F450D XR 2,343,645

March 7, 1944. E. G. DICKINSON ET AL 2,343,645

FOLDING WING AIRPLANE

Filed July 3, 1940 4 Sheets-Sheet 1

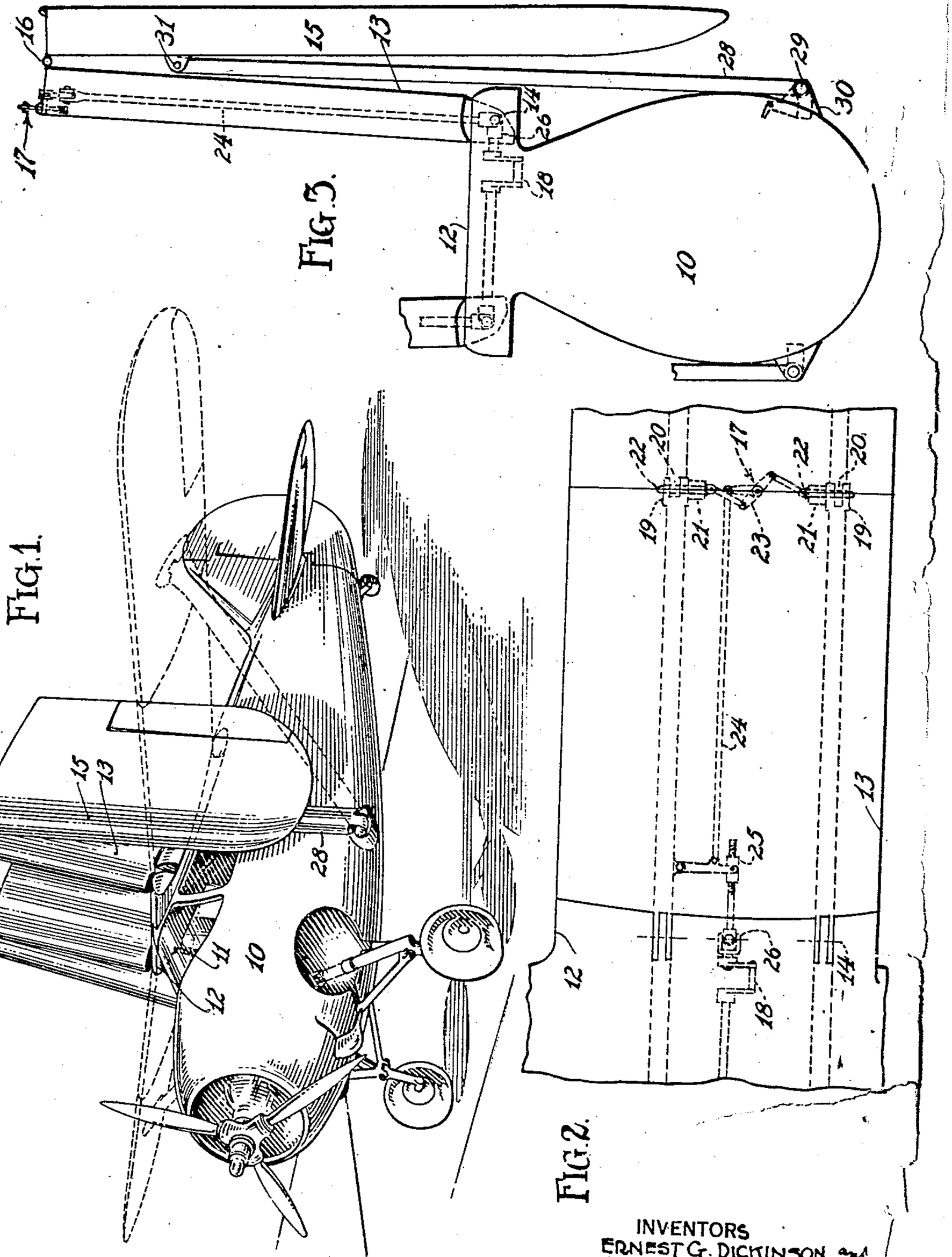


FIG. 3.

FIG. 1.

FIG. 2.

INVENTORS
ERNEST G. DICKINSON and
BY SAMUEL T. PAYNE.
W. E. Stark
ATTORNEY

March 7, 1944. E. G. DICKINSON ET AL 2,343,645

FOLDING WING AIRPLANE

Filed July 3, 1940 4 Sheets-Sheet 2

FIG. 4.

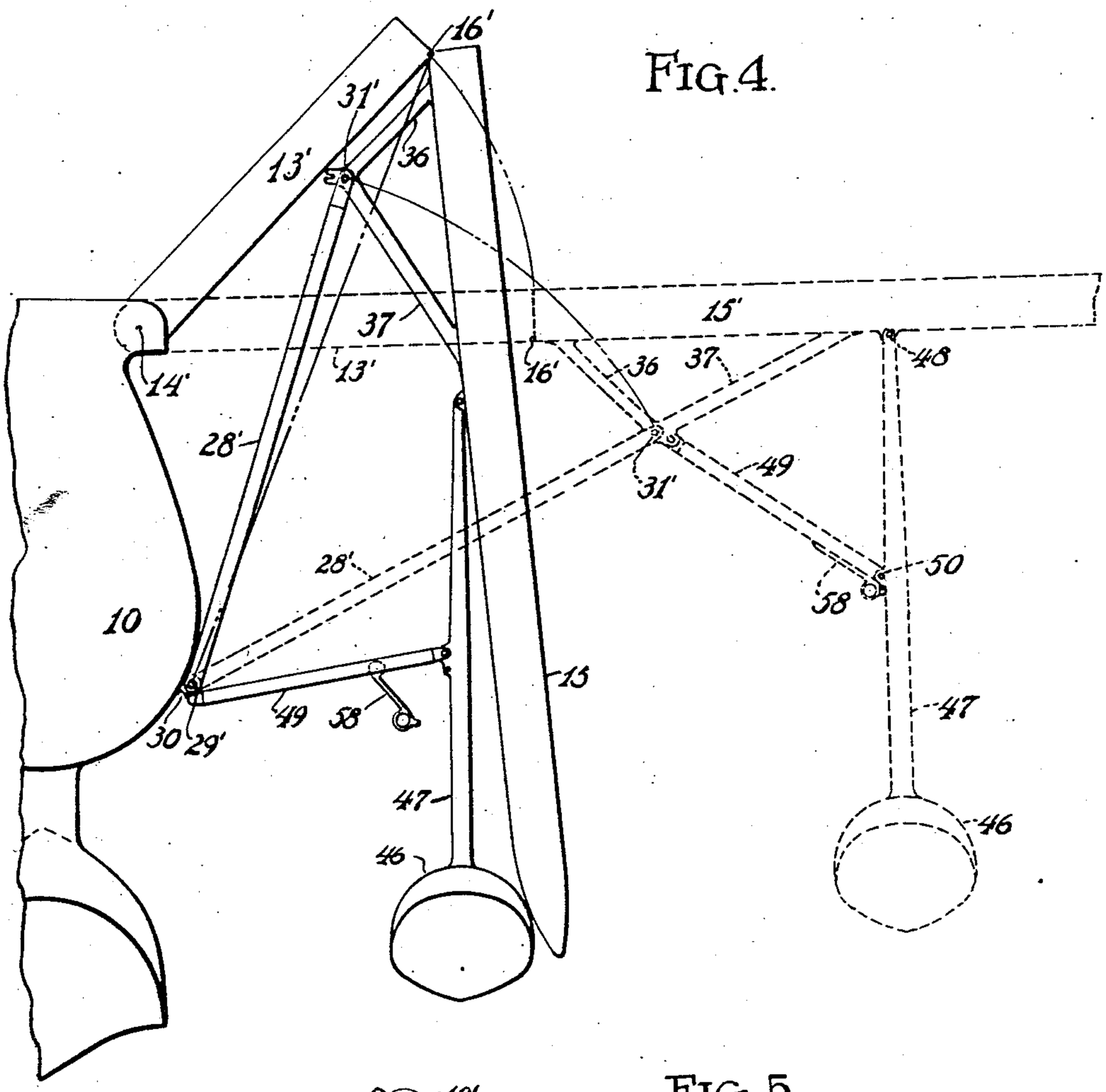
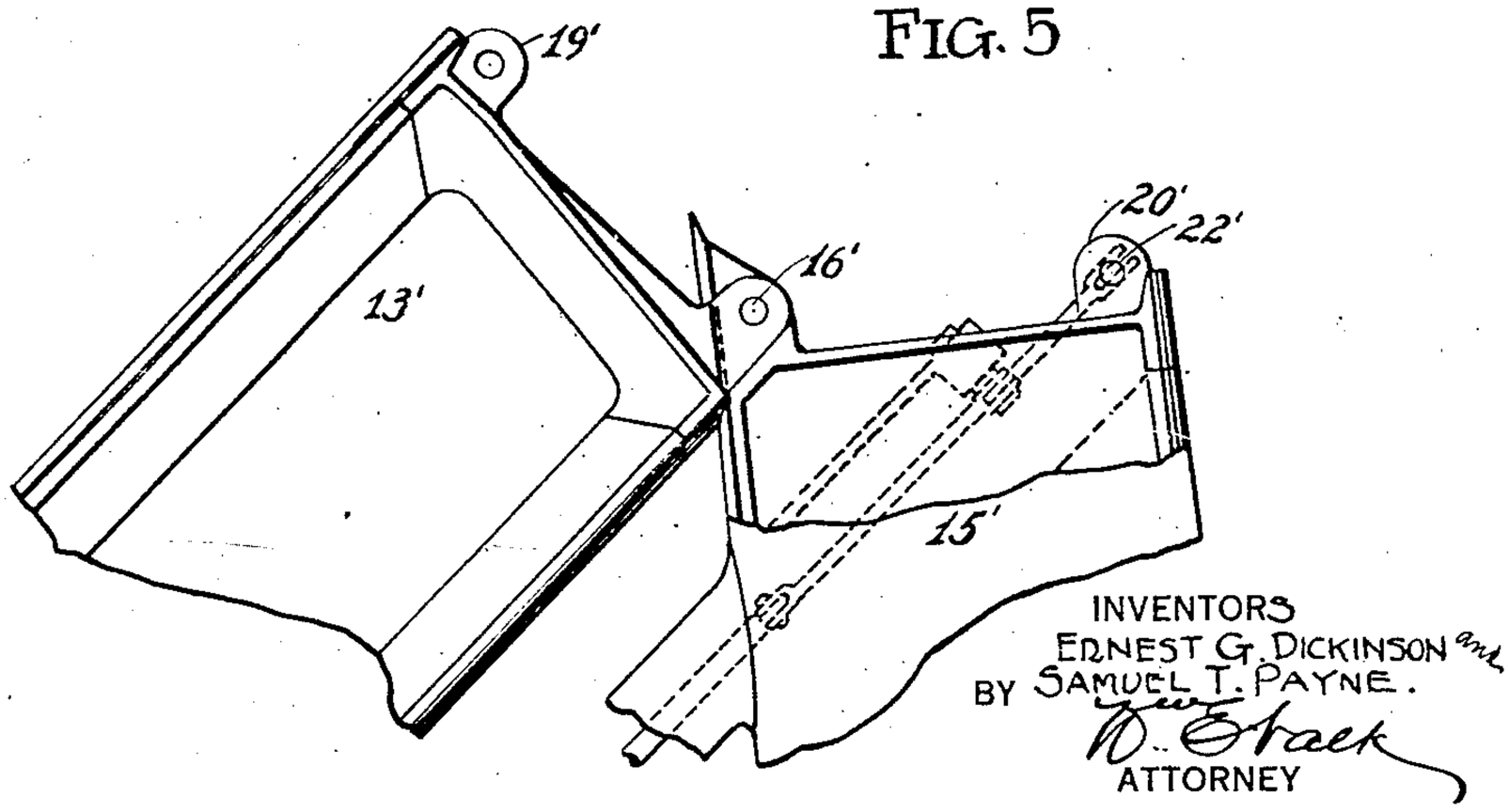


FIG. 5



INVENTORS
ERNEST G. DICKINSON and
BY SAMUEL T. PAYNE.
W. E. Track
ATTORNEY

March 7, 1944. E. G. DICKINSON ET AL 2,343,645

FOLDING WING AIRPLANE

Filed July 3, 1940 4 Sheets-Sheet 3

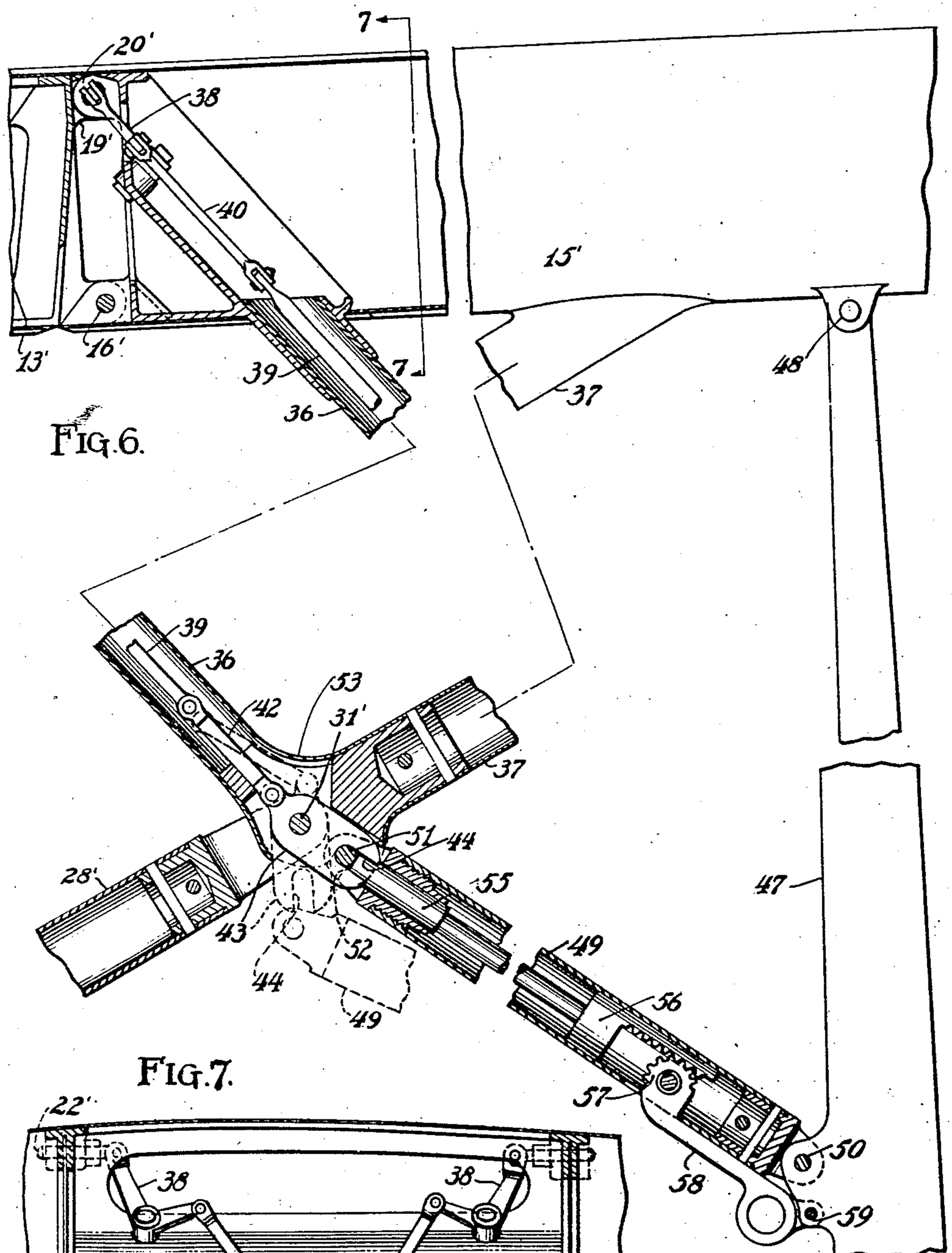
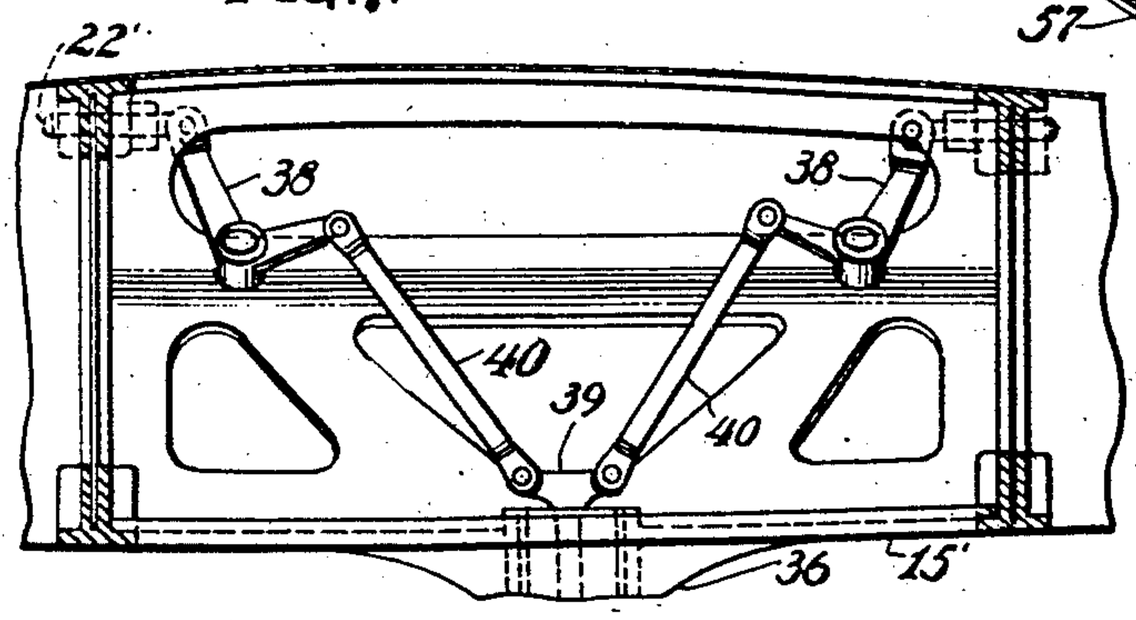


FIG. 6.

FIG. 7.



INVENTORS
ERNEST G. DICKSON and
BY SAMUEL T. PAYNE.
W. E. Falk
ATTORNEY

March 7, 1944. E. G. DICKINSON ET AL 2,343,645

FOLDING WING AIRPLANE

Filed July 3, 1940 4 Sheets-Sheet 4

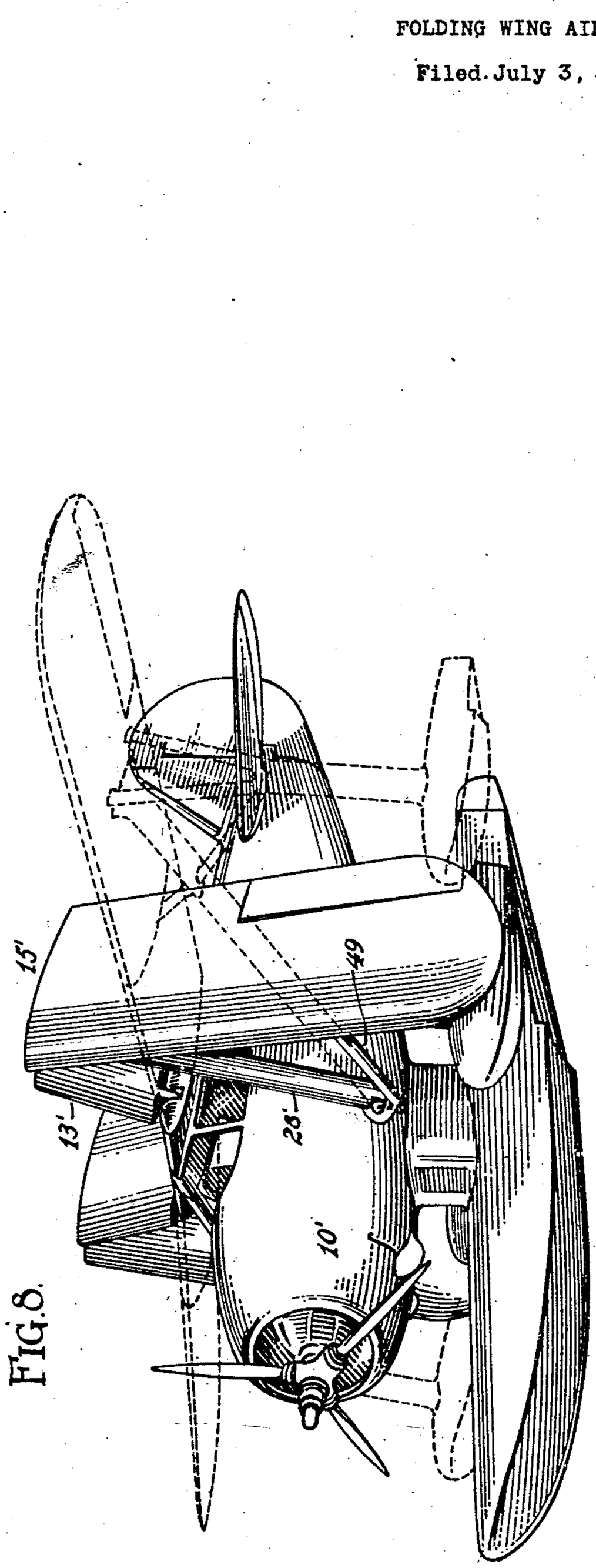


FIG. 8.

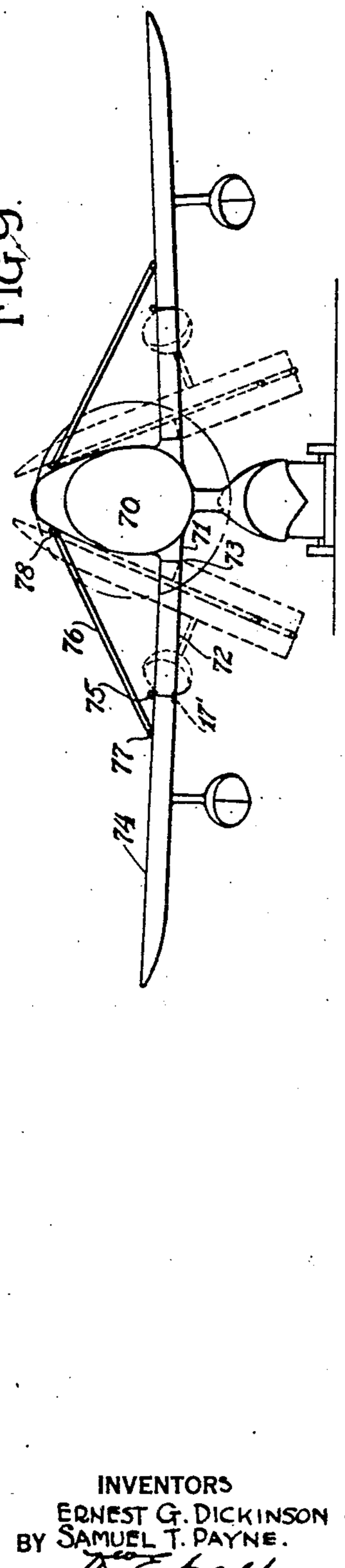


FIG. 9.

INVENTORS
ERNEST G. DICKINSON and
BY SAMUEL T. PAYNE.
W. E. Stalk
ATTORNEY

Patented Mar. 7, 1944 2,343,645

UNITED STATES PATENT OFFICE

2,343,645

FOLDING WING AIRPLANE

Ernest G. Dickinson, Olcott, and Samuel T. Payne, Kenmore, N. Y., assignors to Curtiss-Wright Corporation, a corporation of Delaware

Application July 3, 1940, Serial No. 343,730

6 Claims. (Cl. 244—49)

This invention relates to aircraft and in particular to novel means for folding the wings thereof.

An object of the invention is to provide a folding wing arrangement of such character that the wings fold laterally inwardly toward the airplane body without materially changing the location of the center of gravity of the aircraft, whether the wings be folded or extended.

A further object is to provide a folding wing arrangement in which the weight of the wings is substantially balanced throughout the range of movement thereof whereby the manual effort necessary for folding or extending the wings is minimized and whereby the folding and extending operations may readily be carried out by a single operator.

A further object is to provide a folding wing arrangement wherein the weight of the parts and the pivots about which they move are so organized and disposed that if the parts are left untended without being in either the fully extended or fully folded position, the parts will remain in an intermediate position and will not slam towards one extreme or the other which might result in damage to the wings or its brace structure, and further, to arrange the parts so that they may be moved to extreme positions and remain therein.

A further object is to provide a folding wing arrangement primarily adapted for externally braced monoplanes, either of the high wing or low wing type, and to provide an arrangement which is particularly adapted for use on seaplanes which utilize auxiliary wing tip floats. In this connection, a further object of the invention consists in coordinating the base structure for a wing tip float with the locking means for the wings whereby, by removal or installation of a wing float brace, the main wing locks are actuated coincidentally, to the end that a single operator may readily accomplish either folding or unfolding of the wings while retaining all portions of the assembly under perfect control.

A further object of the invention consists in the provision of a novel form of remotely controlled folding wing locking mechanism.

Further objects of the invention will become apparent in reading the annexed detailed description in connection with the drawings, in which:

Fig. 1 is a perspective view of a high wing land monoplane showing the wings folded, in solid lines, and the wings extended, in dotted lines;

Fig. 2 is a plan of a portion of the aircraft body and the wing in an extended position;

Fig. 3 is a front elevation of the aircraft showing the wing in folded position;

Fig. 4 is a front elevation of an alternative arrangement adapted for use with a seaplane, and in which the wing is shown folded, in solid lines, and extended, in dotted lines;

Fig. 5 is an enlarged fragmentary view of portions of the wing showing one of the wing hinges and one of the wing locks;

Fig. 6 is a fragmentary front elevation, partly in section, showing a portion of the wing and portions of the brace structure associated therewith;

Fig. 7 is a section on the line 7—7 of Fig. 6;

Fig. 8 is a perspective view of the seaplane arrangement of Fig. 4, showing the wings folded, in solid lines, and extended, in dotted lines; and

Fig. 9 is a front diagrammatic elevation showing the invention adapted for use with a low wing monoplane.

Referring first to Figs. 1, 2, and 3, we show a land plane comprising a fuselage 10 and a cabin 11 to the top of which a center section 12 is rigidly secured. Since the aircraft is symmetrical about the central vertical longitudinal plane, a description of the wing arrangement on one side will suffice for both sides. To the end of the center section 12, an inner wing panel or stub 13 is hinged as at 14, the hinge axis extending longitudinally and in substantial parallelism with the wing chord or with the longitudinal axis of the airplane. This stub 13 is movable from a horizontal attitude to a substantially vertical attitude use shown in Fig. 3. To the outer end of the stub 13, a wing outer section or tip 15 is hinged, as at 16, the hinge axis 16 being parallel with the wing chord and extending along the lower surface of the wing sections. Thus, the tip 15 can rotate on the hinge 16 with respect to the stub 13 from the horizontal flight position through approximately 180° to the fully folded position, as is clear from the drawings. When the wing is fully extended for the flight position, the top part of the stub and tip are locked to one another by means 17 which means is controllable from the cockpit 11 by manipulation of a hand crank 18. Means 17 consist in detail of interfitted clevis elements 19 and 20 respectively on the stub 13 and the tip 15, the elements 19 carrying bushings 21 for guiding clevis pins 22 which are coincidentally withdrawn from or passed through the clevis by a linkage 23 connected with an op-

erating rod 24 which is pushed or pulled by the crank 18 through a screw connection 25 and a universal joint having its center is disposed upon the hinge axis 14.

A lift strut 28 is hinged or articulated at its lower end, as at 29, to a body fitting 30 which is disposed a substantial distance below the hinge axis 14. The upper end of the strut 28 is articulated or hinged as at 31 to the wing tip 15 at a point outwardly spaced from the wing hinge 16. The strut 28 serves to establish the path of travel of the wing parts during extension or folding movement thereof and, if necessary, temporary fastening means may be provided between the extreme end of the wing tip and the strut 28 or the body 10 to hold the wings in folded position. In this arrangement, the wings would naturally move, if unrestrained, toward an intermediate position and the operator would be required to exert effort to fold the wings and to extend them. From the above description, it is believed that the operation of the folding of the wings is obvious.

Referring now to Figs. 4 to 8, inclusive, an alternative arrangement is shown in which the elements corresponding to those already described are designated by similar primed numbers. In this arrangement the geometry of the system is so arranged that the wings when folded will remain in the folded position under the influence of gravity and will not tend to extend unless extension is enforced by an attendant. To attain this result, reference being made to Fig. 4, the system is so arranged that the pivot 31' will fold inwardly of a straight line joining the pivots 16' and 29' when the wings are folded, whereby the weight of the wing tip 15' serves to hold the pivot 31' in the above mentioned position by which extension of the wing system is prevented. The pivot 31' is carried by auxiliary lift struts 36 and 37 rigid with the tip 15' and, as will be clear from the dotted lines in Fig. 5, the hinge 31' is disposed below and outwardly of the hinge 16' when the system is extended.

Clevises 19' and 20' are provided on the wing section for engagement by clevis pins 22' which serve to lock the wing system in the flight position, these clevis pins being operated through bellcranks 38 within the tip 15' which are linked to operating rods 39 and 40. The operating rod 39 passes through an auxiliary lift strut 36 to a link 42 pivoted on a plate 43 swingable on the hinge pin 31'. The plate 43 is provided with a notched lever 44 which, when moved into substantial alignment with the auxiliary lift strut 36, forces the clevis pins 22' into locking engagement. When the plate 43 is swung out of line, the clevis pins 22' are withdrawn from the clevises 19' and 20' to unlock the wing for folding.

As the aircraft covered in this embodiment is shown as a seaplane, wing floats 46 are shown as being carried by struts 47 hinged at their upper ends to the bottom of the wing tip 15' as at 48. To secure the wing floats in their proper position while the wing is in flight position, brace struts 49 extend from the vicinity of the hinge axis 31' to an intermediate point along the float strut 47, at which point they are hinged by a pin 50 shown clearly in Fig. 6. The opposite end of the brace strut 49 carries a crosspin 51 which engages both the notch of the lever 44 and an additional notch 52 formed in the fitting 53 forming the junction for the auxiliary lift struts 36 and 37. The brace strut 49 is further provided with a movable locking lug 55 which engages the notched lever 44 as well as the fitting 53 to secure the strut 49 from displacement. The locking lug 55 is actuated through a rack 56 secured to the lower end thereof, and a pinion 57 journalled in the strut and having an integral operating lever 58 which is secured against displacement by a removable pin 59.

To fold the wing system, the operator withdraws the pin 59, pulls the lever 58, which releases the wing locking clevis pins 22' and which also releases the strut 49 from the fitting 53. Thereupon, the wing system may be moved to the folding position during which time the wing float 46 remains in a substantially vertical attitude. When the wing is completely folded, the free end of the brace strut 49 may be engaged with a suitable notch formed in the fitting 30' on the body to secure the float strut 47 from swinging.

Reference may now be made to Fig. 9 which shows the principles of the invention adapted to a low wing externally braced monoplane which, though shown as a seaplane might just as well be a land plane. In this case, the fuselage or body 70 includes a center wing section 71 to the lower edge of which a wing stub 72 is hinged at 73. A wing tip 74 is hinged at 75 to the upper edge of both the stub 72 and tip 74, and an external brace strut 76 is pivoted at its lower end to the top of the wing tip 74, outboard of the hinge 75, as at 77, and is hinged at its upper inner end to the body structure as at 78. Wing locks along the lines of those previously described and comprised by the mechanism 17 would be used at the bottom edge of the joint between the stub 72 and the tip 74. The balance of the system is so delicate that extremely little effort is necessary to either extend or fold the wing system and even with an aircraft of substantial size the operation could be performed easily by a single operator.

While we have described our invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after understanding our invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. We aim in the appended claims to cover all such modifications and changes.

We claim as our invention:

1. In an aircraft including a body portion, a foldable wing extending from said body portion comprising a wing stub portion hinged to said body portion and a wing tip portion hinged to said stub portion, said hinge axes being directed substantially chordwise of said wing with said wing stub portion hinged for swinging movement to an elevated position and said wing tip portion being hinged for downward folding movement, an offset structure secured to and extending a substantial distance below the wing tip portion when said portion is in its normal extended position, and a strut hinged at one end to said body portion at a point below the hinge connection of said wing stub portion with said body portion and hinged at its other end to said offset structure, said wing being foldable to a position in which the wing stub portion is elevated substantially less than to a vertical position and the hinge connection between said strut and

offset structure is disposed inwardly of a line through the hinge between the strut and body portion and the hinge between the wing tip and wing stub portions, whereby the weight of the wing portions can hold the wing in said folded position.

2. In an aircraft including a body portion, a foldable wing extending from said body portion comprising a wing stub portion hinged to said body portion and a wing tip portion hinged to said stub portion, said hinge axes being directed substantially chordwise of said wing with said wing stub portion hinged for swinging movement to an elevated position and said wing tip portion being hinged for downward folding movement, an offset structure secured to and extending a substantial distance below the wing tip portion when said portion is in its normal extended position, a strut hinged at one end to said body portion at a point below the hinge connection of said wing stub portion with said body portion and hinged at its other end to said offset structure, said wing being foldable to a position in which the wing stub portion is elevated substantially less than to a vertical position and the hinge connection between said strut and offset structure is disposed inwardly of a line through the hinge between the strut and body portion and the hinge between the wing tip and wing stub portions, whereby the weight of the wing portions can hold the wing in said folded position, a member for locking the hinge connection between the wing stub and wing tip portions, an auxiliary strut hinged to said wing tip portion, a brace strut having one end hinged to said auxiliary strut and having its other end releasably connected to said offset structure, and means connected to said locking member and engaged by said brace strut when said brace strut is connected to said offset structure for retaining said member in locking position.

3. In an aircraft including a body portion, a foldable wing extending from said body portion comprising a wing stub portion hinged to said body portion and a wing tip portion hinged to said stub portion, said hinge axes being directed substantially chordwise of said wing with said wing stub portion hinged for swinging movement to an elevated position and said wing tip portion being hinged for downward folding movement, an offset rigid truss-like structure secured to and extending a substantial distance below the wing tip portion when said portion is in its normal extended position, a strut hinged at one end to said body at a point below the hinge connection of said wing stub portion with said body portion and hinged at its other end to the lower portion of said offset truss-like structure, said wing being foldable to a position in which the wing stub portion is elevated substantially less than to a vertical position and the hinge connection between said strut and body portion is disposed inwardly of a line through the hinge between the strut and body portion and the hinge between the wing tip and wing stub portions, whereby the weight of the wing portions can hold the wing in said folded position.

4. In a seaplane having a hinged wing portion, a wing float strut hinged to said wing portion and normally depending therefrom, a brace strut having one end hinged to the float strut and having its other end releasably connected to said wing portion, a member for locking said wing hinge, and means connected to said member and engaged by said brace strut when said brace strut is connected to said wing portion for retaining said member in locking position.

5. In a seaplane having a body portion and a foldable hinged wing portion, a wing float strut hinged to said wing portion and normally depending therefrom, a brace strut having one end hinged to the float strut and having its other end releasably connected to said wing portion, a member for locking said wing hinge, and means connected to said member and engaged by said brace strut when said brace strut is connected to said wing portion for retaining said member in locking position, said brace strut, upon disconnection from said wing portion and after folding said wing portion, being connectable to said body portion as a sway brace for said float strut.

6. In an aircraft having a foldable wing, means releasably locking said wing in its extended position comprising a push-pull rod operatively connected to a wing locking member, an arm pivotally connected to the aircraft and to said rod, said arm having an outwardly opening slot extending in a substantially radial direction from the axis of the pivotal connection of said arm to the aircraft, a link having a crosspin engageable with said slot and adapted to swing said arm about its pivotal connection with said aircraft to effect locking and unlocking movements of said locking member, and means slidable longitudinally of said link and adapted to extend into said slot to hold said arm in its wing-locking position.

ERNEST G. DICKINSON.
SAMUEL T. PAYNE.