Feb. 20, 1951 J. H. BENNETT ET AL 2,542,792

AIRPLANE WING FLAP AND SLAT MOUNTING

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Fig. 1.

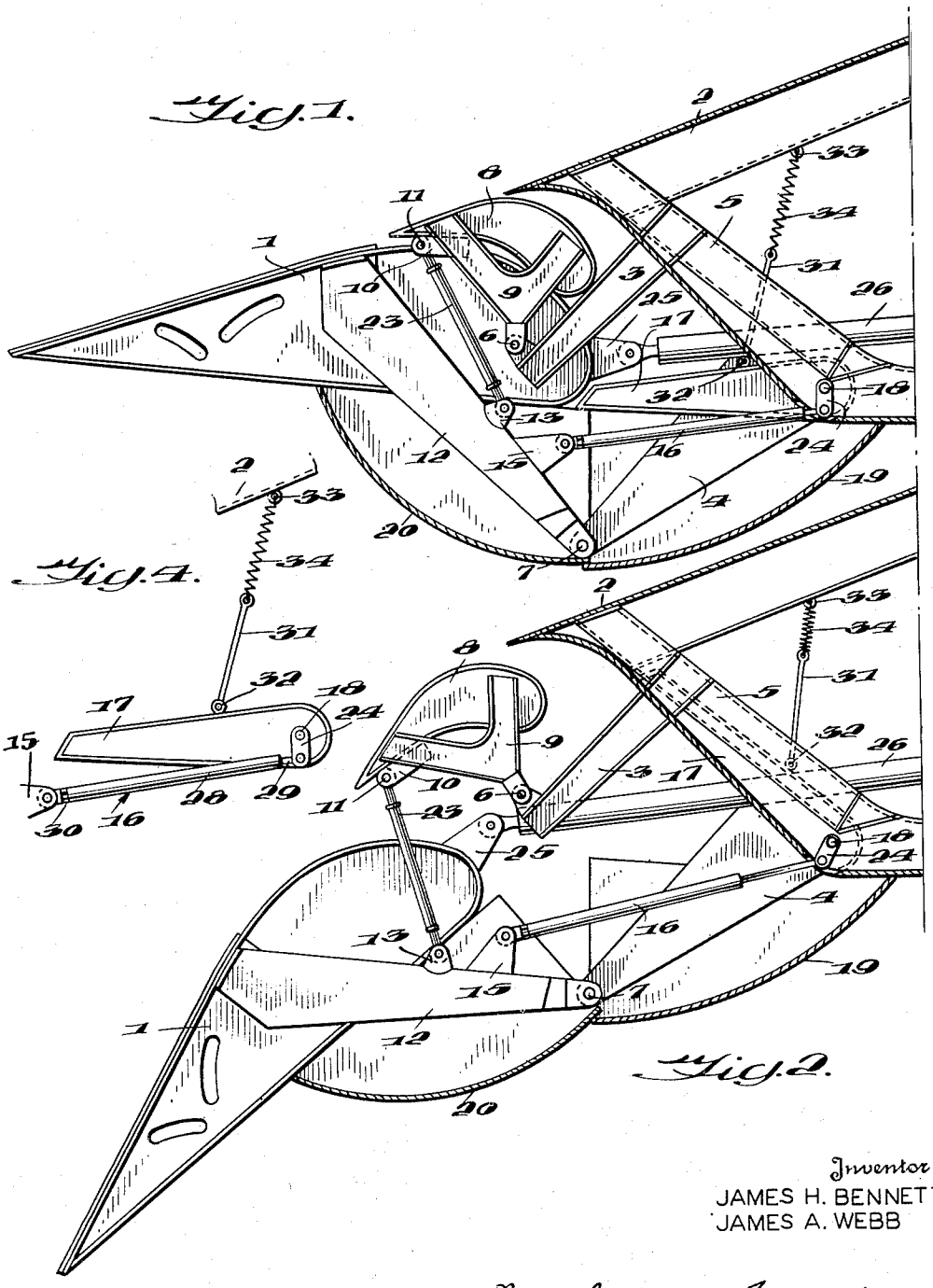


Fig. 2.

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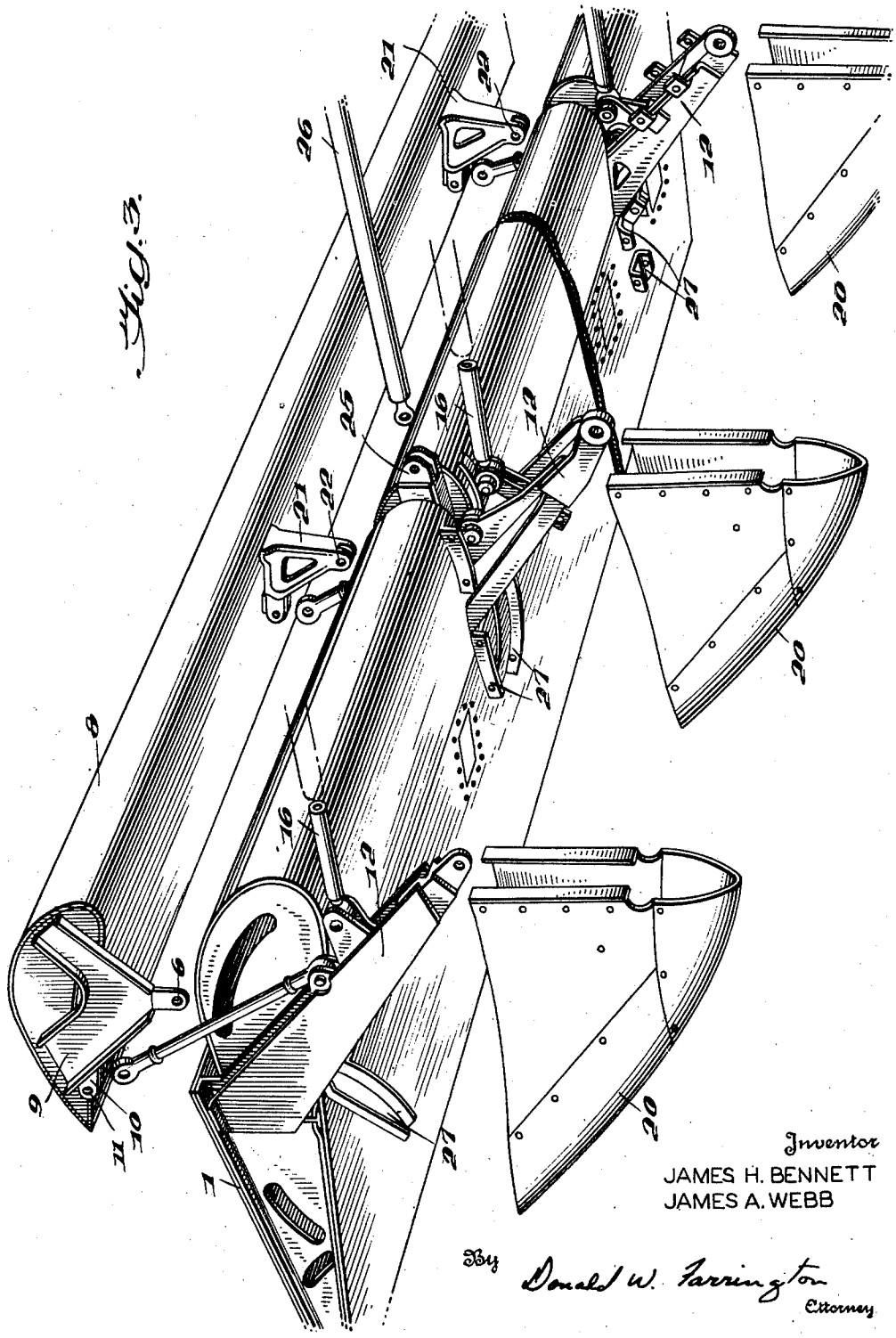
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Fig. 3.



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AIRPLANE WING FLAP AND SLAT MOUNTING

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5 Claims. (Cl. 244—42)

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This invention relates to a novel flap, slat and shutter assembly secured to the trailing edge of a wing, more particularly to the mounting and actuating mechanism arranged to afford adequate mechanical and aerodynamic functions with greatest simplification of parts.

The flap is an auxiliary airfoil on the trailing edge of the wing that can be lowered to an attitude of high lift or a position of high drag. Flips heretofore used have been more or less effective, limited by the mechanism required to position the flap downwardly and rearwardly of the wing. To properly position a flap, it is necesary to get an effective pivot point well below the lower surface of the wing. Many types of mechanism have been worked out to get the effective pivot point below the wing without having the mechanism extend below the wing. None of them is the equivalent of the flap arrangement of this invention wherein the pivot point is actually located below the wing on a bracket where it will be most effective, and the bracket faired to decrease aerodynamic resistance. The purpose of a slat is to increase the maximum lift coefficient by controlling the air flow over the flap when it is in the down position. Slats have been mounted in several ways so that they will be positioned in the space between the trailing edge of the wing and the flap, and usually the mounting is a duplicate of the mounting of the flap, and requires some sort of actuating mechanism to position it on its mounting in space relative to the flap. A shutter has been used between the lower surface of the wing and the leading edge of the flap to close the space and render the lower surface of the wing smooth and continuous when the flap is in the inoperative position. Such shutters have required an intermittent motion mechanism operated by the movement of the flap, because it must operate quickly during initial movement of the flap and stay open until almost final movement of the flap. The mounting mechanism and the actuating mechanism of flap, slat and shutter arrangements has always involved a great weight penalty.

It is an object of this invention to provide a very effective high lift device for an airplane wing with a minimum of weight.

It is a further object of this invention to provide a simple bracket extending rearwardly and downwardly from the trailing edge of the wing having an upper pivot point to which the slat is attached and a lower pivot point to which the flap is attached, and a linkage extending between the trailing edge of the slat and the nose

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portion of the flap forming a quadrilateral linkage arrangement whereby the slat is properly positioned with respect to the flap and moves in response to the movement of the flap.

It is a further object of this invention to provide a flap mounting with an actual pivot point well below the wing for proper position of the flap with respect to the wing.

It is a further object of this invention to provide a slat mounting employing structure common to the mounting of the flap that serves not only as a slat mounting, but also actuates the slat in response to movement of the flap.

It is a further object of this invention to provide a quick opening and quick closing shutter mechanism actuated by and in response to the motion of the flap.

Further and other objects will become apparent from the description of the accompanying drawings which form a part of this disclosure and in which like numerals refer to like parts.

In the drawings:

Figure 1 is a sectional view through the airplane wing showing the mounting of the flap and slat in the inoperative position.

Figure 2 is a view of the flap and slat in the high lift position.

Figure 3 is an exploded perspective view showing the essential parts of the slat, flap and mounting.

Figure 4 is a fragmentary view of the shutter and actuating mechanism.

The flap 1 shown in Figure 1 is mounted along the trailing edge of wing 2 by several hinge assemblies, which good practice dictates will be at least three. Figure 1 is a typical section through such a flap mounting hinge bracket. Members 3 and 4 are secured to member 5 which is secured to the structure of the wing so that members 3, 4 and 5 form a bracket supporting an upper pivot point 6, intermediate the upper and lower surfaces of the wing profile, and a lower pivot point 7 below the lower surface of the wing profile. Slat 8 has a bracket 9 supporting a pivot point that is located forwardly and downwardly from the slat in the operative position and pivotally secured to member 3 at pivot point 6. Slat 8 has a bracket 10 supporting a pivotal connection 11 for member 23 adjacent the trailing edge on the lower side of the profile of the slat. Flap 1 has a main hinge bracket 12 supporting a pivot point forwardly and downwardly from the leading edge of the flap in the operative position, and is pivotally connected to member 4 at pivot point 7.

Bracket 13 is secured intermediate bracket 12

and pivotally supports the lower end of member 23. Bracket 15 is mounted on bracket 12 and pivotally supports one end of push rod 16 which moves crank 24 to move shutter 17 about pivot point 18 as will be explained in detail later. Shutter 17 serves to close the gap between the trailing edge of the wing and the leading edge of the flap on the lower side of the wing profile when the flap assembly is in the up or inoperative position. Shutter 17 moves to the position shown in Figure 2 when the flap is operating in the high lift or high drag position.

A faired cover for the hinge bracket is provided by members 19 and 20. Member 19 is secured to the lower surface of the trailing edge of the wing and provides a faired, streamlined cover around the bracket to decrease drag due to the bracket mechanism extending below the wing. Cover portion 20 is secured to the lower surface of the flap, and moves therewith as the flap moves to a position of high lift or high drag.

The hinge structure illustrated in Figures 1 and 2 is shown in perspective view 3 as the end hinge. Intermediate hinges for the flap and slat are shown in Figure 3. Brackets 21 are mounted on the underside of the flap and pivot points 22 are aligned with pivot point 6 and similarly mounted for a similar function. Figure 3 shows push rods 16 connected to each of the bracket assemblies 12 to operate the corresponding section of the shutter 17 between the hinge assemblies. Bracket 25 is secured to the leading edge of the flap and affords a pivotal support for push rod 26. Push rod 26 is operated to move the flap from the up or inoperative position to positions of high lift or high drag.

Brackets 27 are secured to the underside of flap 1 and afford mounting flanges for securing fairing 29 in place around the hinge bracket.

Push rod 16 consists of a sleeve 28 telescoping with rod 29. Push rod 16 can be adjusted by nut 30 so that rod 29 will bottom in sleeve 28, for a predetermined minimum length. When one end of push rod 16 is secured to bracket 15 and the other end to crank 24, because of its minimum length, it will exert a force on crank 24, secured to shutter 17, that will hold the shutter in the plane of the under surface of the wing. Link 31 is pivotally secured to shutter 17 at 32. The other end of link 31 is secured to the wing structure at 33 with a tension spring 34. When the flap is moved away from the up position, telescoping push rod 16 permits shutter 17 to be moved upwardly by spring 34 into the position shown in Fig. 3. As the flap is moved to a high lift position, or further to a high drag position, telescopic member 28 merely rides on telescopic member 29. When the flap is raised, push rod 16 does not move crank 24 to return shutter 17 to the closed position until the flap is almost in the up position, at which time portion 29 bottoms in portion 28 of push rod 16 to move crank 24 and shutter 17 to the closed position with the final motion of the flap. Thus, it will be seen that with motion of push rod 26 to move the flap, all other required motions for properly positioning the slat and opening the shutter are effected with this flap mounting. The support and actuation of the parts of the wing for high lift and high drag are achieved in a simple and light weight construction to secure the advantages of the highest practical wing loading.

It is to be understood that certain changes, alterations, modifications and substitutions can be made without departing from the spirit and scope of the appended claims.

We claim as our invention:

1. An airplane wing flap mounting comprising a plurality of bracket means rigidly affixed on the trailing edge of an airplane wing extending downwardly and to the rear thereof, each of said bracket means supporting an upper and lower pivot, said upper pivot being located within the wing profile and said lower pivot being located below the under side of the wing, a flap bracket means extending forwardly and downwardly secured to said lower pivot, a slat having bracket means secured thereto extending forwardly and downwardly from the leading edge thereof supported on said upper pivot, linkage means pivoted at a point on said slat adjacent the trailing edge thereof, and a point on said flap adjacent the nose portion thereof to control the incidence of said slat as the flap is moved to a position of high lift or drag, a two-part streamline housing faired around the portions of said brackets extending below the lower surface of said wing, one portion of said housing secured to said wing structure and the other portion of said housing secured to said flap.

2. An airplane wing flap mounting comprising a plurality of bracket means rigidly affixed on the trailing edge of an airplane wing extending downwardly and to the rear thereof, each of said bracket means supporting an upper and lower pivot, said upper pivot being located within the wing profile and said lower pivot being located below the under side of the wing, a flap bracket means extending forwardly and downwardly secured to said lower pivot, a slat having bracket means secured thereto extending forwardly and downwardly from the leading edge thereof supported on said upper pivot, linkage means pivoted at a point on said slat adjacent the trailing edge thereof, and a point on said flap adjacent the nose portion thereof to control the incidence of said slat as the flap is moved to a position of high lift or drag, a two-part streamline housing faired around the portions of said brackets extending below the lower surface of said wing, one portion of said housing secured to said wing structure and the other portion of said housing secured to said flap, a shutter member pivotally mounted on said wing so constructed and arranged that it can be moved to one position to close the opening between the lower surface of the flap and the lower surface of the wing between said bracket housings and to another position retracted within the wing when the slat and flap are moved to a high lift position, spring actuated means to move said shutter to said position within the wing, a push rod having one end secured to said flap bracket, the other end of said push rod adapted to permit said shutter to be moved to the position within the wing when the flap is lowered and to move said shutter to the first mentioned position when said flap is raised.

3. An airplane wing flap mounting comprising a plurality of bracket means rigidly affixed on the trailing edge of an airplane wing extending downwardly and to the rear thereof, each of said bracket means supporting an upper and lower pivot, said upper pivot being located within the wing profile and said lower pivot being located below the under side of the wing, a flap bracket means extending forwardly and downwardly secured to said lower pivot, a slat having bracket means secured thereto extending forwardly and downwardly from the leading edge

thereof supported on said upper pivot, linkage means pivoted at a point on said slat adjacent the trailing edge thereof, and a point on said flap adjacent the nose portion thereof to control the incidence of said slat as the flap is moved to a position of high lift or drag, a two-part streamline housing faired around the portions of said brackets extending below the lower surface of said wing, one portion of said housing secured to said wing structure and the other portion of said housing secured to said flap, a shutter member pivotally mounted on said wing so constructed and arranged that it can be moved to one position to close the opening between the lower surface of the flap and the lower surface of the wing between said bracket housings and to another position retracted within the wing when the slat and flap are moved to a high lift position, means actuated in response to the initial movement of said flap to fully retract said shutter within the wing and other means cooperating with said shutter actuating means to extend the shutter to close the opening between the wing and flap when said flap is raised substantially in the inoperative position.

4. An airplane wing flap mounting comprising a plurality of bracket means rigidly affixed on the trailing edge of an airplane wing extending downwardly and to the rear thereof, each of said bracket means supporting an upper and lower pivot, said upper pivot being located within the wing profile and said lower pivot being located below the under side of the wing, a flap bracket means extending forwardly and downwardly secured to said lower pivot, a slat having bracket means secured thereto extending forwardly and downwardly from the leading edge thereof supported on said upper pivot, linkage means pivoted at a point on said slat adjacent the trailing edge thereof, and a point on said flap adjacent the nose portion thereof to control the incidence of said slat as the flap is moved to a position of high lift or drag, a two-part streamline housing faired around the portions of said brackets extending below the lower surface of said wing, one portion of said housing secured to said wing structure and the other portion of said housing secured to said flap, a shutter member pivotally mounted on said wing so constructed and arranged that it can be moved to one position to close the opening between the lower surface of the flap and the lower surface of the wing between said bracket housings and to another position retracted within the wing when the slat and flap are moved to a high lift position, spring actuated means to move said shutter to said position within the wing, a crank arm secured to said shutter, a telescopic push rod having one portion secured to said flap bracket, the other portion thereof secured to said crank arm adapted to permit said shutter to be moved to the position within the wing upon initial movement of the flap, and to move said shutter to the first mentioned position upon final movement of the flap to the inoperative position.

5. An airplane wing flap mounting comprising a plurality of bracket means rigidly affixed on the trailing edge of an airplane wing extending downwardly and to the rear thereof, each of said bracket means supporting an upper and lower pivot, said upper pivot being located within the wing profile and said lower pivot being located below the under side of the wing, a flap bracket means extending forwardly and downwardly secured to said lower pivot, a slat having bracket means secured thereto extending forwardly and downwardly from the leading edge thereof supported on said upper pivot, linkage means pivoted at a point on said slat adjacent the trailing edge thereof, and a point on said flap adjacent the nose portion thereof to control the incidence of said slat as the flap is moved to a position of high lift or drag, a two-part streamline housing faired around the portions of said brackets extending below the lower surface of said wing, one portion of said housing secured to said wing structure and the other portion of said housing secured to said flap, a shutter member pivotally mounted on said wing so constructed and arranged that it can be moved to one position to close the opening between the lower surface of the flap and the lower surface of the wing between said bracket housings and to another position retracted within the wing when the flap is moved to a high lift position, and a push rod extending from said wing within said faired housing and being pivotally secured to said flap bracket means intermediate said lower pivot and said flap structure to move said shutter as said flap is moved.

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