E. F. GALLAUDET.

AEROPLANE.

APPLICATION FILED MAR. 20, 1912.

1,145,013.

Patented July 6, 1915.

3 SHEETS—SHEET 1.

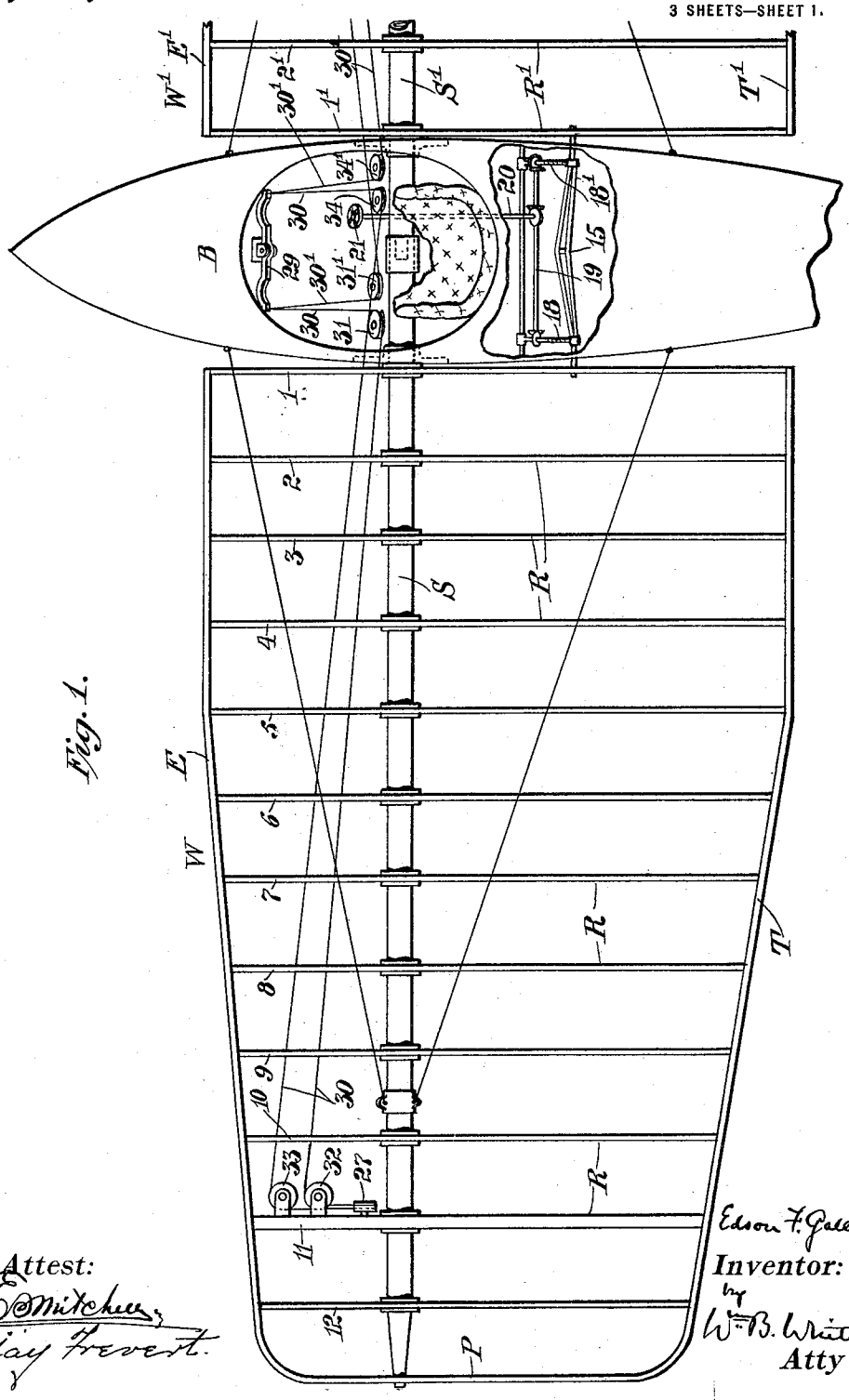

Fig. 1.

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3 SHEETS—SHEET 2.

Fig. 2.

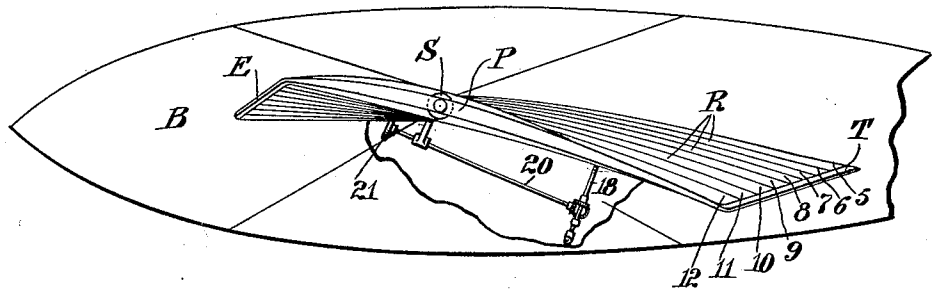
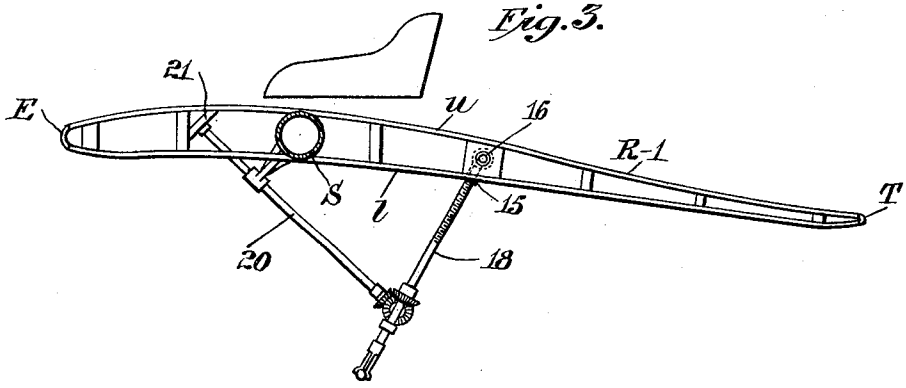


Fig. 3.



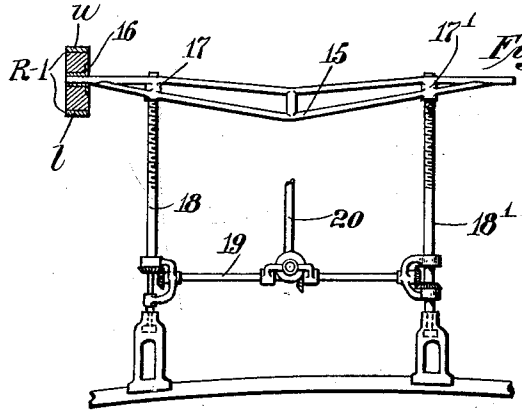


Fig. 4.

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3 SHEETS—SHEET 3.

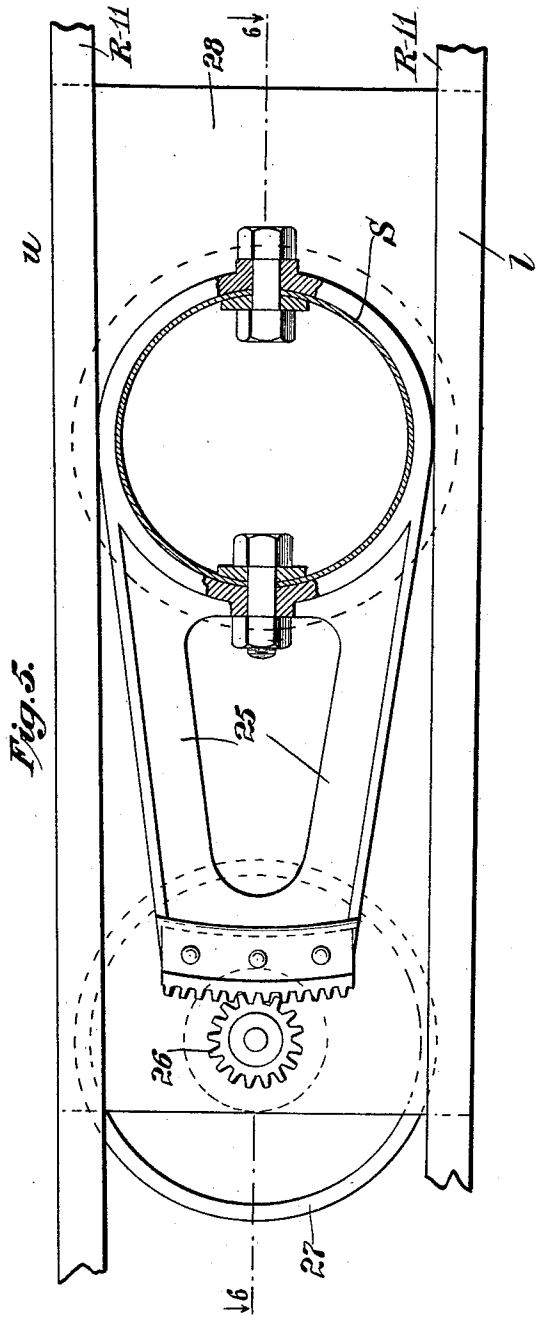

Fig. 5.

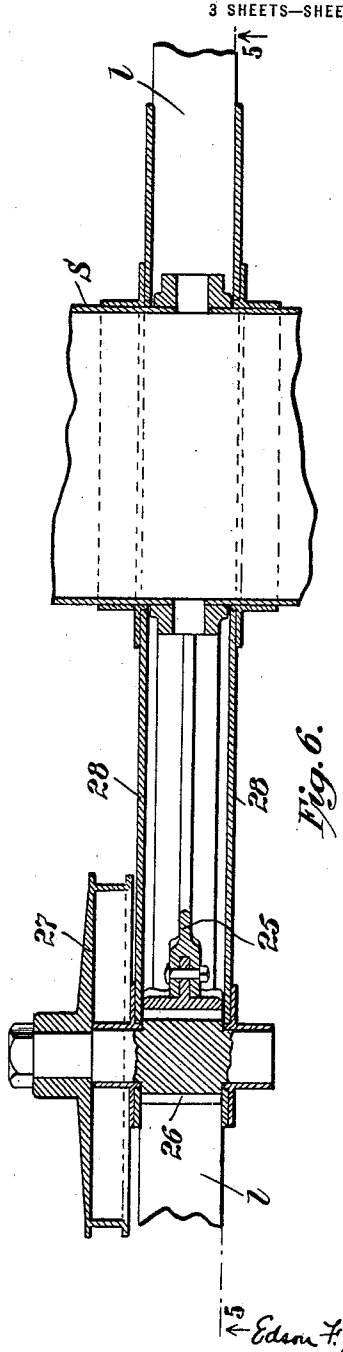

Fig. 6.

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UNITED STATES PATENT OFFICE.

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AEROPLANE.

1,145,013. Specification of Letters Patent. Patented July 6, 1915.

Application filed March 20, 1912. Serial No. 684,947.

To all whom it may concern:

Be it known that I, EDSON F. GALLAUDET, a citizen of the United States, and resident of the town of Norwich, in the county of New London and State of Connecticut, have invented certain new and useful Improvements in Aeroplanes, of which the following is a specification.

My present invention relates to flying-machines of the aeroplane type, and more particularly to the construction and control of the main planes or wing-surfaces by means of which such machines are raised and sustained in the air.

The object of the invention is to provide an improved wing construction and control mechanism which will enable the operator during flight both to control the angular position of the wings considered as a whole, to adapt them to changing conditions, and especially to changes in speed, and to warp the wings by varying the angular position of their outer with respect to their inner portions, to maintain lateral balance, while permitting the wings to be securely attached and guyed to the body of the machine.

With this end in view, the invention comprises certain novel features of construction, arrangement, and combinations of parts, as hereinafter fully described with reference to the accompanying drawings and more particularly pointed out in the claims.

Referring to the drawings, wherein there is illustrated one specific embodiment of my invention, Figure 1 is a plan of the skeleton or frame of the port wing and of a part of the starboard wing mounted in position upon the torpedo-shaped body of the common monoplane type of machine, showing their construction and portions of the mechanism for their control; Fig. 2, a side elevation, showing the port wing as it appears when warped to raise that side of the machine; Figs. 3 and 4, detached details, on an enlarged scale, of the means employed to control the angular position of the two wings as a whole; and Figs. 5 and 6, enlarged longitudinal sections, on the lines 5 5 and 6 6 of Figs. 6 and 5, respectively, showing in connection with one of the outer ribs of the port wing the means provided for moving that rib to different angular positions to produce a warping of the wing.

As therein shown, B is the body and W and W′ the two oppositely extending wings of a monoplane flying-machine. The skeleton frame of the port wing W comprises a main transverse spar S, preferably of steel tubing, which is mounted at its inner end to rotate in suitable bearings secured in the side of the body and a series of ribs R and a tip-piece P which are mounted upon the spar and are connected at their ends by more or less flexible nose and tail pieces E and T forming, respectively, the entering and trailing edge of the wing. The ribs are preferably of trussed construction, with upper and lower battens *u l* stiffened by suitable webs, and one or more at the inner end of the wing, those numbered from 1 to 5, for example, although the precise number is immaterial, are rigidly mounted upon and rotate with the spar, while the remaining or outer ribs, numbered from 6 to 12, and the tip-piece are mounted with loose collars to rotate thereon. The starboard wing W′, comprising a main transverse spar S′, ribs R′ and tip-piece, and nose and tail pieces E′ and T′, is similarly framed and mounted. The spars of the two wings are preferably formed either of a single length of steel tubing or of two pieces rigidly coupled together at their inner ends as indicated.

For the control of the angular position of the two wings as a whole, a yoke 15 is pivoted at its two ends in bearings 16 16′ carried, respectively, by the innermost rib of each of the two wings, at a suitable distance behind the spars. This yoke is provided near its ends with two threaded bearings 17 17′ in which turn the upper threaded ends of two posts or rods 18 18′, respectively, which posts at their lower ends are stepped in suitable bearings secured to the bottom frame of the body of the machine. The two threaded posts are respectively geared, so as to be turned together in the same direction if provided with like screw-threads or in opposite directions if provided with right and left screw-threads, to a cross-shaft 19 which is journaled in yokes carried by the threaded posts and which in turn is geared to a shaft 20 journaled at one end in a yoke carried by the cross-shaft and at the other, suitably supported in a bearing depending from the main spar, carrying a hand-wheel 21 conveniently located with respect to the operator's seat in the body of the machine. It is evident that by turning the hand-wheel a rotary motion will be communicated through shaft 20 and

cross-shaft 19 to the two threaded posts which, turning in the threaded bearings in the yoke, will raise or lower the yoke 15, according to the direction in which the hand-wheel is turned, and thus, acting through the two ribs as lever-arms, rock the spars S and S′ about their longitudinal axes and with them all the ribs mounted thereon, thereby equally decreasing or increasing, as the case may be, the angle of both wings. It is also evident that, when once adjusted, the wings will be securely held in position without effort on his part until the operator again turns the hand-wheel to change the adjustment.

For varying the angular position of the outer rotatable ribs upon the spar S, of the port wing, a gear-sector 25 is rigidly mounted thereon between the upper and lower battens of one of the outer ribs, the next to the last, numbered 11, as here shown. The teeth of this gear-sector mesh with those of a gear-pinion 26 which is mounted to rotate with a drum-sheave 27 on a shaft journaled in suitable bearings supported in plates 28 boxing at this point the sides of the rib, and the drum-sheave is operatively connected with a foot-lever 29, pivotally mounted in the body of the machine, by a cable or wire 30 which is wound around the sheave and secured at its ends to the two ends of the foot-lever after passing over guide-sheaves 31, 32, 33, 34, preferably between the upper and lower battens of the ribs so as to be inclosed within the wing structure. The two ends of the foot-lever are operatively connected by the crossed cable or wire 30′ with a drum-sheave and gear-pinion similarly mounted upon the corresponding rib of the starboard wing W′, and the gear-pinion meshes with a gear-sector similarly fixed to the spar S′. When the operator, seated within the body, wishes to tilt the machine to starboard he presses down on the starboard end of the foot-pedal. A pull is thereby given to that end of the cable 30 and to the lower side of the drum-sheave 27, which causes the sheave to rotate backward and its pinion to climb on the end of the gear-sector, thus giving an upward inclination to the rib 11 and, through the flexible nose and tail pieces which will be bent from the points where they are connected to the outer fixed rib 5, proportional angular elevations to all the rotatably mounted ribs and the tip-piece of this wing, as shown in Fig. 2. At the same time a pull is given to the same end of the crossed cable 30′ and thereby to the upper side of the drum-sheave mounted on the corresponding rib of the starboard wing W′, causing that sheave to rotate forward and its pinion to descend upon the end of the gear-sector on the spar S′, thus giving a downward angular inclination to the rotatable ribs on that wing equal to the angular elevation of the corresponding ribs of the port wing. Pressure upon the port end of the foot-pedal will, of course, impart opposite reverse angular movement to the movable ribs of the two wings and cause the machine to tilt to the port side.

The angular adjustability of the wings as a whole is of especial advantage in connection with a hydro-aeroplane, since it is impossible to obtain as high speed in a machine running upon the water as in one running upon the land, and the desired adjustment is secured with slight effort on the part of the operator and with little or no strain upon the wings and control mechanism by reason of the fact that the spars on which the wings are supported and about which they rock are located at substantially the center of the pressure of the wings. By reason of this construction and also because of the leverage afforded by the gear-sectors, the operator is also able to warp the wings and hold them in warped position with much less effort than is usually required for the purpose.

While I have hereinabove specifically described my invention only with reference to the particular embodiment thereof which is illustrated in the drawings, it will be understood that the invention is equally applicable to the wing-surfaces of biplanes and to wing-surfaces which, as in the common type of biplanes, extend integrally from one side to the other of the machine, and, further, that it can be greatly modified in its various details, within the scope of the appended claims, without departing from the principle or sacrificing the advantages thereof.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an aeroplane, a flexible wing structure comprising a transverse spar, a series of fore and aft ribs mounted upon the spar, rigidly at its inner and rotatably at its outer ends, and connected together at their front and rear ends respectively by flexible nose and tail pieces, and means independent of the rotation of the spar for rocking thereon one of the outer rotatable ribs to thereby produce a warping of the entire outer portion of the wing.

2. In an aeroplane, a flexible wing structure comprising a main spar, a series of fore and aft ribs mounted upon the spar, rigidly at its inner and rotatable at its outer ends, and connected together at their front and rear ends respectively by flexible nose and tail pieces, and means independent of the rotation of the spar and located wholly between the upper and lower edges of the ribs for rocking one of the outer rotatable ribs to thereby produce a warping of the outer portion of the wing.

3. In an aeroplane, a flexible wing structure comprising a transverse spar, a series of fore and aft ribs mounted upon the spar, rigidly adjacent the body and rotatably at its outer end, and connected together at their front and rear ends respectively by flexible nose and tail pieces, and means including a fore and aft member rigidly mounted upon the spar near its outer end and operatively connected with an adjacent rotatable rib for rocking said rotatable rib to thereby produce a warping of the outer portion of the wing.

4. In an aeroplane, a wing structure comprising a main transverse spar, a series of fore and aft ribs mounted thereon, those at its inner end rigidly and those at its outer end rotatably, and means including a gear-sector rigidly mounted upon the spar near its outer end and a gear-pinion rotatably mounted upon one of the rotatable ribs adjacent the gear-sector for rocking the rotatable ribs upon the spar.

5. In an aeroplane, a wing structure comprising a main transverse spar, a series of fore and aft ribs mounted thereon rigidly at its inner and rotatably at its outer end, a gear-sector mounted upon the spar near its outer end, a gear-pinion mounted upon one of the outer rotatable ribs adjacent the gear-sector, and means adapted to be actuated by the operator, in the body of the aeroplane, for rotating the gear-pinion to rock the outer rotatable rib upon the spar.

6. In an aeroplane, the combination with a wing structure comprising a main transverse spar and a series of fore and aft ribs mounted thereon, those at its inner end rigidly and those at its outer end rotatably, of means within the control of the operator for rotating the spar about its longitudinal axis to vary the inclination of the wing with respect to the body and means also within the control of the operator for rocking the rotatable ribs about the spar to vary the inclination of the outer with respect to the inner portion of the wing.

7. In an aeroplane, the combination with a wing structure comprising a main transverse spar and a series of ribs mounted thereon, rigidly at its inner and rotatably at its outer end, of means including a rotatable threaded post and a threaded bearing pivotally connected with a lever-arm fixed to the spar for rotating the spar and means including a gear-sector mounted upon the spar near its outer end and a gear-pinion mounted upon one of the outer rotatable ribs adjacent the gear-sector for rocking the outer ribs upon the spar.

8. In an aeroplane, the combination with a wing structure comprising a main spar extended transversely on opposite sides of the body of the aeroplane and a series of ribs mounted on the spar, rigidly at its center and rotatably at its ends, of means within the control of the operator for rotating the spar about its longitudinal axis and means also within the control of the operator for simultaneously rocking the rotatable ribs about the spar in opposite directions at its opposite ends.

9. In an aeroplane, the combination with a wing structure comprising a spar extending transversely on opposite sides of the body of the aeroplane and a series of ribs mounted upon the spar, rigidly at the central and rotatably at the two end portions of the spar, of means for rotating the spar about its longitudinal axis and means independent of the rotation of the spar for simultaneously rocking the rotatable ribs about the spar in opposite directions at its opposite ends.

10. In an aeroplane, the combination with a wing structure comprising a spar extending transversely on opposite sides of the body of the aeroplane and a series of fore and aft ribs mounted upon the spar, rigidly adjacent the body and rotatably at its two outer ends, and connected together at their front and rear ends respectively by flexible nose and tail pieces, of means independent of any movement of the spar for simultaneously rocking in opposite directions a single rotatable rib near each outer end of the spar to thereby produce a differential warping of the two end portions of the wing structure.

11. In an aeroplane, the combination with a wing structure comprising a spar extending transversely on opposite sides of the body of the aeroplane and a series of fore and aft ribs mounted upon the spar, rigidly adjacent the body and rotatably at the two outer ends of the spar, and connected together at their front and rear ends respectively by flexible nose and tail pieces, of means including a fore and aft member rigidly mounted upon the spar near each of its outer ends and operatively connected with an adjacent rotatable rib for differentially warping the two outer end portions of the wing structure.

12. In an aeroplane, the combination with a wing structure comprising a rotatable main spar extending transversely on opposite sides of the body and having a series of ribs mounted thereon of means for rotating the spar about its longitudinal axis, including a lever arm mounted upon the spar, a threaded post pivotally mounted at one end upon the body to rotate within a threaded bearing suitably connected with the lever arm, and a shaft rotatable by the operator geared to the threaded post.

13. In an aeroplane, the combination with a wing structure comprising a main spar extending transversely on opposite sides of the

body and having a series of ribs mounted thereon of means, including a yoke pivotally mounted at each end in the rib adjoining the body on each side and behind the spar, a threaded nut carried by the yoke, a threaded post mounted upon the body to rotate within the nut, and means located in the body within reach of the operator for rotating the threaded post to vary the angle of the wing with respect to the body.

EDSON F. GALLAUDET.

In presence of—
JOHN B. O'BRIEN,
JOSEPH T. FANNING.