J. M. FUNK.

AEROPLANE.

APPLICATION FILED OCT. 16, 1918.

1,327,543.

Patented Jan. 6, 1920.

6 SHEETS—SHEET 1.

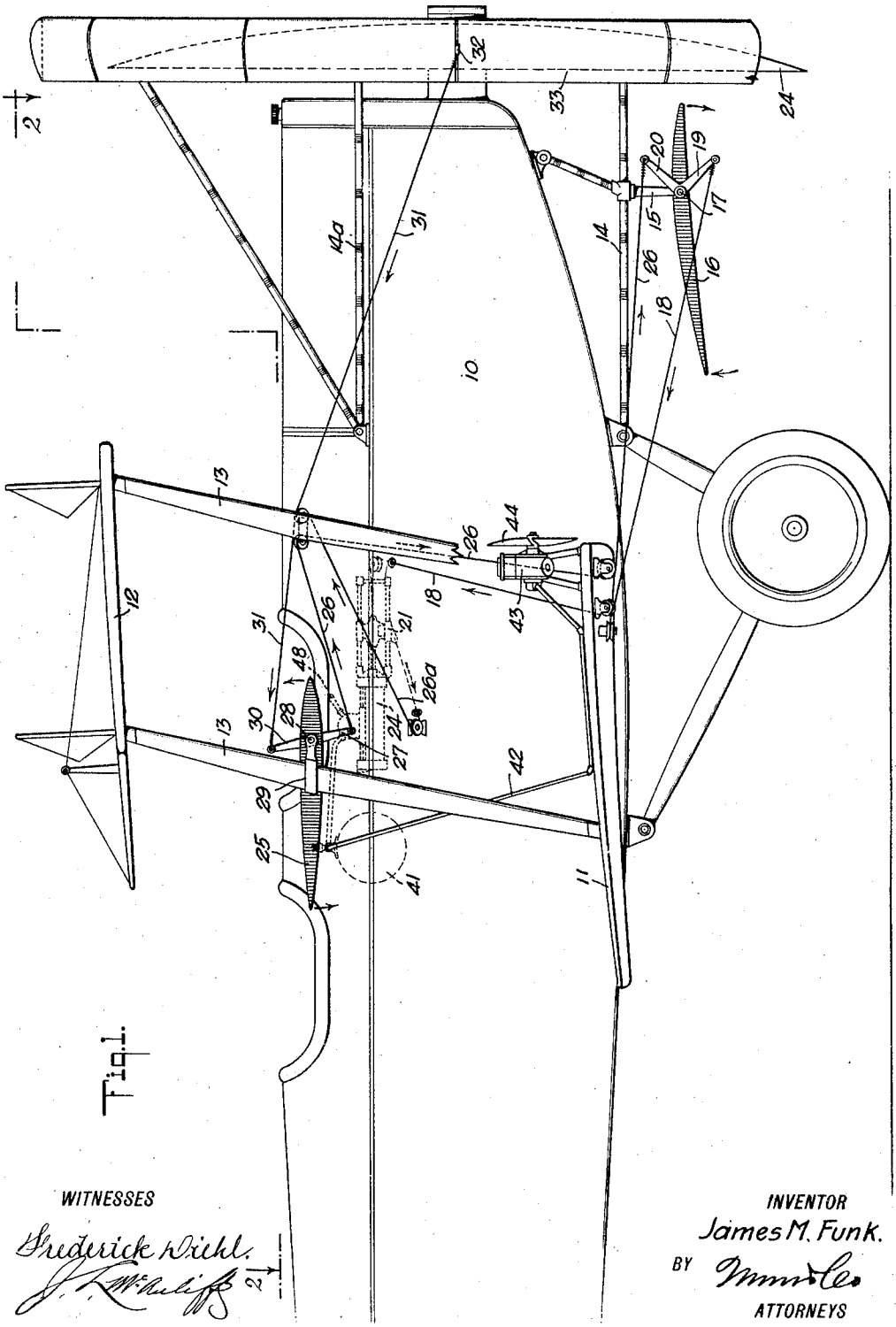


Fig. 1.

WITNESSES

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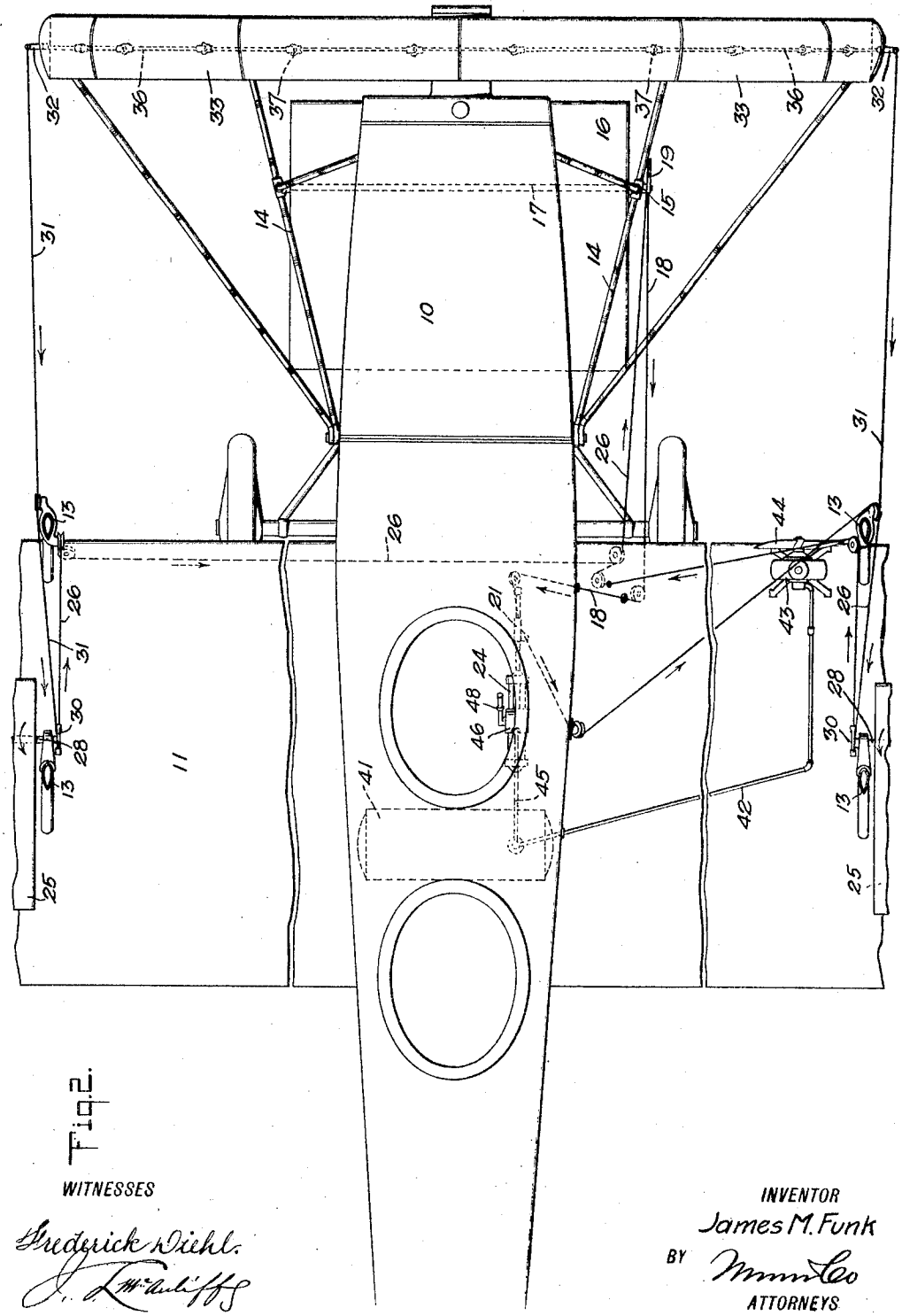


Fig. 2.

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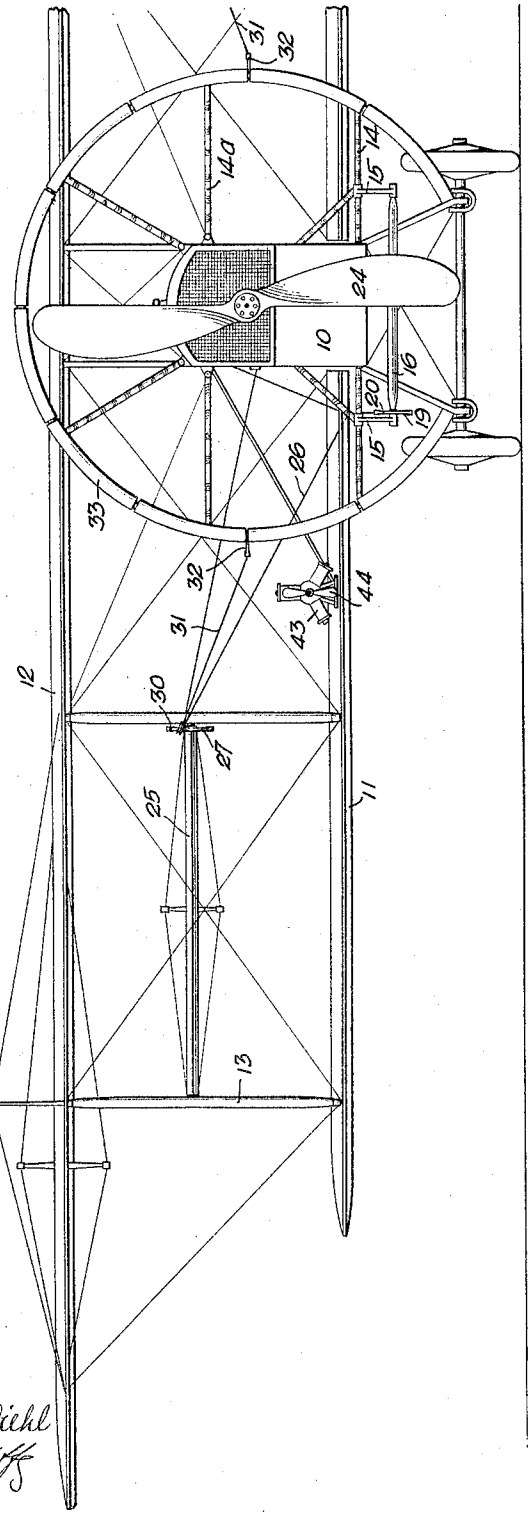


Fig. 3.

WITNESSES

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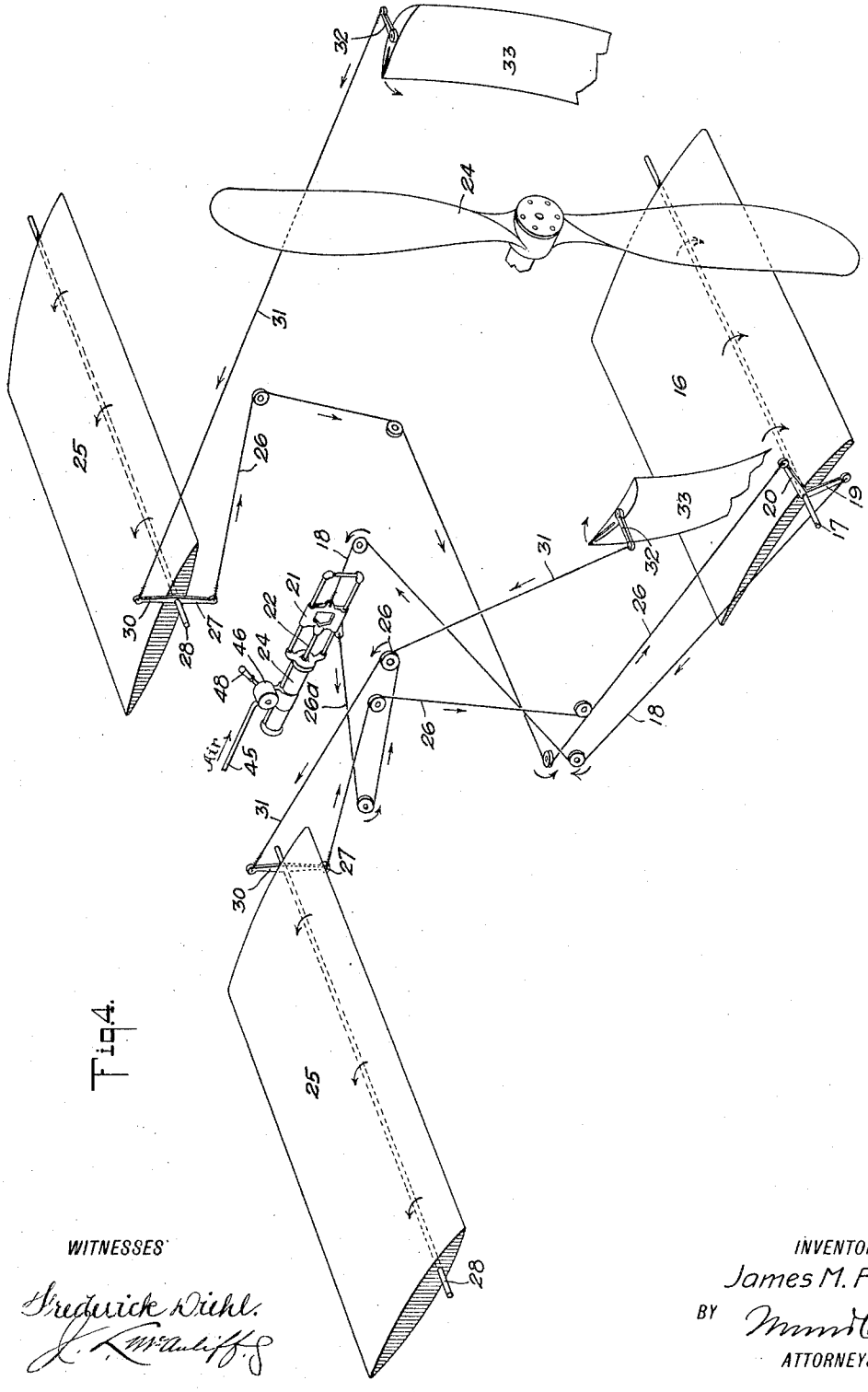


Fig.4.

WITNESSES

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6 SHEETS—SHEET 5.

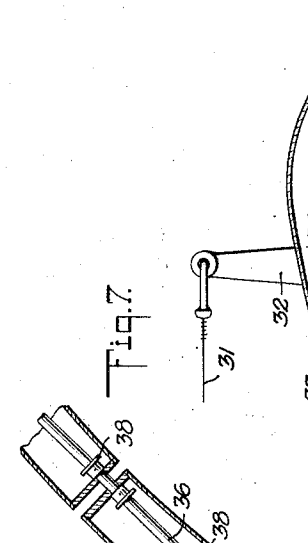


Fig. 7.

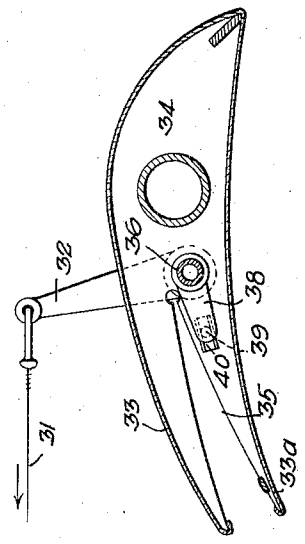


Fig. 8.

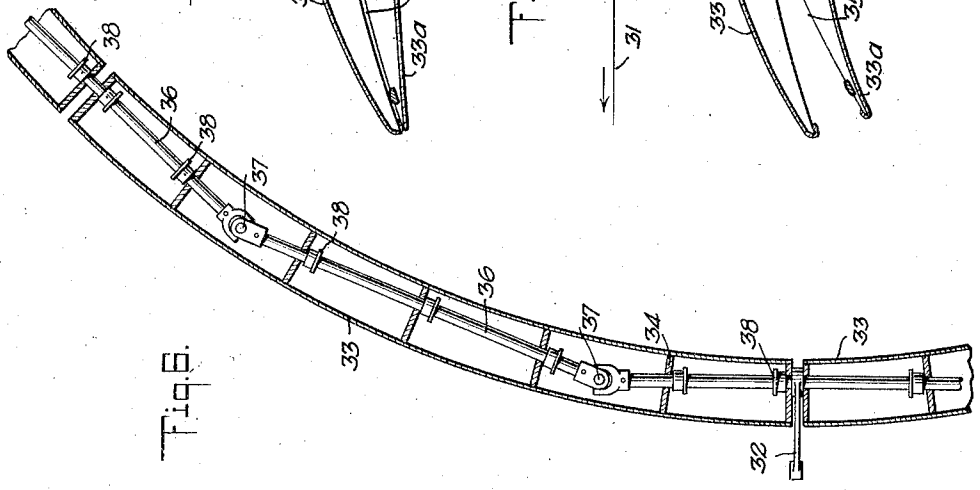


Fig. 6.

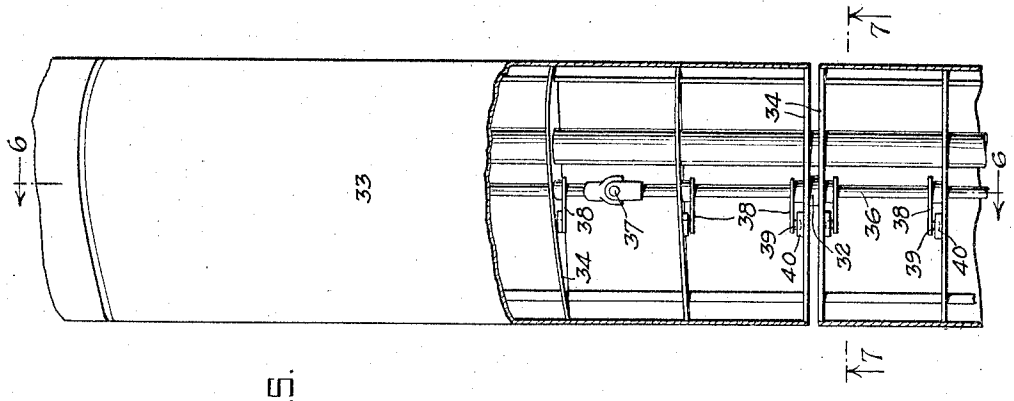


Fig. 5.

WITNESSES

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6 SHEETS—SHEET 6.

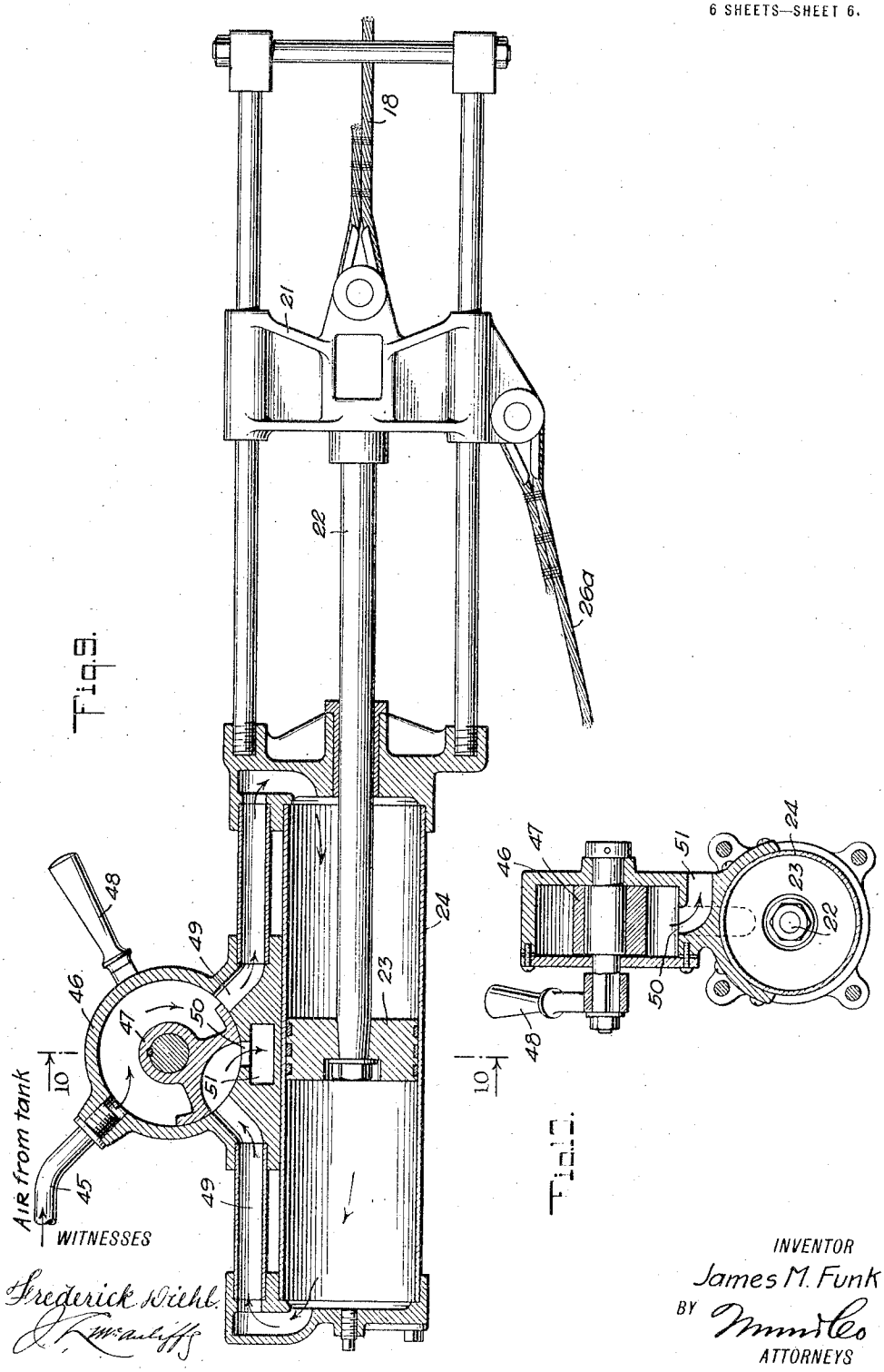


Fig. 9.

Fig. 5.

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UNITED STATES PATENT OFFICE.

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AEROPLANE.

1,327,543. Specification of Letters Patent. **Patented Jan. 6, 1920.**

Application filed October 16, 1918. Serial No. 258,363.

To all whom it may concern:

Be it known that I, JAMES M. FUNK, a citizen of the United States, and a resident of Ottawa, in the county of La Salle and State of Illinois, have invented a new and Improved Aeroplane, of which the following is a full, clear, and exact description.

The invention relates to the stabilizing and controlling of aeroplanes by means additional to ailerons and the like.

An object of the present invention is to provide a vane or plane element and controlling means therefor adapted to automatically function upon a stoppage of the propeller or upon a material decrease of the air current generated thereby, due to the stoppage of the motor or the encountering of an air-pocket, a cross current, "upcomer" or "downcomer" or other abnormal atmospheric condition.

A further important object of the invention is to coördinate the stabilizing vane thus characterized, with interplane surfaces to vary the angle of incidence of the latter proportionate to the movement of the stabilizing vane, and whereby to position said controlled plane element at a low angle for flying and a high angle for landing.

A further important object is to provide automatically controlled means to produce a maximum compression of air at the propeller center upon encountering an air-pocket or abnormal atmospheric conditions and to so arrange said means as to protect the propeller from cross currents.

The improved machine is characterized by other important advantages and results in providing longitudinal as well as lateral equilibrium, and affording means to prevent side-stepping, skidding, and slides; it provides an automatic safety device in the event of engine trouble; it is designed to enable a machine to fly at higher altitudes and to accomplish a cross country flight objective in the minimum time considering irregular atmospheric movements encountered; and it provides means permitting of manual control to regulate the propeller thrust in normal air as well as in abnormal air as will appear from the specific description following.

The stated objects are attained by a system involving means whereby to exert a force on a stabilizing vane in a direction to swing the same downwardly for functioning, and said force in the operation of the propeller under normal conditions and exerting its maximum thrust is counteracted by the air blast or current generated by the propeller to maintain the stabilizing vane inactive, there being an interconnection between the stabilizing vane system, the interplane elements, and a propeller thrust regulator.

Reference is to be had to the accompanying drawings forming a part of this specification, it being understood that the drawings are merely illustrative of one example of the invention.

Figure 1 is a partial side elevation of an aeroplane equipped with one embodiment of my invention, parts being broken away in the interest of clearness;

Fig. 2 is a sectional plan view as indicated by the irregular line 2—2, Fig. 1;

Fig. 3 is a partial front elevation;

Fig. 4 is a schematic view indicating generally the relative positions of the stabilizing vane, interplane elements, the propeller and the thrust controlling shrouds, with the means to subject said vane to a force in opposition to the propeller thrust, the view showing diagrammatically the connections between the various elements of the system;

Fig. 5 is a sectional side view of a portion of the propeller shrouds;

Fig. 6 is a transverse section on the line 6—6, Fig. 5;

Fig. 7 is a cross section on the line 7—7, Fig. 5, showing the shrouds adjusted for normal air conditions;

Fig. 8 is a view similar to Fig. 7 but indicating the shrouds adjusted to constrict the same and produce an increase in the air directed to the propeller;

Fig. 9 is a sectional side elevation of one form of pressure means to subject the stabilizing vane to a force in opposition to the propeller thrust;

Fig. 10 is a cross section on the line 10—10, Fig. 9.

In the illustrated example of the invention I have shown the same as embodied in a tractor type of biplane, said type lending itself to demonstration purposes but it will be understood that the invention is applicable to aeroplanes of the pusher type involving a different position of the propeller.

The body 10 of the machine may be of

any approved design and the machine includes a lower main plane 11 and an upper main plane 12, the latter being sustained by suitable struts 13. A stabilizing vane or plane element 16, hereinafter referred to as a vane, is supported in frame members 14, there being hangers 15 thereon in which the shaft 17 carrying said vane is rotatably mounted. On said shaft to rock the same are levers or rocker arms 19, 20 preferably in bellcrank form.

The propeller 24 here shown as at the front of the machine as in the tractor type, is adapted to exert the blast generated thereby against the rear end portion of the vane 16, tending to hold said vane normally inactive, that is to say, approximately parallel with the direction of travel and I provide means to exert a counteracting force on said stabilizing vane in a direction to swing the same downwardly for functioning, said force, with the propeller operating under normal conditions and exerting its maximum thrust, being counteracted by the blast or current generated by the propeller. The counteracting pressure means and its connection with the vane 16 in the illustrated form are as follows: To the lower arm 19 for rocking the plane downwardly is connected a cable or other suitable flexible element 18, said cable connecting also with means to exert a predetermined pull thereon. Said cable connects with a fluid pressure means comprising a slide 21 on the piston rod 22, the piston 23 of which operates in a cylinder 24 supplied with fluid under pressure as hereinafter explained. The arrangement is such that pressure is applied in front of the piston equal to the maximum thrust exerted by the propeller against the vane 16 so that the one force counteracts the other. I arrange interplane elements designated generally by the numeral 25, one of said elements at each side of the machine and I coördinate these with the stabilizing vane 16 to partake of the movements of the latter as follows: A cable 26 connects at one end with the upper rocker arm 20 on the shaft 17 of vane 16 and runs over suitable guide sheaves and is branched to connect with the lower arms 27 on rock shafts 28 carrying the respective plane elements 25. Also, linked up with the interplane elements 25 are shroud elements extending about the propeller 24 and arranged to vary the volume of air passing through the shroud elements to the propeller. Thus, on the shaft 28 of the plane elements 25 are upper levers or rock arms 30 connected with which are cables 31 running over suitable guides to levers 32 adapted to cause a constriction of the inner periphery of the shroud which is arranged in almost a complete circle about the propeller. Each shroud section 33 is of aerofoil shape and hollow. The inner walls of the shroud sections are arranged to be flexed to have in effect hinged connection so that when flexed inwardly, the shroud is in effect constricted to deflect an increased volume of air to the propeller toward the center of the latter. In the arrangement each section has a series of flexible ribs 34 preferably of vulcanite fabric, the rear portions of which are slotted as at 35 (Figs. 7 and 8). The levers 32 are mounted on a jointed rod or tumbler shaft 36, the sections of which are connected by universal couplings 37, the shaft extending through the several shroud sections 33, the levers 32 being connected between the sections as best seen in Fig. 6. On the tumbler shaft sections 36 are lever arms 38 (Figs. 7 and 8), the outer end of each of which has a pin 39 operating in a slotted guide 40 on the adjacent rib 34 radially inward from the adjacent slot 35, so that the swinging of the arm 38 through an angle corresponding with the angular movement of the lever 32 will exert pressure radially inward on the guide 40 and therefore will flex the inner wall 33^a of the shroud section to vary its curvature from the normal position of Fig. 7 and approximately parallel with the axis of the propeller to an angular position as indicated in Fig. 8.

By the described arrangement with the piston 23 subject to a pressure equal to the equivalent, safe-speed thrust, or at any predetermined thrust of the propeller, under normal air conditions, the vane 16 and the plane elements 25 will be maintained approximately parallel with the direction of travel and also no pull will be exerted on the levers 32 tending to constrict the shrouds 33. When, however, due to an air-pocket or the like, there is a reduction of the thrust exerted by the propeller on the stabilizing vane 16 and this becomes inferior to the pressure on the piston 23, the latter pressure will move the piston 23 rearwardly exerting thereby a pull on the cable 18 and through the arm 19 will swing the vane 16 downwardly, thereby throwing the machine into a nose dive under any atmospheric disturbance tending to stall the machine. At the same time the rocking of the shaft 17 and the upper arm 20 associated with the stabilizing vane will through the cables 26, rock the planes 25 to vary the angle of incidence to incline them to a lifting position. Simultaneously, with the swinging of the stabilizing vane 16 and plane elements 25, a rearward pull will be exerted on the cables 31 and levers 32 to flex the inner wall 33^a of the shrouds in the manner described for constricting the air passage provided by the shrouds to the propeller so that more air is directed to the propeller and toward the center thereof to restore the air current and thrust exerted against the stabilizing vane 16

and thereby tend to restore the equilibrium between the force exerted by the propeller and that exerted by the counteracting pull of the piston 23. A forward movement of the piston 23 in restoring the plane 16 exerts a pull on a cable 26[a] connected with the slide 21 and connecting as at 26[b] with a cable 31, thereby through the adjacent lever 30 rocking the shaft 28 of a plane element 25, thus exerting a reverse pull on the cable 26 and lever arm 20 and thereby simultaneously restoring the stabilizing plane 16, plane elements 25 and shrouds 33, to normal positions.

I would state here with respect to the plane elements 25 that they are not provided for the purpose of balancing the machine as in the case of ordinary ailerons but they are for the purpose of increasing the lift. Both the said planes 25 act in the same direction and at the same time so that both make a positive angle with the air stream whereas the regular ailerons and control surfaces of the machine, it is to be understood, are retained with my improved control system which is entirely independent of the surfaces used for lateral and longitudinal balance. The fluid pressure for the cylinder 24 may be provided by a tank 41, a reliable supply in which is maintained by connecting the same as by a pipe 42 with a pump 43 of any suitable design and operated by a fan 44 on the pump shaft and subject to the resistance of the air when the machine is traveling. Said tank 41 connects as by a pipe 45 with the valve chest 46 having a rock valve 47 manually operable by a handle 48. Said valve chest communicates with the opposite ends of the cylinder 24 by ports or passages 49, there being an exhaust port 50 from the valve chest to the exhaust 51, so that the valve may establish communication between either end of the cylinder or the exhaust or may cut off said passages to any desired extent. A surplus of air is always confined in the tank 41, the air valve 47 is manually operated by its handle which when once set or adjusted renders the operation of the piston 23 practically automatic, the valve being manipulated to allow any used air to escape through the exhaust port. For manual control in landing, it being desired for safety reasons that the motor be left running, any incidence angle of the planes 25, or lift, which in this instance is a head resistance, may be had by varying the position of the piston by manipulating the valve 48. When making turns at low altitudes, any similar necessary plane element conditions may be had. The same conditions, that is, the maximum thrust, are necessary before starting; the maximum incidence angle virtually creates a head resistance comparatively great, and the ascent is not started until the screw is delivering maximum, at which time the surfaces are rectified through the control of the valve and piston, a run is made—which in this instance is comparatively short—thus getting momentum to take the air.

It will be observed that the propeller shroud 33 surrounds the propeller at the sides and directs the air in to the propeller, an incidental object being to enshroud the propeller to allow it to receive only that air which is directly ahead and also to protect it against side drift and cross currents.

I would state in conclusion that while the illustrated example constitutes a practical embodiment of my invention, I do not limit myself strictly to the mechanical details herein illustrated, since manifestly the same can be considerably varied without departure from the spirit of the invention as defined in the appended claims.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. In an aeroplane, stabilizing means including a vertically swingable vane, and means tending to swing the vane from a neutral position for functioning, said vane being located rearward of the propeller of the aeroplane and in such proximity thereto as to be subject to the air current generated by the propeller to such a degree that said current in the normal operation of the propeller will counteract the second-mentioned means to maintain the vane neutral.

2. In an aeroplane, stabilizing means including a vertically swingable vane in the rear of the propeller of the aeroplane, a plane member movable with said vane to vary its angle of incidence, and means to swing the vane from a neutral position for functioning, said vane being positioned to be subject to the air current generated by the propeller so that said current in the normal operation of the propeller will conteract the last-mentioned means to maintain the vane neutral.

3. In an aeroplane, a vertically swingable plane positioned to receive the air current produced by the propeller of the machine, means to exert a counteracting force against said vane, and plane elements at opposite sides of the machine and both movable in the same direction simultaneously to vary their angle of incidence with the swinging of said vane.

4. In an aeroplane, a propeller, stabilizing means including a vertically swingable vane, means tending to swing the vane from the neutral position for functioning, said vane being located rearward of the propeller and thereby subject to the air current generated by the propeller in the normal operation of the latter for counteracting the second-mentioned means and maintaining the vane neutral, and means associated with the propeller and variable to vary the vol-

ume of air directed to the propeller, said last-mentioned means being connected with the stabilizing vane to be actuated with the swinging of the latter.

5. In an aeroplane, a propeller, stabilizing means including a vertically swingable vane, means tending to swing the vane from the neutral position for functioning, said vane being located rearward of the propeller of the aeroplane to be subject to the air current generated by the propeller in the normal operation of the latter for counteracting the second-mentioned means and maintaining the vane neutral, curved elements mounted to flex for varying their curvature, and disposed adjacent to the propeller to direct air thereto, and means to flex said elements to a position convergent rearwardly to increase the volume of air directed to the propeller when the stabilizing vane moves to a position for functioning.

6. In an aeroplane, a propeller, means to direct air to the propeller, and means controlling said first means and subject to the action of the propeller, to vary said first means upon a reduction of the thrust of the propeller.

7. In an aeroplane, a vane in the rear of the propeller and swingable about a horizontal axis, means tending to swing said vane from a neutral position for functioning, means tending to exert a counteracting force on the vane to maintain the same in the neutral position against the tendency of the first-mentioned means, a main plane on the machine, an auxiliary plane at each side of the longitudinal center of the machine and swingable downwardly through an angle relatively to the main plane, and means to actuate said auxiliary planes by movements of the vane.

8. In an aeroplane, a propeller, a vane mounted to swing through an angle about a horizontal axis rearward of the propeller and subject to the air current generated by the latter to maintain the vane in a neutral position, a fluid-pressure cylinder, and a piston operating in said cylinder and subject to the pressure therein in a direction to swing the vane upon a reduction of the force of the air current generated by the propeller.

9. In an aeroplane, a propeller, a vane mounted to swing through an angle about a horizontal axis rearward of the propeller and subject to the air current generated by the latter to maintain the vane in a neutral position, a fluid-pressure cylinder, and a piston operating in said cylinder and subject to the pressure therein in a direction to swing the vane upon a reduction of the force of the air current generated by the propeller; together with a fluid pressure tank communicating with said cylinder, and means independent of the motive power of the aeroplane to maintain pressure in said tank.

10. In an aeroplane, a main plane, plane elements additional to the main plane and disposed at opposite sides of the aeroplane, and means controlled by the action of the propeller to simultaneously vary the angle of incidence of said additional plane elements to move the same in a corresponding direction, upon a reduction of the thrust of the propeller.

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