March 25, 1947. D. L. McFARLAND 2,417,987

FOLDABLE STEP

Filed Nov. 16, 1944

Fig. 2

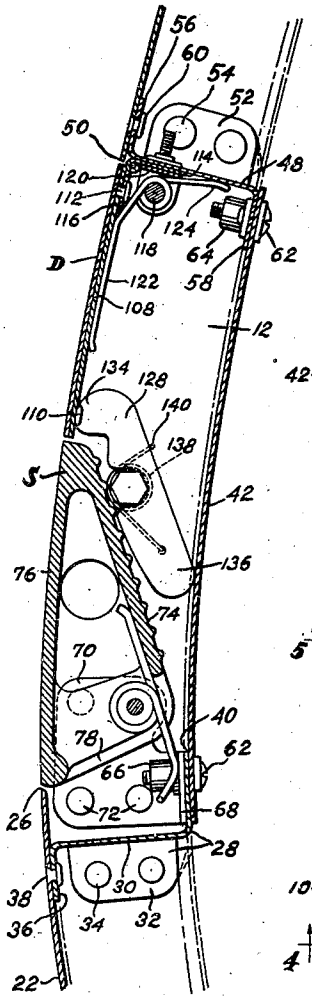
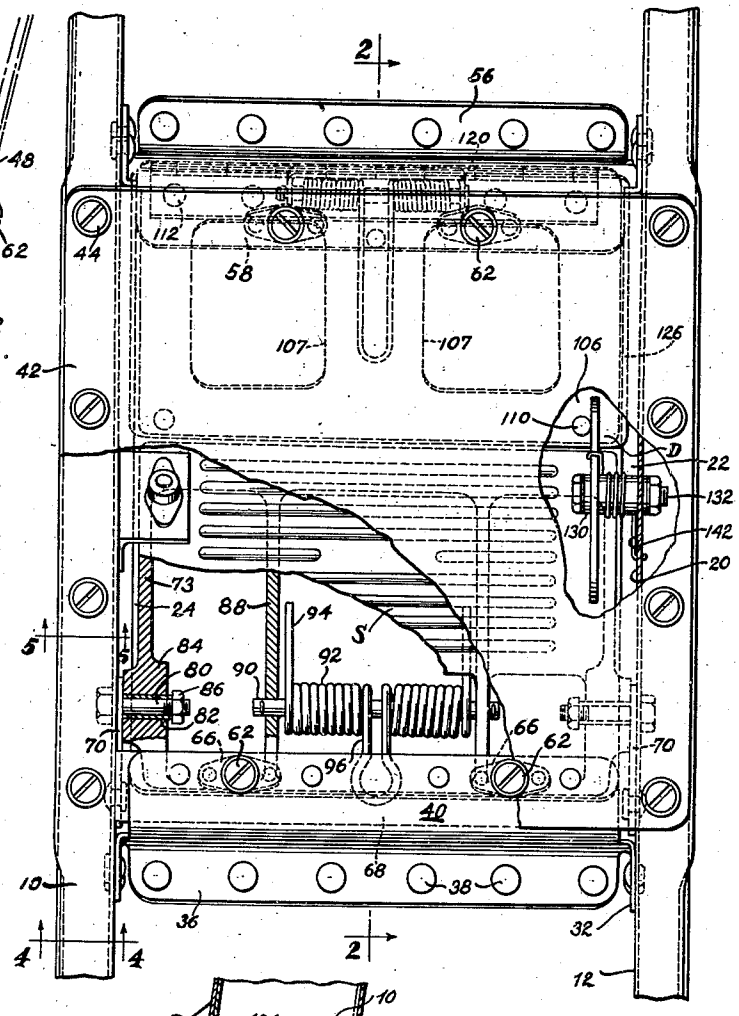


Fig. 1



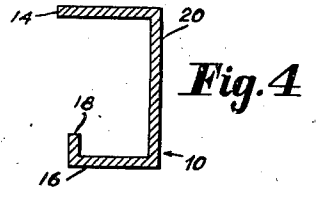


Fig. 4

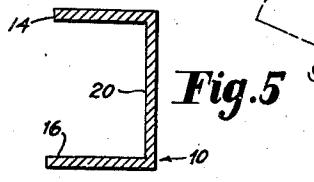


Fig. 5

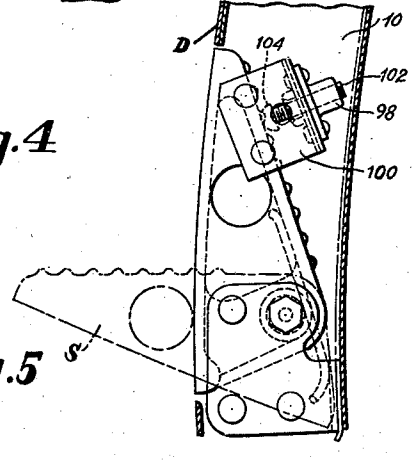


Fig. 3

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FOLDABLE STEP

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11 Claims. (Cl. 244—129)

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This invention relates to a foldable step for streamlined vehicle bodies and has particular reference to an improved foldable step for use in entering and leaving the cockpit of an airplane.

An object of the invention is to provide an improved vehicle cockpit step of the type which swings between an extended operative position and a folded inoperative position in which latter position it is concealed within the vehicle body and forms a part of the exterior surface or skin so that the latter presents a smooth surface having a minimum of surface drag.

A further object of the invention is to provide a foldable step of this general type which is normally biased into concealed position and having foot operative means associated therewith for moving the step temporarily into an extended position.

A still further object of the invention is to provide a foldable step which is entirely foot operated and is disposed in its folded position wholly within the inter-frame space in the vehicle frame without projecting inwardly beyond the frame.

Other objects and advantages of the invention will appear from the following detailed description of a preferred embodiment thereof, considered in connection with the accompanying drawing which is submitted for purposes of illustration.

In the drawings,

Fig. 1 is a rear view of a portion of an airplane fuselage having installed therein a foldable step embodying the present invention, the step being shown in folded position and certain parts being broken away to facilitate illustration.

Fig. 2 is a section on line 2—2 of Fig. 1.

Fig. 3 is a view illustrating the adjustable stop structure for arresting the step in its folded position.

Fig. 4 is a section on line 4—4 of Fig. 1, and

Fig. 5 is a section on line 5—5 of Fig. 1.

Referring particularly to Figs. 1 and 2, 10 and 12 indicate portions of adjacent curved frames of an airplane fuselage structure, at one side of the fuselage, between which an outwardly swingable step S and an inwardly swingable door D are pivotally mounted, together with certain mechanism hereinafter described for operatively connecting the two.

The frames 10 and 12 comprise special channel sections disposed back to back. As shown in Fig. 4, each of these channels comprises parallel legs 14 and 16, the latter having an inturned flange

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portion 18 which lies parallel with the back 20 of the channel. The unflanged legs 14 of the frames provide the outer curved surface of the frame on which the skin 22 of the fuselage is secured. A generally rectangular opening 24 is provided in the skin between frames 10 and 12 to accommodate the foldable step S and the door D immediately above it, this opening extending almost the entire distance between the backs 20 of the channels 10 and 12.

Slightly below the lower edge 26 of opening 24, the frames 10 and 12 are connected by an intercostal member 28 having a transverse web portion 30 which extends from back to back of the channels and has depending ears 32 which are secured by rivets 34 to the backs 20 of the channels. Frame member 28 also has a depending front apron 36 which extends across the opening between the channels and is disposed in the plane of the legs 14 of said channels and constitutes the support for the edge of the skin along the lower edge 26 of the skin opening 24, suitable rivets 38 having their heads flush with the outer surface of the skin being provided to connect the skin to apron 36. The frame member 28 also has an upstanding rear apron 40 which is disposed in the plane of the legs 16 of channels 10 and 12 and, among other things, constitutes the bearing surface for an inner closure plate 42 which covers the inter-rib space between the channels.

The plate 42 overlies the inner surfaces of legs 16 and is secured removably thereto by a series of screws 44 which extend through the plate and the legs 16 and are screw threaded into nut plates permanently secured to the inner faces of channel legs 16. In order to provide sufficient space to receive these nut plates the flanges 18 are rolled outwardly into the plane of legs 16 for a distance along the frame members slightly greater than the height of the plate as is clearly shown in Fig. 1.

An intercostal member 48 similar to member 28 is disposed between the frames 10 and 12 above the upper edge 50 of the skin opening 24. This intercostal member has upwardly extending ears 52 overlying the backs 20 of the frames and secured thereto by rivets 54 and also has aprons 56 and 58 which lie respectively within the planes of channel legs 14 and 16. Apron 56 is secured to the skin 22 by rivets 60. The plate 42 is secured at its lower and upper edges to aprons 40 and 58 by screws 62 which are screw threaded into nut plates 64 and 66. The nut plates 64 are permanently secured to the outermost surface of

apron 58 while the nut plates 66 are secured to the corresponding surface of a cross bar 68 of a U-shaped supporting bracket. In addition to the cross bar 68 this bracket has parallel generally rectangular end plates 70 which overlie the backs 20 of channels 10 and 12 and are riveted thereto by rivets 72.

The step S is a hollow casting having end walls 73 generally triangular in section, a flat transversely ridged tread portion 74, a bottom portion 76 which is slightly curved to conform to the normal skin contour of the fuselage, and a short heel portion 78, which forms an abutment adapted to seat against the inner surface of bar 68 when the step is in its open position shown dotted in Fig. 3.

The step is pivoted adjacent the junction of its heel and tread portions on short bolts 80, which extend through the back 20 of each of the channel members 10 and 12 and through the adjacent plates 70. Each of these bolts has a sleeve 82 which is of approximately the length of a thickened portion 84 of the step end walls, nuts 86 serving to hold the spacing sleeves 82 in position on the bolts.

The step S is also provided with intermediate flanges 88 in which is mounted a spring supporting rod 90 for a torsional spring 92. This spring has parallel arms 94 extended beneath the tread portion of the step and an intermediate, oppositely extended loop portion 96 bearing against the bar 68 in such manner that the step S is constantly biased into its closed position shown in Fig. 2 in which its curved bottom surface 76 forms a continuation of the skin surface 22. As shown in Fig. 3, a nut plate 98 is secured to the outstanding leg of an angle member 100 which is riveted to the back 20 of channel frame 10. This nut has a stop bolt 102 screw threaded therein, the head 104 of which engages the tread of the step in its folded position, thus providing an accurately adjustable stop for positioning the surface 76 flush with the skin in the normal position of the step.

The step S occupies somewhat more than one-half the height of the opening 24. The remainder of the opening above it is closed by the door D which has a suitable curvature to conform to the skin contour of the fuselage. The door comprises an inner plate member 106 of a width slightly greater than the width of opening 24, as is clearly illustrated in Fig. 1, having cut outs 107 and having an outer plate member 108 riveted thereto by rivets 110 at the lower edge thereof and by rivets 112 at the upper edge. The door D is hinged adjacent its upper end to swing inwardly by two complemental piano hinge members 114 and 116 the former of which is connected to the web 48 and the other of which is secured by rivets 112 to the door. A torsional spring is provided on a rod 118 mounted in a bracket 120 and has its oppositely extending spring arms 122 and 124 abutting the inner surface of the door and the web 48 respectively to constantly bias the door outwardly to position the overlapping side edges 126 of the inner door plate 106 against the inner surface of the skin 22 along the side margins of the opening 24.

The door D and the step S are operatively connected by a cam lever 128 which has an integral outer sleeve 130 journalled on a bolt 132 secured to the back 20 of channel 12. This lever has an upper nose portion 134 which engages the inside of door plate 106 and has a depending cam portion 136 which overlies the inner surface of the

tread portion 74 of the step in the normal position thereof. The member 128 is biased into the above described position by a torsional spring 138 which has one end 140 thereof hooked over the back of the cam lever and the other end 142 hooked through an aperture in the back 20 of channel 12 so that member 128 is constantly biased in a counter-clockwise direction as viewed in Fig. 2.

When it is desired to climb in or out of the cockpit, the pilot merely pushes the door in with the toe of the foot on which he is about to step. The inward movement of the door D rotates the cam lever 128 in a clockwise direction, as viewed in Fig. 2, and the cam portion 136 thereof moves the step S in a counter-clockwise direction into a partially extended position so that upon a natural downward movement of the pilot's foot the door will move to the dotted fully open position, as shown in dotted lines in Fig. 3. As soon as the pilot removes his foot from the step the latter will return to its concealed position, abutting the head 104 of stop bolt 102 against which it is held by the relatively heavy spring 92. The door D having returned to its normal position as soon as the pilot steps down onto step S, the parts are again in their normal position in which the outer surface contour of the fuselage is unbroken.

It will be evident from the above description that this invention provides a foldable step suitable for use in aircraft fuselage, or any other streamlined vehicle body, which occupies a minimum of space within the body frame structure and which preserves the outer streamlined contours of the body. It will further be evident that the improved step construction is both convenient to use and simple and inexpensive to manufacture.

Further by reason of the operative connection between the entrance door and the step the previous difficulties with steps of this general type in which the pilot was obliged to unfold the step by a downward and outward motion of his foot has been entirely eliminated.

While I have shown what is believed to be a preferred embodiment of my invention in connection with an airplane fuselage it will be evident that various changes in the construction and arrangement of the parts may be made without exceeding the scope of the invention and, further, that the invention is applicable to many uses outside of the aircraft field.

I claim:

1. In a streamlined body having a step-opening in a side thereof, a step pivotally mounted in said opening adjacent the lower margin thereof and swingable between a concealed position within said body in which it forms a flush closure for a lower portion of said opening and an operative position in which it extends laterally therefrom, means for biasing said step into concealed position, a door pivotally mounted adjacent the upper margin of said opening forming a closure for an upper portion of said opening and swingable into said body, means for biasing said door into a position in which it is flush with the surface of said body and means responsive to inward pivotal movement of said door for moving said step toward its operative position.

2. In a streamlined body having a step-opening in a side thereof, a step having a tread pivotally mounted in said opening adjacent the lower margin thereof and swingable between a concealed position within said body in which it forms

a flush closure for a lower portion of said opening and an operative position in which it extends laterally therefrom, means for biasing said step into concealed position, a door pivotally mounted adjacent the upper margin of said opening and swingable into said body, means for biasing said door into a position in which it is flush with the surface of said body, and means having an operative connection with said door for moving said step toward its operative position when said door is swung inwardly.

3. In a streamlined body having a step-opening in a side thereof, a step having a tread pivotally mounted in said opening adjacent the lower margin thereof and swingable between a concealed position within said body in which it forms a flush closure for a lower portion of said opening and an operative position in which it extends laterally therefrom, means for biasing said step into concealed position, a door pivotally mounted adjacent the upper margin of said opening and swingable into said body, means for biasing said door into a position in which it is flush with the surfaces of said body, and pivoted means actuated by inward movement of said door for simultaneously moving said step outwardly.

4. In an airplane having a frame and a skin covering said frame, said skin having a step-opening therein and said frame including supporting means adjacent said opening, a step supported on said supporting means and having a pivotal connection therewith, said step being spring biased into a concealed position within said frame wherein it fills a lower portion of said opening and presents a surface continuous with the skin surface, a door supported on said supporting means and having a pivotal connection therewith, said door being spring biased into a position in which it prevents a surface continuous with the skin surface and being movable inwardly from said position into said airplane, and a cam lever having a pivotal support intermediate its ends on said frame, said lever having a portion disposed in the path of said door when the latter moves inwardly and a portion disposed behind said step at a point remote from the pivotal support for the latter for swinging said step outwardly simultaneously with inward movement of said door.

5. In an airplane, a frame including a pair of spaced rib members and a skin covering the outer surfaces of said ribs, said skin having a step-opening therein and said frame having supporting means adjacent the upper and lower margins of said opening, a step supported on the supporting means adjacent said lower margin and having a pivotal connection therewith, said step being spring biased into an inoperative position within said frame wherein it fills a lower portion of said opening and presents a surface continuous with the skin surface, a door supported on said supporting means adjacent said upper margin and having a pivotal connection therewith, said door being spring biased into a position in which it presents a surface continuous with the skin surface and being movable inwardly from said position into the space within said frame, means having an operative connection with said door for moving said step toward its operative position in which it projects outwardly from said opening upon inward movement of said door, and an inner skin covering the inner surfaces of said ribs in the vicinity of said opening.

6. In an airplane, a frame including a pair of spaced rib members comprising channel members disposed back to back, an outer skin covering the frame and attached to the outer channel legs, said skin having a step-opening between said ribs, an inner skin member covering the frame in the vicinity of said opening and attached to the inner channel legs thereof and defining an intercostal step receiving space back of said opening, a step pivotally connected to said frame adjacent the lower margin of said opening and swingable between an inoperative position in which it is disposed wholly within said space and presents an outer surface continuous with the skin surface over a lower portion of said opening and an operative position in which it projects substantially horizontally from said opening, a door pivotally connected to said frame adjacent the upper margin of said opening and swingable into said space, means for biasing said door into a normal position in which it presents an outer surface flush with said outer skin over the remainder of said opening, means for biasing said step into inoperative position, and means operatively connecting said door and step for moving the latter toward operative position by the inward movement of said door.

7. In an airplane having a frame and a skin covering said frame, said skin having a step-opening therein, a step pivotally connected to said frame adjacent the lower margin of said opening and swingable between an inoperative position in which it is disposed wholly within said frame and an operative position in which it projects substantially horizontally from said opening, a door pivotally connected to said frame adjacent the upper margin of said opening and swingable inwardly, means for biasing said door for outwardly swinging movement, means for biasing said step for inwardly swinging movement, means responsive to inward pivotal movement of said door for moving said step toward its operative position, and means for arresting the movement of said door and said step in the direction of their bias so that both present an external surface flush with the skin surface and completely closing said opening.

8. In a vehicle body having a cockpit enclosed by a frame and having an outer skin provided with an opening therein between frame members, mechanism for facilitating the entry of a passenger into said cockpit over the side of said vehicle body, said mechanism being operated by a combined inward and downward movement of the passenger's foot and including, a movable step member normally biased into an inoperative position in which it forms a closure for the lower portion of said opening, an upper member forming a closure for the remainder of said opening having a portion immediately above said step member which is engageable by the passenger's foot and is movable inwardly by the inward movement of the passenger's foot, and means responsive to inward movement of said upper closure member for moving said step member into a projected position in which it is engageable upon the downward movement of the passenger's foot.

9. In a vehicle body having a frame and an outer skin provided with an opening therein between frame members, a step pivoted to said body and swingable between an operative position in which it projects outwardly beyond said skin and an inoperative position in which it forms a closure for the lower portion of said opening, a door pivoted at its upper end to said body adjacent the upper end of said opening and

swingable between an inoperative position in which it forms a closure for the remainder of said opening and an operative position in which it projects into said body, and means responsive to pivotal movement of said door into said body for initiating movement of said step into its operative position.

10. In a vehicle body having spaced rib members and a skin on the outer surfaces of said members, said skin having an opening therein between adjacent members, a step pivotally supported on said body and swingable between an operative position in which it projects outwardly beyond said skin and a normal inoperative position in which it forms a closure for the lower portion of said opening, a door pivoted to said body near the upper end of said opening and swingable between an operative position in which it projects within said body and an inoperative position in which it forms a closure for the remainder of said opening, means for biasing said door and said step into their inoperative positions, a skin on the inner surfaces of said rib members back of said opening forming a shallow body-wall compartment of rib depth in which said door and said step are normally contained, and mechanism disposed within said compartment and responsive to pivotal movement of said door into said compartment for swinging said step out of said compartment.

11. In a vehicle body having a cockpit enclosed by a frame and having an outer skin provided with an opening therein between frame members, mechanism for facilitating the entry

of a passenger into said cockpit over the side of said body which is operated by the inward and downward movement of the passenger's foot including, a step pivoted to said body and swingable between an operative position in which it projects outwardly from said skin and an inoperative position in which it forms a closure for the lower portion of said opening, a door pivoted to said body adjacent the upper end of said opening and swingable between an inoperative position in which it completes the closure for said opening and an operative position within said body, and a member pivoted to said body and operable by said door as the latter swings inwardly to initiate the movement of said step into its operative position, means for returning said door to its inoperative position free from said pivoted member, and means for subsequently returning said step to its inoperative position upon removal of the passenger's foot.

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