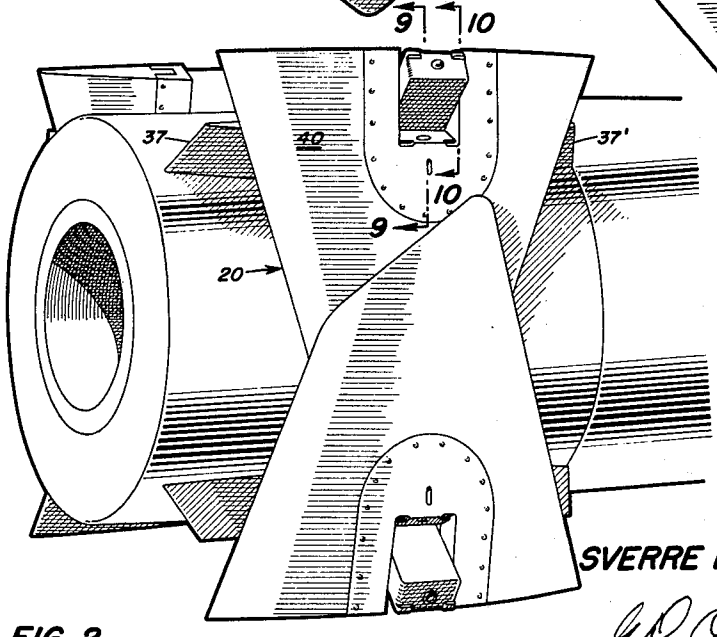


FIG. 2.

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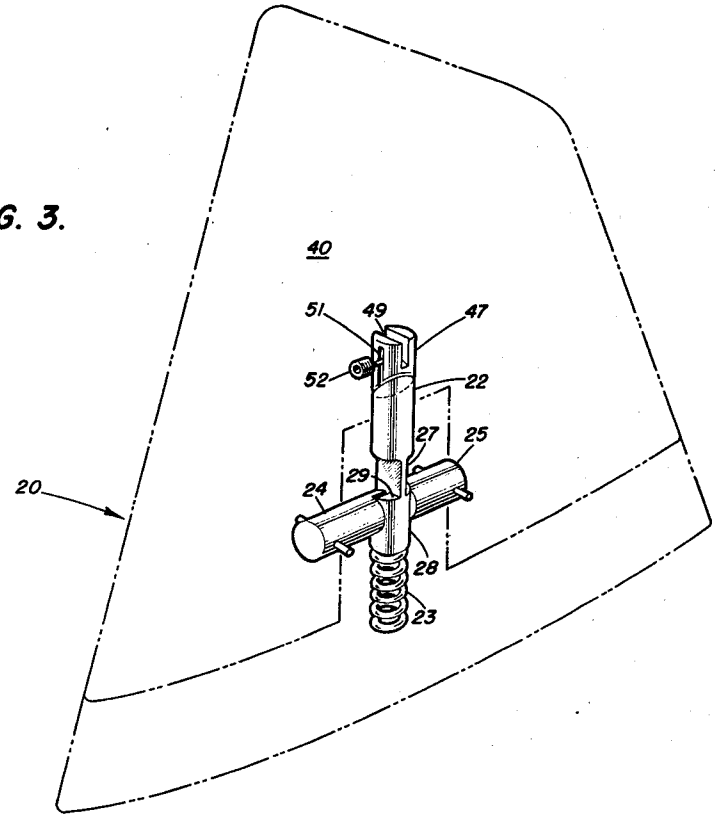
FIG. 3.



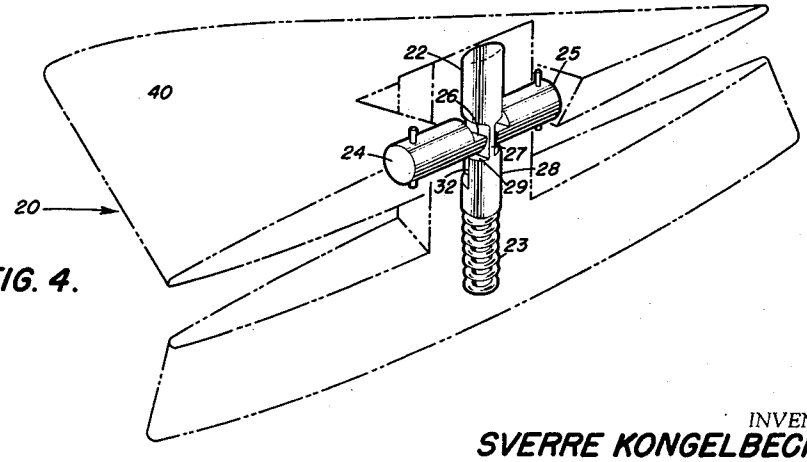


FIG. 4.

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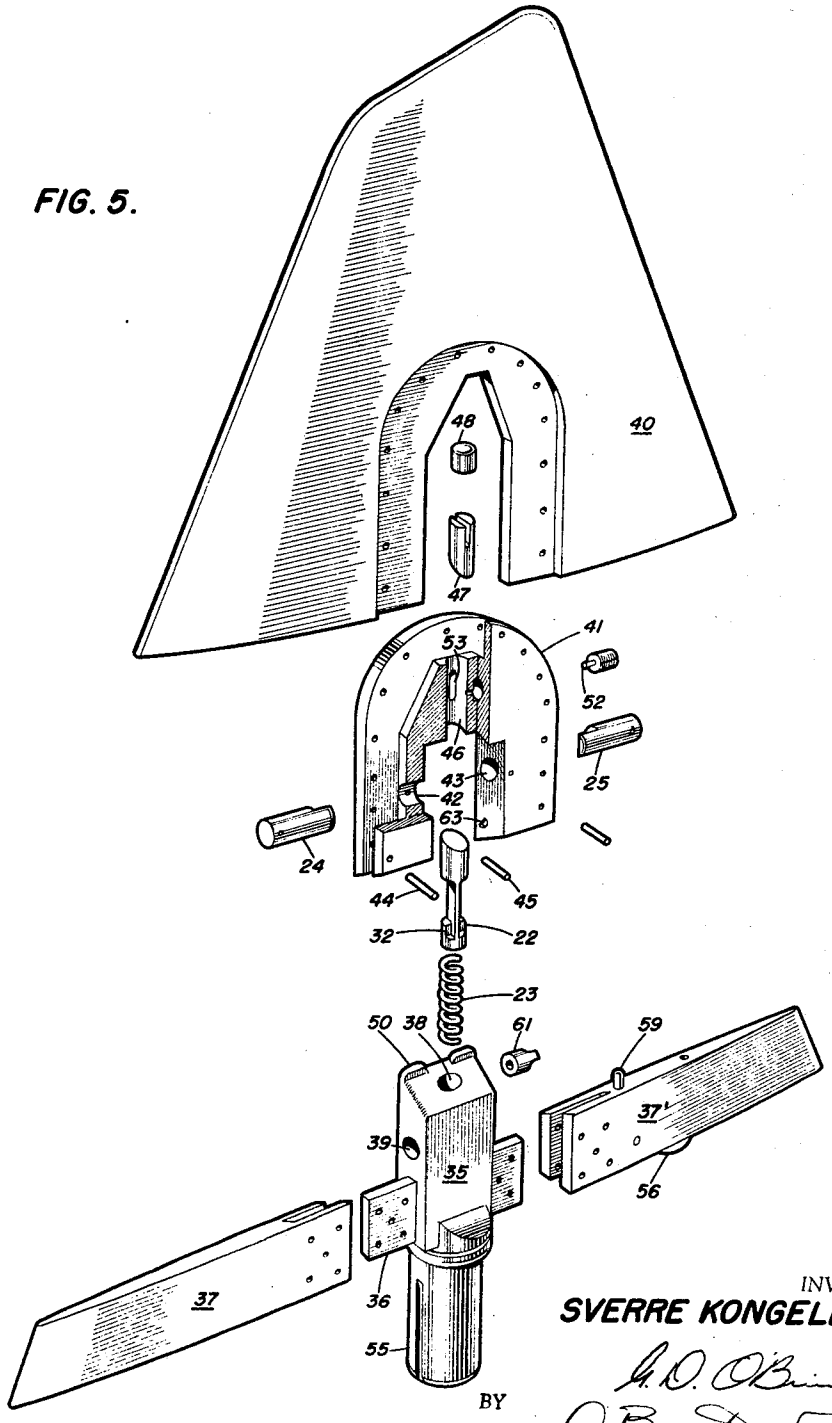
FIG. 5.



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FOLDING FIN OR WING FOR MISSILES

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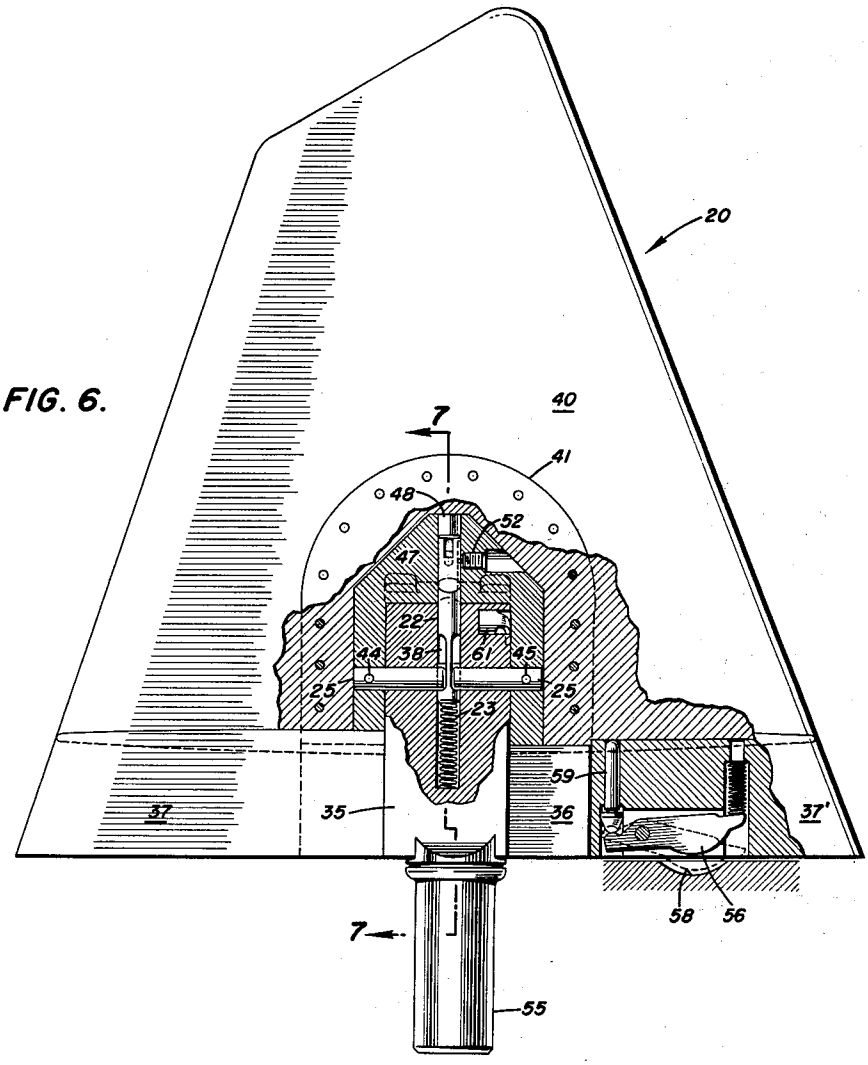
FIG. 6.



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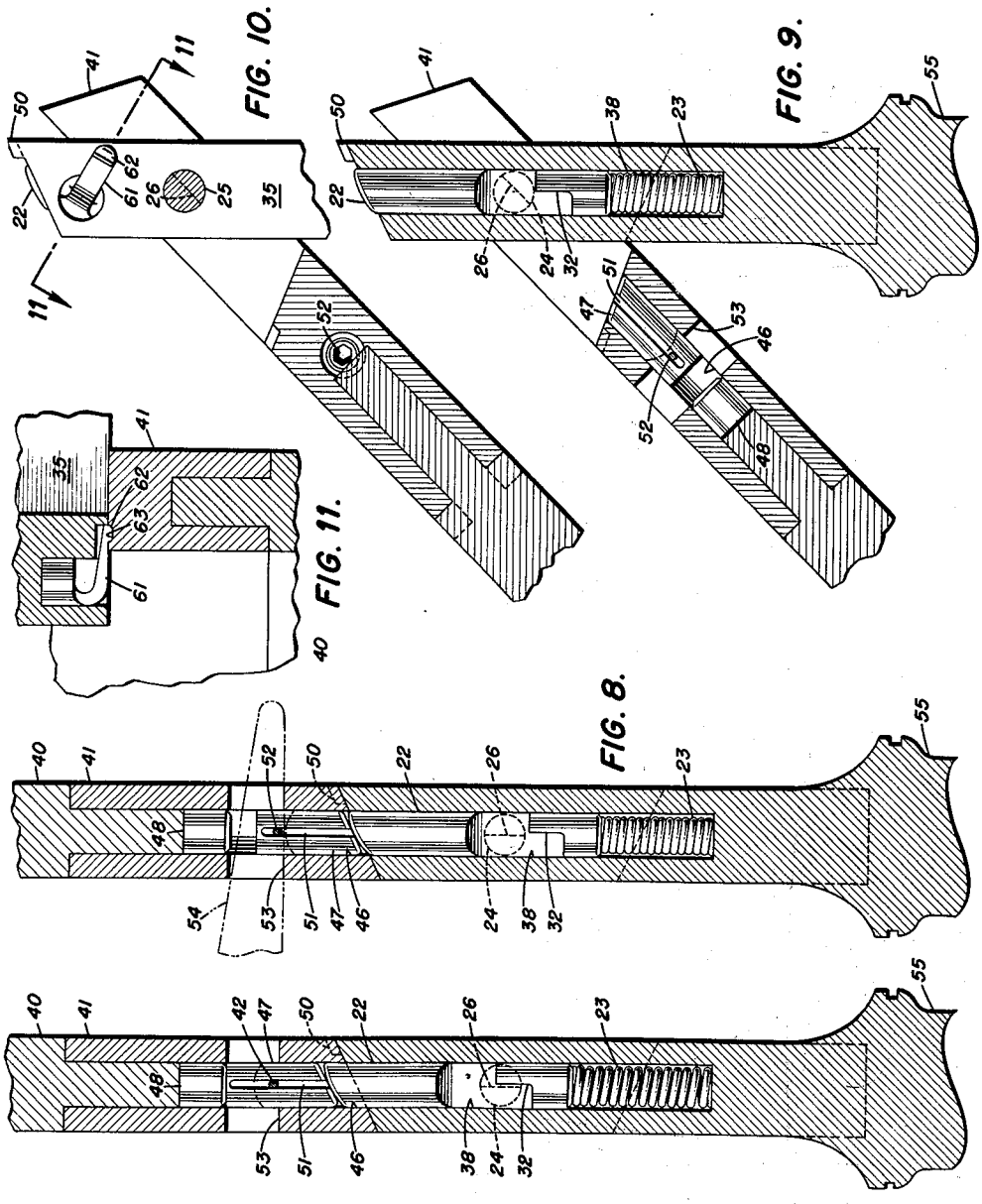

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United States Patent Office 2,925,966
Patented Feb. 23, 1960

2,925,966

FOLDING FIN OR WING FOR MISSILES

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Application October 8, 1957, Serial No. 689,020

6 Claims. (Cl. 244—14)

The present invention relates to a latching mechanism. More particularly it relates to a latching mechanism especially suited to locking in a rigid operative position hinged rocket fins or guided missile wings.

Rockets, guided missiles and the like are customarily fitted with fins or wings for stabilizing and controlling their flight through the atmosphere. In stowing such vehicles it may very well be found that vehicles assembled with fins or wings require double or triple the amount of space necessary to house the vehicle bodies alone. In applications of limited space, for example, on shipboard, the past practice has been to stow vehicle bodies and fins separately and to provide an assembly area where the fins and bodies are assembled prior to launching. This practice, however, limits the number of vehicles in the ready-to-launch status, and thus seriously lengthens the firing cycle. It is further disadvantageous in that space is wasted and time and manpower are consumed in the assembly area.

The present invention contemplates the provision of a vehicle having its wings arranged to fold against its body and thus consume only slightly more stowage space than the body alone. It further contemplates a vehicle having folded wings which can be erected rapidly by hand or a mechanical device after the vehicle is in position upon a launcher, or mechanically, after the vehicle is in flight.

The provision of a locking mechanism for folding wings attached to a supersonic vehicle is complicated by the fact that supersonic airfoils are necessarily thin structures which are subjected to unusually high panel loads. A satisfactory locking mechanism must fulfill the requirements of strength, rigidity and reliability. At the same time, the locking mechanism must be so devised as to be capable of being completely contained within the airfoil since projecting hinges, latches, etc. spoil the flow over the airfoil surface and induce excessive amounts of drag.

Accordingly, it is the principal object of the present invention to provide a means for collapsing or folding aerodynamic surfaces.

Another object of the present invention is to provide a folded fin or wing having means for insuring rigid and accurately aligned surfaces upon erection thereof.

An additional object of the present invention is to provide a folding mechanism contained internally of a thin wing or similar aerodynamic surface so as to present no interfering structures to the airstream.

A further object of the present invention is to provide a mechanism for use with pivotally movable wings to prevent pivotal movement of the wings while in a folded condition.

Still another object of the present invention is to provide a wing or fin folding mechanism which permits easy and rapid erection of the folded structure and which is releasable from a locked erected condition by means of a special tool.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following

detailed description when considered in connection with the accompanying drawings, wherein:

Fig. 1 is a perspective of the rear portion of an aerial vehicle provided with pivotally moveable steering wings and illustrating the wings in an erected condition;

Fig. 2 is a perspective view of the vehicle illustrated in Fig. 1, illustrating the wings thereof folded transversely by means of the present invention;

Figs. 3 and 4 are perspectives, respectively, illustrating the locking mechanism of the present invention in a locked or erect condition and in an unlocked or folded condition, the wing surface containing the mechanism being shown in outline form;

Fig. 5 is an exploded perspective illustrating the assembly of the wing and the locking mechanism of the present invention;

Fig. 6 is a plan view of an erected wing with parts of the wing surface broken away to illustrate the mechanism for preventing pivotal movement of a folded wing;

Fig. 7 is a section taken along the line 7—7 of Fig. 6 and illustrating a locked mechanism of the invention;

Fig. 8 is a section similar to Fig. 7 except that the mechanism is shown being unlocked;

Fig. 9 is a section taken along the line 9—9 of Fig. 2;

Fig. 10 is a section taken along the line 10—10 of Fig. 2; and

Fig. 11 is a section taken along the line 11—11 of Fig. 10.

In Figs. 1 and 2, a guided missile or similar aerial vehicle is illustrated as being provided with four pivotally moveable steering wings 20. For the purpose of conserving stowage space, the wings 20 are arranged to be folded in opposite directions so as to provide the overlapped pattern shown in Fig. 2, or if desired, the folding direction may be the same for all wings without departing from the scope of the invention.

As seen in Figs. 3 and 4, the basic elements of the present invention include a bolt 22 loaded by a compression spring 23 so as to be forced outward along the wing axis. The wing 20 folds on cylindrical hinge pins 24 and 25 each of which are rabbeted at their inner ends to provide axially extending flat surfaces 26. The upper center portion 27 of bolt 22 is milled flat across its entire width. The lower center portion 28 is milled flat only across half the diameter of bolt 22, thereby providing detent shoulders 29 and flat vertical clearance surfaces 32.

As will be readily understood, in the folded condition (Fig. 4), the detent shoulders 29 bear on the outer surfaces of pins 24 and 25 and hold the bolt 22 securely against the expansive force of spring 23. Upon rotation of the wing 20 to an upright or erected condition (Fig. 3), the rounded surfaces of pins 24 and 25 run off the detent shoulders 29 permitting the clearance surfaces 32 to pass the surfaces 26 of said pins. The bolt 22 is then free to be driven upward by spring 23.

In Fig. 5 the details of construction of the present invention are illustrated. The wing 20 includes a hub 35 having transversely extending tongues 36 to which are secured root sections 37 and 37'. Hub 35 is provided with an axial bore 38 receiving bolt 22 and spring 23 and a transverse bore 39 for receiving hinge pins 24 and 25. The fin portion 40 of wing 20 is suitably recessed to receive a channeled insert member 41 which may be secured thereto by rivets. Hinge pins 24 and 25 are secured in apertures 42 and 43 provided in insert 41 by taper pins 44 and 45. A vertical bore 46 extends axially through insert 41 to receive the upper portion of bolt 22 which strikes thereinto upon release of said bolt by rotation of hinge pins 24 and 25. Bolt 22 fits into bore 46 with a close sliding fit thereby insuring alignment of the erected fin surface 39 with root sections 37 and 37'.

As best seen in Fig. 9, the upper end of bolt **22** is domed and protrudes slightly above the surface of hub **35** when said bolt is held in a retracted position by hinge pins **24** and **25**. The domed surface of bolt **22** prevents binding at hinge pins **24** and **25** during wing erection, as will shortly be described.

Again referring to Fig. 5, a bolt depressor **47** and a buffer **48** are carried in the upper portion of bore **46** and function, as hereinafter described, to release bolt **22** to allow the folding of an erected wing. To prevent over-travel of fin **40** in moving from a folded to an erected condition, the upper face of hub **35** is bevelled and provided with a pair of stop lugs **50**. The surface of insert **41** engaging the bevelled surface of hub **35** is likewise bevelled and is provided with recesses for receiving lugs **50**. The bevelled surface of insert **41** performs an important supplementary function in that as the fin **40** is moved from a folded to an erected position, the leading edge of said surface engages the domed upper end of bolt **22**. Bolt **22** is thus slightly depressed relieving hinge pins **24** and **25** against binding at the bolt detent shoulders **29**.

As best seen in Fig. 3, a slot **49** is cut in the upper end of bolt depressor **47**. A groove **51**, extending vertically along the outer surface of depressor **47**, receives a guide pin **52** which serves to maintain slot **49** aligned with a slot **53** (Fig. 5) extending transversely through insert **41**.

Figs. 7 and 8 illustrate the operation of the bolt depressor **47** in releasing the bolt **22** from a locked position. A tapered drift pin **54**, shown in outline form, is inserted in slot **53** to force depressor **47** downward. The bolt **22** is thereby released from locking engagement with bore **46** and surfaces **26** and **32** are disengaged. The fin **40** is then freed to swing to the folded position illustrated in Figs. 2 and 9.

Referring to Fig. 6, a stub shaft **55**, having a keyway therein, extends from hub **35** and is secured to a suitable servo-actuator (not shown) carried within the vehicle. Rotation of shaft **55** moves the wing **20** pivotally and thereby supplies control movements to the vehicle mounting the wing. To prevent pivotal movement of the wings in their folded condition a pivotally mounted latch bar **56** is mortised into the root section **37'** of wing **20**. A compression spring **57** biases latch bar **56** into a keyway **58** formed in the vehicle surface adjacent root section **37**. Upon erection of the fin **40**, a push rod **59**, mounted to bear on the end of latch bar **56** opposite spring **57**, is depressed to move the latch bar out of engagement with keyway **58**. The erected wing **20** may then be freely pivoted upon shaft **55**.

Referring to Figs. 5, 10 and 11, and particularly to Figs. 10 and 11, the fin **40** is maintained folded by a generally U-shaped spring detent **61**. Detent **61** is recessed into the sidewall of hub **35** and carries an elevated portion **62** at its outer end. Upon folding the fin **40**, the elevation **62** snaps into a socket-like depression **63** (Fig. 5) formed in insert **41**. The wing **20** is thus maintained folded until sufficient erecting force is applied to fin **40** to cause the elevation **62** to recede from the socket **63**.

While the invention has been illustrated and described with reference to a wing embodying but a single locking mechanism, wings having exceptionally long chord lengths can be provided with a plurality of locking mechanisms extending in serial fashion along the chord. The problem of properly aligning the bolts could be readily solved by the provision of floating center bolt receivers, as is well understood in the art.

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 wing for an aerial vehicle, comprising a rotatable hub, a bolt slidably mounted in said hub so as to act along the axis of said hub, an aerodynamic surface, hinge means on said hub for mounting said surface to swing about an axis transverse to the axis of rotation of said hub, and means controllable by said hinge means for driving said bolt into engagement with said surface to lock said surface in a fixed position relative to said hub.

2. A wing as claimed in claim 1, with additionally means for latching said hub against rotation, and means for releasing said latch means upon engagement of said bolt.

3. A pivotally moveable control wing for an aerial vehicle, comprising an aerodynamic surface, said surface being divided into a root portion and a fin portion, said root portion including a shaft for pivotally mounting the wing on the vehicle, means including a hinge pin for joining said fin portion to said root portion, means in said root portion for locking said fin and root portions into an aligned wing structure, means in said root portion for latching said root portion against pivotal movement, and means for releasing said latching means upon the locking of said fin and root portions into an aligned wing structure.

4. A wing as claimed in claim 3, wherein said means for locking said fin and root portions into an aligned wing structure comprises the combination of a bolt having a detent surface engageable by said hinge pin and a spring for urging said bolt into engagement with said fin portion, the engagement of said bolt with said fin portion being restrained by the coaction of said detent surface and said hinge pin until said fin and root portions are moved into alignment.

5. A pivotally moveable control wing for an aerial vehicle, comprising, an aerodynamic surface, said surface being divided into a root portion and a fin portion, said root portion including a shaft for pivotally mounting the wing on the vehicle, a hinge pin for hinging said fin portion to said root portion, said hinge pin being rotatable with said fin portion and having a rabbeted end portion, a bolt slidably mounted in said root section for locking said fin section into alignment with said root section, said bolt being provided with a first flat surface running axially of said bolt and a second flat surface running transversely so as to intersect said first surface, said hinge pin and said bolt being arranged so that the end portion of said hinge pin rests upon said second flat surface of said bolt and restrains said bolt until said hinge pin is rotated to allow said rabbet to clear said first surface of said bolt, and a spring for urging said bolt into locking position.

6. A wing as claimed in claim 5, with additionally a pivotally mounted latch bar in said root portion and arranged to project from said root portion for preventing pivotal movement of said wing, and a push rod in said root portion and arranged to retract said latch bar upon rotation of said fin portion into alignment with said root portion.

References Cited in the file of this patent

UNITED STATES PATENTS

17,407	Sibley	May 26, 1857
772,293	Reese	Oct. 11, 1904
1,879,840	Brandt	Sept. 27, 1932
2,594,533	Baker	Apr. 29, 1952