P. A. WATSON.

FLYING MACHINE.

APPLICATION FILED DEC. 28, 1909.

988,415. Patented Apr. 4, 1911.

2 SHEETS—SHEET 1.

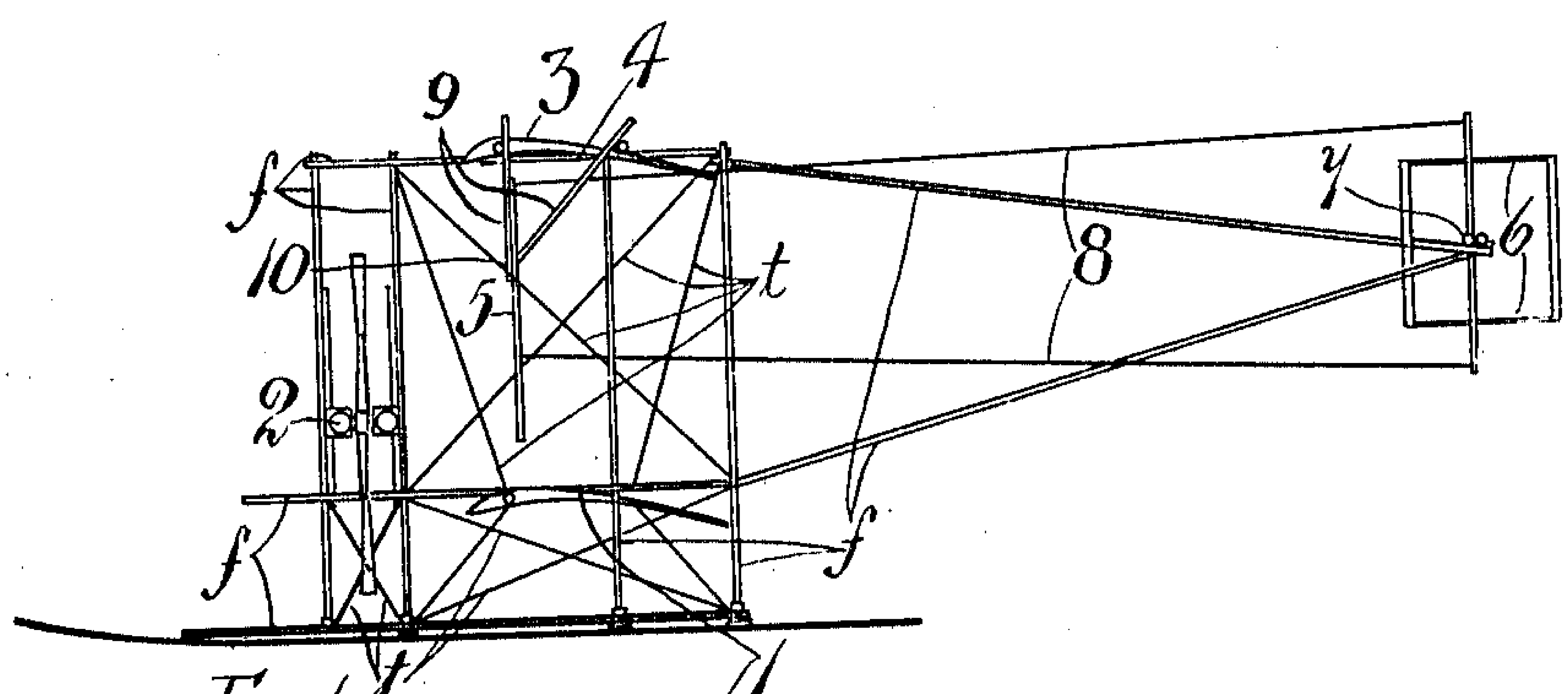

Fig. 1

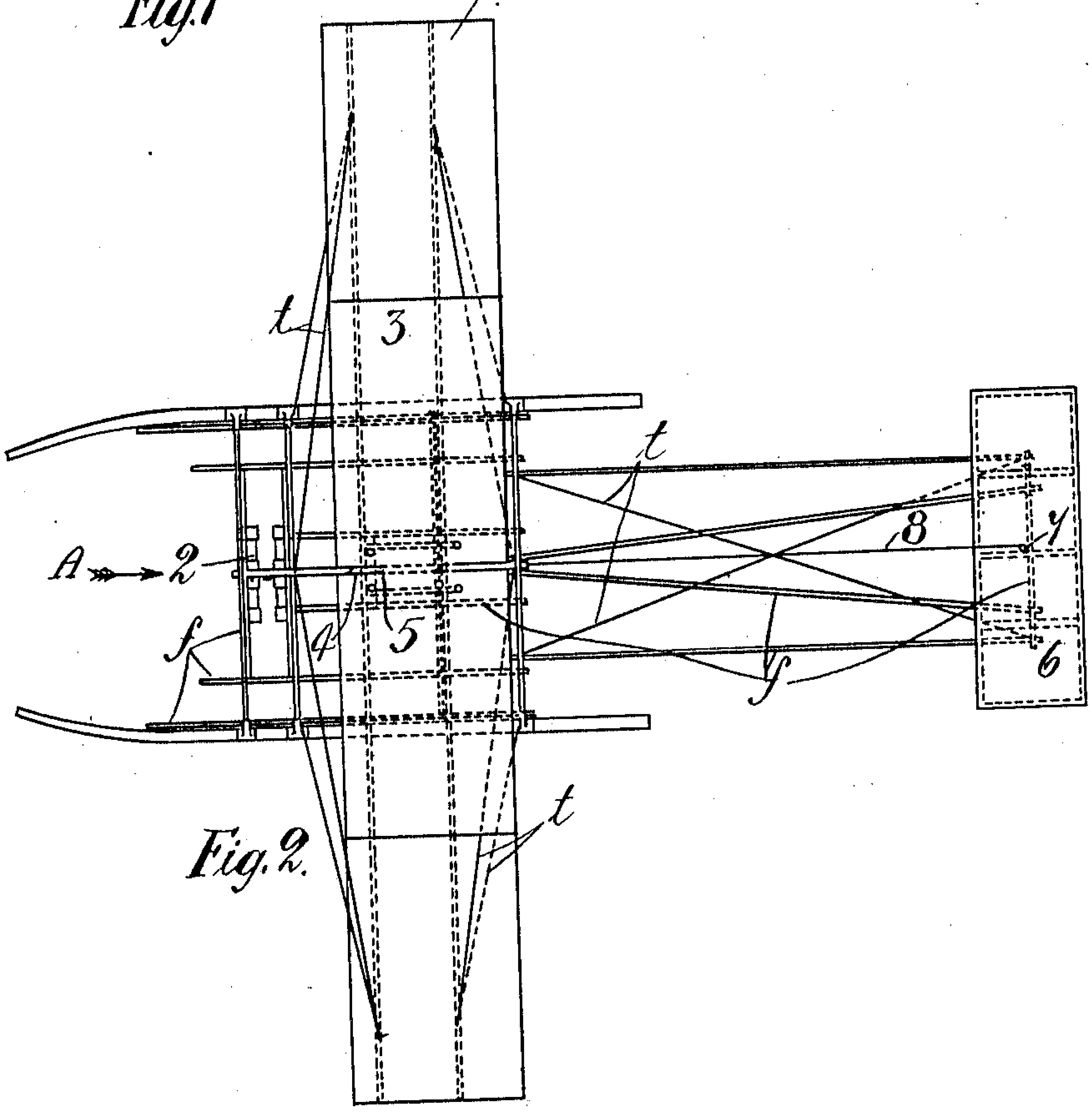

Fig. 2.

WITNESSES

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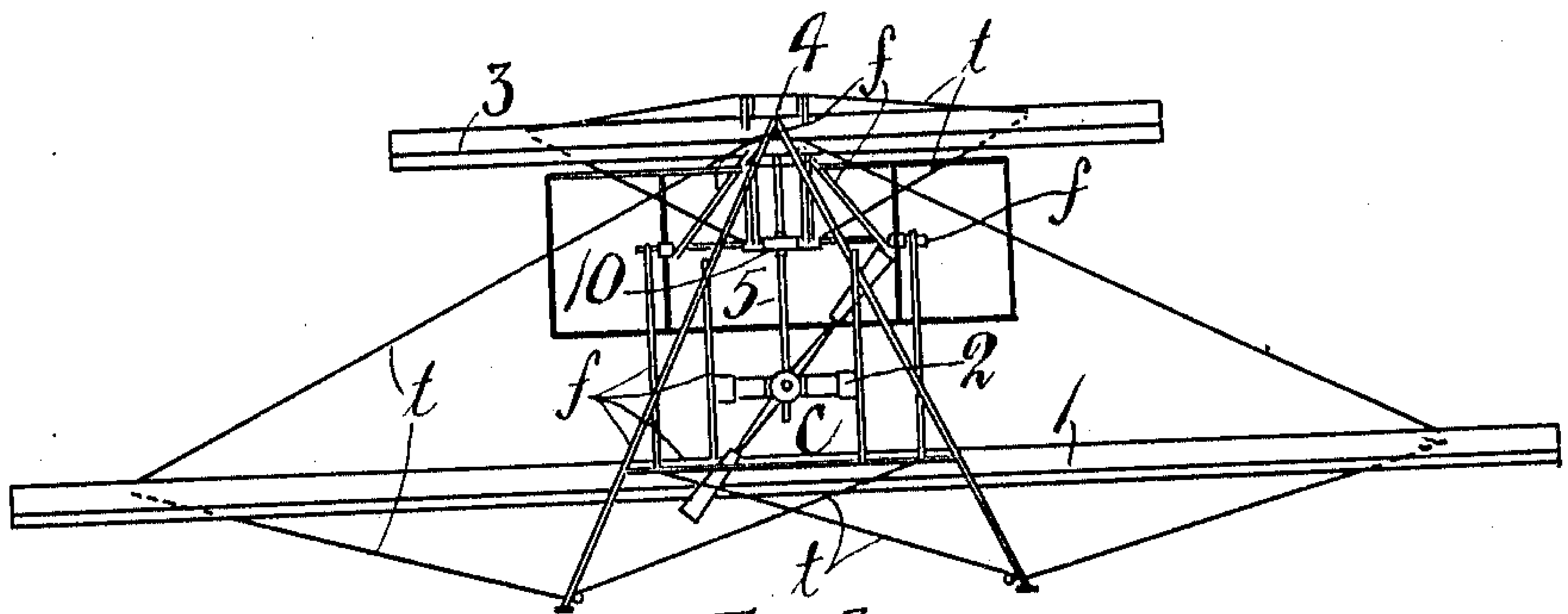

Fig. 3.

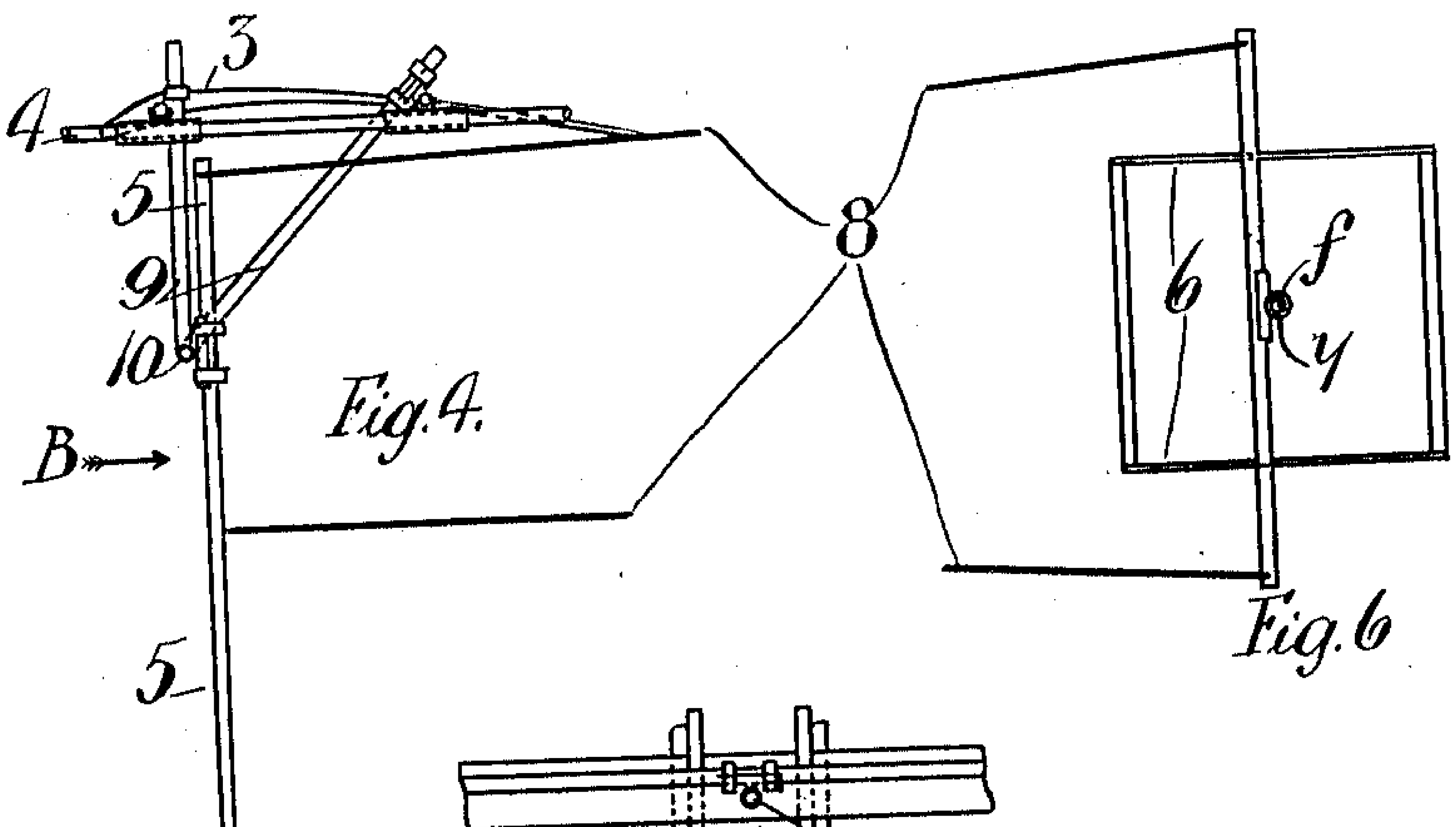

Fig. 4.

Fig. 6

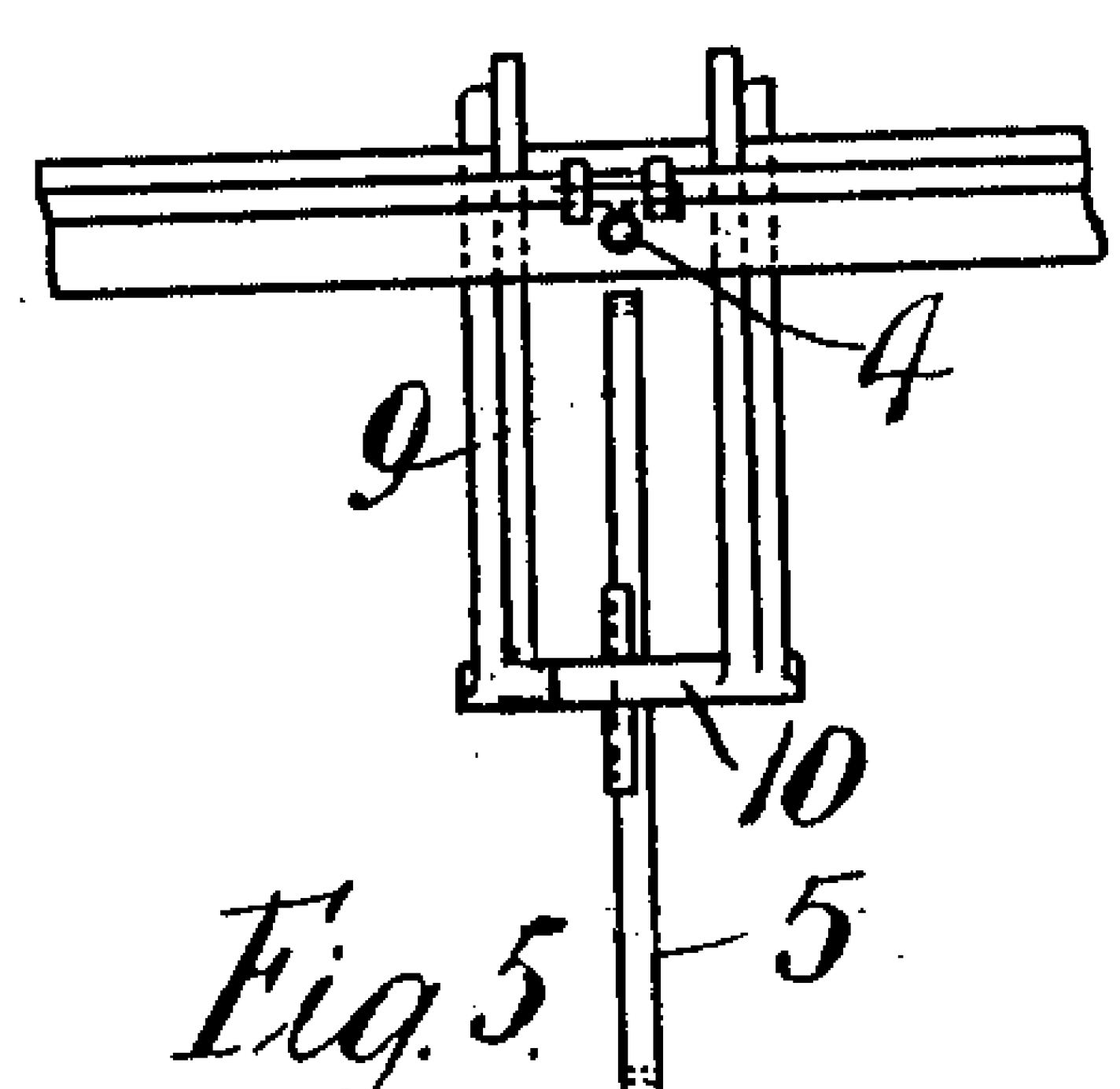

Fig. 5.

WITNESSES

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UNITED STATES PATENT OFFICE.

PRESTON ALBERT WATSON, OF DUNDEE, SCOTLAND.

FLYING-MACHINE.

988,415. Specification of Letters Patent. Patented Apr. 4, 1911.

Application filed December 28, 1909. Serial No. 535,281.

To all whom it may concern:

Be it known that I, PRESTON ALBERT WATSON, a subject of the King of Great Britain and Ireland, residing at "The Retreat," 370 Perth road, Dundee, in the county of Forfar, Scotland, have invented new and useful Improvements in Flying-Machines, of which the following is a specification.

This invention relates to flying machines, the objects being to provide means for giving lateral stability and for steering, such means being positively controlled by the operator.

In order that my said invention and the manner of putting the same into practice may be properly understood, I have hereunto appended an explanatory sheet of drawings in which the same reference numerals and letters are used to indicate corresponding parts in the figures shown.

Figure 1 is a side elevation of a flying machine constructed and arranged in accordance with my invention. Fig. 2 is a plan and Fig. 3 a view looking in the direction of the arrow A (Fig. 2). Fig. 4 is an enlarged side view of the lever and its appurtenances for rocking the stability aeroplane and for operating the rudder. Fig. 5 is a view looking in the direction of the arrow B (Fig. 4). Fig. 6 is an enlarged side view of the rudder.

In carrying out my invention I use a main aeroplane 1 whose position is fixed relative to the propelling mechanism 2 and the ballast, this plane being of the usual type. The rigid frame work of the machine is indicated by the letters *f* and the tension wires by the letters *t*. Above this plane 1 and carried by the frame of the machine is a rocking aeroplane 3 capable of rocking about a fore and aft central axle 4. The pivot 4 is above the fore and aft central axis of the main plane and depending from the rocking plane 3 at right angles to it is a bracket 9 fixed rigidly to such rocking plane 3. This bracket 9 carries the lever 5 on a transverse axle 10. The bracket 9 and transverse axle 10 are rigid with the plane 3 and all rock together around the axle 4. The lever 5 is pivoted on the axle 10 and can vibrate about the same. The lever 5 may therefore tilt the plane 3 about the axle 4 while at the same time it is free to vibrate about the axle 10 for a purpose now to be described, namely the actuation of the horizontal rudder 6. As in all aeroplanes the front edges of these aeroplanes 1 and 3 are higher than the trailing edges relative to the flight path so that during forward motion the aeroplanes support the machine.

The rudder (or rudders) which gives fore and aft stability consists of one or more planes 6 normally in a horizontal position and carried by the frame so that they can vibrate about a transverse axle at 7. The controlling lever 5 actuates the rudder by means of a pull and push rod or by two flexible wires 8 on opposite sides of the pivot. The lever 5 is compound being able to rock the plane 3 by means of the standards 9 which are rigid with the stability plane 3 such standards carrying the pivot 10 about which the lever 5 can vibrate in a fore and aft direction. The rudder is at the rear.

When in flight the machine is guided in the following manner;—The action of the rocking aeroplane is as follows;—When the rocking aeroplane 3 is tilted out of the horizontal about the axle 4 by moving the lever 5 to one side, the normal pressure of the rocking aeroplane 3 is inclined out of the vertical and gives rise to a horizontal component pulling its axle 4 to one side relative to the line of flight. The frame *f* and the fixed plane 1 are thus caused to rotate about the line of flight that is to say the plane 1 becomes tilted about the line of flight and out of the horizontal. The normal pressure of the fixed plane 1 is thus inclined out of the vertical and gives rise to a horizontal component pulling the frame *f* to one side of the line of flight. The tail planes 6 are usually horizontal in a fore and aft direction and therefore have no normal pressure and consequently do not give rise to a horizontal component although tilted around the line of flight. The tail planes do not therefore pull to one side of the line of flight whereas the frame *f* is so pulled. The frame *f* being pulled to one side moves to that side that is the direction of flight is altered because the resultant of the side movement with the original forward movement is a new direction of flight. The tail being at the posterior end brings the longitudinal axle of the machine into the new direction of flight in the same way as the feathers of an arrow keep its longitudinal axis in the line of flight. Therefore the machine turns to one side. It is thus shown

that by moving the lever 5 to one side the frame *f* can be made to rotate about the line of flight and that the machine can be made to turn to one side, that is to say lateral stability and steering right and left can be controlled by means of the lever 5.

Should the aeronaut desire to ascend or descend when he is moving in a straight line the lever 5 is moved fore or aft thus causing the front edge of the rudder to be moved downward or upward. Again, if he desires to turn to the right or the left he moves the lever to the left side or to the right, thus causing the plane 3 to incline relative to the main plane 1 and thus as described above turning the machine to the right or the left. As the direction of motion of the lever can be compounded from these two motions, the plane 3 and the rudder can be moved so as to cause the machine to move up or down while at the same time moving to the one side or the other, that is to say by simply moving the hand which actuates the lever in any desired direction the machine can be steered in any desired direction and the trim altered. By having the rocking plane 3 considerably above the fixed plane 1 it can be of small size and easily tilted.

The method of preserving lateral stability by rocking the whole supporting surface has been tried and found unsatisfactory and the particulars of the machines and the experiments are common knowledge, notable examples being those of Lillienthal and Chanute, who attempted gliding flight while suspended beneath the supporting surface, thus having the center of gravity below the center of support, the whole supporting surface being rocked about their shoulders as an axis. This method may be looked upon either as a shifting of the center of gravity from side to side in a circle around the center of a support, or as a rocking of the supporting surface relative to the frame of the machine, or relative to the man, because the rocking of the surface relative to the machine or man is the result of the shift of ballast. The torque rotating the frame or the man about the line of flight may be regarded as the result of shifting the ballast to one side of the center of support or as the result of the supporting surface being rocked relative to the frame, thereby giving rise to a component side force pulling the top of the frame to one side and thereby rotating the frame about the line of flight. The difficulty met with in endeavoring to preserve lateral stability by thus rocking the whole supporting surface is that the power of the pilot is not sufficient to rock the whole surface sufficiently and quickly enough to counteract the effects of gusts of wind and to counteract the tendency of the outer wing to rise while turning. Power is required to rock the surface because in so doing the center of gravity is brought closer to the supporting surface against the force of gravity pulling the center of gravity away from the supporting surface, and the rocking surface has a resistance to rocking, because, in rocking, the surface is dragged through the air. The object of my invention is to provide means whereby the lateral stability can be preserved by the application of less power on the part of the pilot. To this end the rocking surface consists of only part of the whole supporting surface and is therefore more easily rocked. In order that when rocked it may give rise to a sufficient torque rotating the frame around the line of flight, this rocking surface is situated on a higher level relatively to the center of gravity of the machine. Thus the component side force resulting from the surface being rocked acts with a greater leverage in rotating the frame around the line of flight. The power which so rotates the frame around the line of flight comes from the engine, inasmuch as the engine propels the machine and by reason of the front edges of the rocked plane being higher than the posterior edges, the engine provides the rocked plane with its upward pressure; when the plane is rocked about a longitudinal axis the engine therefore supplies the component side force and when this component side force performs the work of pulling the top part of the frame to one side and thereby rotating the frame about the line of flight, the power which performs this comes from the engine. The action is similar to the steering of a vessel at sea by operating the rudder which requires small power on the part of the pilot and the power of the engine turns the steamer, the power required from the pilot being much less than would be required to turn the vessel by means of ropes to the shore. In the machine of my invention, although the rocking surface is on a high level relative to the center of gravity, the average center of support of the rocking upper wing and the fixed lower plane is not far above the center of gravity. This is an advantage because when the distance between the center of support and the center of gravity is great, the center of gravity has an exaggerated pendulum action causing the machine to roll about the line of flight. The upper wing in my machine acts like a rudder in preserving lateral stability, and the lower fixed plane acts as a damper to prevent rolling about the line of flight. The machine is successful in flight while machines in which the whole surface is rocked have been abandoned and other means of preserving lateral stability, such as warping the wing tips, resorted to. By such an arrangement the machine can be guided with the least possible mental strain and the least possible work. No increased

resistance on one side to forward motion is caused when preserving lateral stability as is the case when the wings are warped or supplementary side surfaces are brought into play. Therefore no vertical rudder is required. The wings may be built rigid and can be kept constantly at the most efficient angle for aeroplaning. Further there is no side slipping during turning, the "banking" being automatically correct.

It has been shown that by having a rocking surface above a fixed plane, steering right and left and preservation of lateral stability is accomplished.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is;—

1. The combination of a rigid nonwarping main plane rigid with the frame of the machine; with a rigid nonwarping plane on a higher level than the main plane, a movable tail, the upper plane being capable of being rocked about an axis extending longitudinally of the machine independently of the movement of the tail, the movement of the upper plane being positively controlled by the aeronaut; and the tail capable of being tilted about an axis transverse of the machine independently of the movement of the rocking plane, this tilting of the tail being also positively controlled by the aeronaut, as described.

2. In aeroplanes, the combination of a rigid framework composed of struts and ties with lower main plane fixed thereto; a rocking plane situated on a higher level than the main plane, this upper plane being capable of being rocked about an axis extending longitudinally of the machine; a horizontal rudder at the rear which can be vibrated on a transverse axis; a bracket with its transverse axis rigidly attached to the rocking plane; a lever pivoted on this axis and operating wires to the rudder as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

PRESTON ALBERT WATSON.

Witnesses:

GEORGE CAMERON DOUGLAS,

AGNES CULBARD DOUGLAS.