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A SWING-WING

This invention relates to a swing-wing, more especially but not exclusively for a projectile, having interengaging lamellae.

Such a swing-wing having lamellae engaging in telescopic-like manner in one another is shown in United States Patent Specification No. 4 364 531. That wing consists substantially of a front limb and a rearward limb hinged together and held opposite one another in a sliding guide extending along the outer wall of a fuselage or body. The lamellae extend between the front limb and the fuselage outer walling, interengaging transversely to the longitudinal extent thereof. For erection of the wing, with the limbs initially butting stretched along the fuselage, a balloon situated inside the box-like lamellae is inflated from a gas supply; in order, through the excess pressure in the interior, to push the box lamellae apart and thereby to raise the jointed limbs from the fuselage, until the appropriately profiled frontward edge of the rear limb, on erection thereof, seals off in a rectilinear manner the extended lamellae boxes on the rear wing side. Such a configuration having box-like lamellae, extended transversely to the longitudinal axis of the projectile by excess pressure built up from the inside, for the movement aside of limbs initially stretched expanded on the projectile fuselage is, however, more especially very space-consuming. Also, the freedom of the wing from interference, provided during opening of the wing leaves much to be desired; since shortly prior to engagement of the rear limb into its final position most unfavourable force-introduction lever ratios exist and this engagement procedure into the operational position is additionally hindered by the dynamic pressure acting increasingly on the front limb.

Considerably more space-consuming is the construction of the swing-wing shown in United States Patent Specification No. 4 106 727. The lamellae thereof which interlock or interengage in telescopic-like manner represent in pairs the longitudinal sides of acute-angled triangles, the respective bases of which triangles are given by the

stretch or extent between lamellae hinges in the fuselage of the flying body. To meet required kinematics, sliding guides are necessitated, between the interlocking or interengaging lamellae, (which guides tend to be susceptible to trouble) in the regions of the triangle apex lying opposite the base. The long overlapping lamellae yield high friction moments upon unfolding of the wing; with kinematically unfavourable forces being introduced during unfolding by means of an adjusting member; this necessitates considerable additional space in the flying-body fuselage behind the lamellae hinges.

In recognition of these factors, an object of the present invention is to provide a wing, which can be fitted relatively simply, takes up relatively little installation space and which can be erected in an operationally reliable manner in a kinematically favourable way.

According to the present invention there is provided a swing-wing, for example for a projectile, with telescopic-like interlocking lamellae for erection of the wing surface, and in the swing-wing a nose spar, hingable in the region of one end by means of a pivot, in use, in a longitudinal groove receiving the swing-wing, has a chamber opening away from its leading edge and situated between the wing part surfaces for receiving the interlocking lamellae, which lamellae are profiled in U-shaped manner, the chamber also being for receiving a root spar which is hinged in the region of its front end to the nose spar such that it can be swung rearwards into the chamber and the front ends of the lamella straddle the root spar and are hinged to the root spar offset from one another therealong.

Further according to the present invention there is provided a projectile or flying body comprising at least one swing-wing, said wing having, a nose spar, a root spar and overlapping interengaging lamellae which are pivotally connected along the root spar, the arrangement being such that the wing is stored in a folded condition with the lamellae successively envelopping or nesting within one another, in a groove in the projectile or body, and the wing is

erectible by the nose spar being pivoted outwardly from the groove thereby pivoting the lamellae relative to the root spar and unfolding the lamellae from one another and from the nose spar into a locking position in which the wing shape is defined in part by the lamellae, said root spar being moved or swung relative to the groove as the wing is erected.

The individual lamellae may be swung out, contrary to the folding movement of the nose spar, in a similar manner to unfolding a fan; namely about swivel axes which are situated mutually offset on the root spar (which is for its part swung out of the nose spar). In this way the wing can be separately fitted and tested; and the installation in a flying-body fuselage needs only one swivel hinge for the nose spar, about which a force (for example a torsion spring) acts. The lamellae, which for their part define the wing rear edge, shorten increasingly in their succession rearwards, from which correspondingly short telescope (straddle) overlappings and therefore low swing-out friction moments result.

Additional alternatives and further developments as well as further features and advantages of the present invention will become apparent from the sub-claims and from the following description of a preferred exemplified embodiment of a swing-wing in accordance with the present invention which is shown in the drawings along with a restriction to that which is essential in a much simplified manner but approximately true to scale.

FIGURE 1 shows the swing-wing in the folded-in state, arranged within the outer contour of a projectile fuselage;

FIGURE 2 shows the swing-wing in accordance with FIGURE 1 in the spread-out or erected state;

FIGURE 3 shows a sectional view taken on the line III-III in FIGURE 2, but with transverse dimensions shown to larger scale, and

FIGURE 4 shows a sectional view taken on line IV-IV in FIGURE 2, and represented on a larger scale than FIGURE 3.

In FIGURE 1, a projectile 1, shown in cut-away axial longitudinal section has, in its fuselage 2, a longitudinal groove 4 opening towards the outer surface of the walling 3, which groove 4 is for the reception of a swing-wing 5 in its folded state.

As is evident more especially from FIGURE 2, the wing surface 6 is composed of overlapping-interengaging or telescopic-like interlocking lamellae 7 arranged between a nose spar 8 and a root spar 9; the wing 5 is erected by swinging out the nose spar 8 about hinge pivot 10 to pull the wing from the longitudinal groove 4 and thereby erect the wing from its folded-up state in a similar manner to unfolding a fan. To maintain the wing erect a traction wire 12 is fastened in the region of the rear end 11 of the root spar 9, hinged oppositely to the nose spar 8. The other end of the wire 12 is secured to the projectile fuselage 2 (for example to the bottom of the longitudinal groove 4) and is tensioned when a torque or moment acts outwardly about the hinge pivot 10.

For the reception of the lamellae 7 and of the root spar 9 when the wing 5 is folded-up, the nose spar 8 has a rearward reception chamber 13 profiled substantially in a U-shaped manner and opened towards the projectile fuselage 2 and defined between its wing surfaces 6 on each side thereof. In the folded-up condition the lamellae 7 successively envelop or nest within one another. As shown in FIGURE 2, the front end 15 of the root spar 9 is connected to the nose spar 8 by a hinge connection 14 which is provided at the innermost end of chamber 13.

In the region of the rear end 11, the root spar 9 is straddled by a relatively short U-shaped lower lamella 7.3. The upper edge of the lamella 7.3 is straddled by a central, somewhat longer lamella 7.2 which also straddles the central region 16 of the root spar 9. The upper edge of lamella 7.2 is straddled by the longest lamella 7.1 which also straddles a part of the front end 15 of the root spar 9. The upper edge of lamella 7.1 is straddled by the side walls of the chamber 13 of the nose spar 8 which also straddles the front end 15

of the root spar 9. In the erect state of the wing 5, the overall wing surface 6 thereof is thus composed of the sequence of the lamellae 7, projecting from one another and in each case straddled at their inclined upper edges 17, as well as being composed of part of the nose spar 8 (of greatest transverse dimension) and of the root spar 9 (least transverse dimension); the three-dimensional curved configuration of the individual partial wing surfaces 6 - with the exception of the flat, lower edges 18 - yields as a whole the aerodynamically desired geometry of the spread-out (erect) swing-wing 5.

For the erection of this overall wing surface 6, the individual lamellae 7 are hinged in the region of their front innermost ends 19, by way of pivots 20, to the root spar 9. Engagement projections 21, (not shown in more detail in the drawings) provided at the inclined upper or leading edges 17 and lower or trailing edges 18 near the rear edges 22 bring about, by mutual form-locking engagement, a continuous closed rear edge (comprising all the rear edges 22 shown in FIGURE 2) to the wing 5. Upon tensile stressing of the traction cable 12 as a result of the nose spar 8 being swung out of the longitudinal groove 4 of the fuselage and thus as a result of the root spar 9 swinging out of the chamber 13, successively, from the uppermost lying lamellae 7.1 as far as the innermost 7.3, the lamellae 7 are swung out of the projectile fuselage 2 telescopically about their hinge connections 20; until, with mutual abutment of all the projections 21, said closed rear edge of the wing 5 is formed.

Leaf springs 24 may be provided as catching locking members (detents) to restrain the lamellae from folding back into one another, for example because of dynamic pressure against the wing leading edge 23. The leaf springs 24 may be provided in the inner space of the lamellae 7, engaging over the neighbouring lamella 7 or respectively the root spar 9. Other forms of catching locking members may be provided. Springs 24 lie, in the folded-in state of two mutually adjacent lamellae 7, between the adjacent wall surfaces; so that in the final drawn out position of a lamella 7.3 (see FIGURE 3) the

springs 24 will engage behind the adjacent edge 17 - in other words the region of the yoke 25 of the U-shaped structure, for example of the root spar 9 - and support said edge 17 by way of securing against the lamella 7.2 lying therebefore - in other words in similar fashion with the remaining lamellae eventually against the nose spar 8.

Where, however, a greater installation space is available for catching locking members in the direction transverse to the wing surface 6 (such as in the region of the lamella front ends 19 which are situated further forward and which therefore, by reason of the lamella 7 straddling one another, protrude further from the central plane of the root spar 9) it is more expedient to design the catching members in the form of index pins 26 (FIGURE 4); these pins 26 can be designed to support the erected wing against greater forces, since there is little risk of buckling or of an engagement between adjacent lamella 7. The index pins 26 are axially displaceable in the root spar 9, for example between ribs 31, and supported against a compression spring 28 received in a longitudinal bore 27. The stepped end 29 is thus engaged in a spring-loaded manner into a bore 30 in the lamella 7 (for possibly also in the nose spar 8), as soon as the desired erected angular position with regard to the root spar 9 is reached.

The individual lamellae 7 as well as the root spar 9 (and in the appropriate circumstances also the nose spar 8) are of U-shaped sheet construction with yokes 25 situated towards the edges 17, 23 and are possibly provided with stiffening ribs 31 between the limbs 32 which make up the wing surfaces 6. Edges 17 may be bevelled edges on an integral sheet, as indicated in FIGURE 3 for the root spar 8; or else fashioned from curved individual sheets, which are connected together along the edges 17 (for example by spot-weld connections 33) as indicated in FIGURE 3 for the smallest lamella 7.3.

The term telescopic-like is used throughout the specification as a broad general term to mean an interengaging relation where relative parts may be moved further in and further out of one another.

CLAIMS

1. A swing-wing, for example for a projectile, with telescopic-like interlocking lamellae for erection of the wing surface, and in the swing-wing a nose spar, hingable in the region of one end by means of pivot, in use, in a longitudinal groove receiving the swing-swing, has a chamber opening away from its leading edge and situated between the wing part surfaces for receiving the interlocking lamellae, which lamellae are profiled in U-shaped manner, the chamber also being for receiving a root spar which is hinged in the region of its front end to the nose spar such that it can be swung rearwards into the chamber and the front ends of the lamella straddle the root spar and are hinged to the root spar offset from one another therealong.

2. A swing-wing as claimed in Claim 1, in which the upper or leading edges of the lamellae and of the root spar as well as the trailing or lower edges of the lamellae and of the nose spar are equipped in the region of their rear edge with engagement projections which co-operate in pairs in a form-locking manner.

3. A swing-wing as claimed in Claim 1 or 2, in which a fettering in the form of a traction cable is provided between the region of the rearward end of the root spar and, in use, said longitudinal groove.

4. A swing-wing as claimed in any one of the preceding claims, in which detents are provided between the lamellae (or the nose spar) and the adjacent leading edges of the lamellae (or of the root spar).

5. A swing-wing as claimed in Claim 4, in which as a detent a leaf spring is arranged between the limbs of at least one U-shaped lamellae.

6. A swing-wing as claimed in any one of Claims 1 to 5, in which provided in the root spar as detents are provided index pins for engagement in bores in limbs of the U-shaped lamellae or of the nose spar.

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7. A swing-wing as claimed in Claim 6, in which each index pin is equipped with a compression spring which engages into a longitudinal bore.

8. A swing-wing as claimed in any one of the preceding claims, in which the profiles of the lamellae and of the root spar (as well as possibly also of the nose spar) are given by a bevelled sheet with limbs extending in accordance with the desired wing surface.

9. A swing-wing as claimed in any one of Claims 1 to 7, in which the profiles for the lamellae (and possibly for the root spar) are given by sheets which are welded together in the region of their upper or leading edges and which extend arched in accordance with the desired wing surface.

10. A swing-wing substantially as herein described with reference to the accompanying drawings.

11. A projectile or flying body including at least one swing-wing as claimed in any one of the preceding claims.

12. A projectile or flying body comprising at least one swing-wing, said wing having, a nose spar, a root spar and overlapping interengaging lamellae which are pivotally connected along the root spar, the arrangement being such that the wing is stored in a folded condition with the lamellae successively envelopping or nesting within one another, in a groove in the projectile or body, and the wing is erectible by the nose spar being pivoted outwardly from the groove thereby pivoting the lamellae relative to the root spar and unfolding the lamellae from one another and from the nose spar into a locking position in which the wing shape is defined in part by the lamellae, said root spar being moved or swung relative to the groove as the wing is erected.

13. A projectile or flying body as claimed in Claim 10 in which the lamellae straddle one another.

14. A projectile as claimed in Claim 12 or 13 in which the nose spar

straddles the lamellae and the root spar when the wing is in the folded state.

15. A projectile or flying body as claimed in any one of Claims 12 to 14 in which lamellae of different lengths are provided which progressively shorten towards the rear end of the projectile or body.

16. A projectile or flying body as claimed in any one of Claims 12 to 15 in which three lamellae are provided which are hinged about parallel axes along the root spar.